

GEOPOLITICAL IMPLICATIONS OF RISING OIL DEPENDENCE AND GLOBAL WARMING

HEARING BEFORE THE SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING HOUSE OF REPRESENTATIVES ONE HUNDRED TENTH CONGRESS

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WEDNESDAY, APRIL 18, 2007

HOUSE OF REPRESENTATIVES,
SELECT COMMITTEE ON ENERGY INDEPENDENCE
AND GLOBAL WARMING,
Washington, DC.

The committee met, pursuant to call, at 9:35 a.m. In Room 1100, Longworth House Office Building, Hon. Edward J. Markey [chairman of the committee] Presiding.

Present: Representatives Markey, Blumenaur, Inslee, Larson, Herseth Sandlin, Cleaver, Hall, McNerny, Sensenbrenner, Shadegg, Walden, Sullivan, Blackburn, and Miller.

Staff present: Ana Unruh-Cohen and Michal Freedhoff.

The CHAIRMAN. The committee will come to order. We thank you all for being with us for this, the inaugural hearing of the Select Committee on Energy Independence and Global Warming. Today's witnesses have been invited because they have spent their lives thinking about what must be done to defend our planet and how the twin imperatives of defending our environment and defending our freedom have begun to merge into a single issue.

This committee has been given an awesome charge, to press the institutions of democracy, to change business as usual in an overdue effort to respond to the twin challenges of our dependence on imported oil and the looming catastrophe of global warming. These problems are intertwined, and this hearing today is intended to highlight the fact that just as the oil security problem has a major global warming dimension, climate change has a major global security dimension. If we are to address either problem effectively, we must make sure we don't make one problem better by making the other one worse.

It seems clear that our geopolitical and national security posture will only grow worse if we do not act forcefully to curb our dangerous dependence on imported oil and reduce our emissions of global warming pollution. It is a double threat like Orthus, the monstrous two-headed hound of Greek mythology, with one head facing backwards and the other forwards.

Our ever-rising oil dependence is directly attributable to a backwards-facing energy policy. While looking forward, we can see the threat of rising temperatures and the subsequent increasing risk of natural and humanitarian disasters. We have become all too familiar with the volatility in gasoline prices that occurs as a result of domestic or foreign events, be it the capture of British sailors by Iran or the devastation brought by Hurricane Katrina. Gas prices

have jumped up early this year, well before the summer driving season, and are now over \$3 a gallon for regular at many stations, reflecting once again the insecurity and, indeed, sheer folly of tethering our economic well-being to unstable foreign sources of oil, governed by regimes which are in some cases supporters of or participants in the war on terror.

Forty-five percent of the world's oil is located in Iraq, Iran and Saudi Arabia. Events in those countries have a dramatic impact on oil prices and our national security. In the late 1970s the oil embargo, Iranian revolution, and Iran-Iraq war sent the price of oil skyrocketing. And today with Osama bin Laden urging his followers to attack Saudi Arabian oil, with Iraq descending further into chaos and with Iran marching further down the path towards developing nuclear weapons, we are seeing the very same sort of pain at the pump because of the very same sort of global instability.

In an article in the New York Times magazine this past weekend, Thomas Friedman stated that soaring oil prices are poisoning the international system by strengthening antidemocratic regimes around the globe. It is no coincidence that we have 130,000 young men and women in Iraq right now, with at least another 25,000 on the way. It is no coincidence that we are spending more than \$100 billion a year to keep those troops there, in addition to the nearly \$300 billion we spend each year importing all the oil we use in the first place. Much of these funds end up in the pockets of Arab princes and potentates who then funnel the money to al Qaeda, Hezbollah, Hamas and other terrorist groups.

Our energy policy has compromised our economic freedom, and the American people want action because they know that the price has become much too high. We know that we cannot simply drill our way to energy independence.

The United States is home to less than 3 percent of the world's oil reserves, but it is itself the world's largest consumer and importer of oil. Last year oil imports reached 60 percent, an average of 12.5 million barrels per day, amounting to an annual cost of \$291 billion to the American people.

While moving to renewable fuels that has grown in the soil of the Midwest rather than removed from the sands of the Middle East can help, the single biggest step we can take to curb today's oil dependence and remove OPEC's leverage is to raise the fuel economy standards of our automotive fleet.

I have introduced a bill, H.R. 1506, which would require the combined car and light truck fleet to achieve 35 miles per gallon by 2018, which amounts to an average of 4 percent per year improvement, an increase that is mandatory over this first 10 years by ensuring that fuel economy standards keep pace with technological development. By 2022, it would be an increase to 40 miles per gallon.

From the most recent scientific evidence, it is clear that we must act now as well on the threat of carbon emissions from cars and other sources which pose threats to the environment.

At the beginning of February, the world's top scientists, as part of the United Nations Intergovernmental Panel on Climate Change, provided a scientific smoking gun that human activities

were unequivocally responsible for global warming. Two weeks ago, their second report told us what happens when the climatic bullet hits; the developed world will bear the brunt—the developing world, rather, will bear the brunt of the collateral damage from our historic global warming emissions, but the United States will experience its own self-inflicted wounds, including threats to our national security and military readiness.

Today we will hear the first congressional testimony on this critical issue. Generals and admirals who have spent a lifetime on battlefields are telling us that global warming is a major strategic weakness. So today I am introducing the Global Climate Change Security Oversight Act which authorizes a national intelligence estimate to assess the security implications of global warming to the United States and its military. The bill, the House companion to the legislation already introduced by Senator Durbin and Senator Hagel, will provide a crucial planning and risk assessment tool as the Congress seeks innovative solutions to global warming. Developed to assess the most serious threats to the United States, NIEs are the most authoritative intelligence judgments concerning national security issues. This legislation will also fund research by the Defense Department into the consequences for U.S. military operations posed by global warming.

But U.S. military leaders are not the only ones concerned about the security implications of global warming. Yesterday the United Nations Security Council held a historic debate on energy climate and security. Representatives of 55 countries discussed global warming's implications for peace and security around the world. Hercules eventually vanquished the two-headed Orthus. And as we will hear today, we have the tools, the technology, and the know-how to accomplish our own Herculean task of overcoming both oil dependence and global warming pollution.

Let me now turn and recognize the Ranking Member of the committee, the gentleman from Wisconsin, Mr. Sensenbrenner.

[The statement of Mr. Markey follows:]

[The information follows:]

Opening Statement for Edward J. Markey (D-MA)
“Geopolitical Implications of Rising Oil Dependence and Global Warming”
Select Committee on Energy Independence and Global Warming
April 18, 2007

This hearing is called to order.

Thank you all for being with us for this, the inaugural hearing of the Select Committee on Energy Independence and Global Warming. Today’s witnesses have been invited because they have spent their lives thinking about what must be done to defend our planet, and how the twin imperatives of defending our environment and defending our freedom have begun to merge into single issue. This committee has been given an awesome charge -- to press the institutions of Democracy to change business as usual in an overdue effort to respond to the twin challenges of our dependence on imported oil and the looming catastrophe of global warming. These problems are intertwined, and hearing today is intended to highlight the fact that just as the oil security problem has a major global warming dimension, climate change has a major global security dimension. If we are to address either problem effectively, we must make sure we don’t make one problem better by making the other worse.

It seems clear that our geopolitical and national security posture will only grow worse if we do not act forcefully to curb our dangerous dependence on imported oil and reduce our emissions of global warming pollution. It is a double-threat, like Orthus, the monstrous two headed hound of Greek mythology, with one head facing backwards and the other forwards. Our ever-rising oil dependence is directly attributable to a backwards-facing energy policy, while looking forward we can see the threat of rising temperatures and the subsequent increasing risk of natural and humanitarian disasters. We have become all too familiar with the volatility in gasoline prices that occurs as a result of domestic or foreign events – be it the capture of British sailors by Iran, or the devastation brought by Hurricane Katrina. Gas prices have jumped up early this year, well before the summer driving season, and are now over \$3.00 a gallon for regular at many stations, reflecting once again the insecurity and, indeed, sheer folly of tethering our economic well-being to unstable foreign sources of oil governed by regimes which are, in some cases, supporters of or participants in the War on Terror.

45 percent of the world’s oil is located in Iraq, Iran and Saudi Arabia. Events in those countries have a dramatic impact on oil prices and on our national security. In the late 1970s, the Oil Embargo, Iranian Revolution and Iran/Iraq war sent the price of oil skyrocketing. And today, with Osama Bin Laden urging his followers to attack Saudi Arabian oil, with Iraq descending further into chaos, and with Iran marching further down the path towards developing nuclear weapons, we are seeing the very same sort of pain at the pump – because of the very same sort of global instability. In an article in the New York Times Magazine this past weekend, Thomas Friedman stated that “Soaring oil prices are poisoning the international system by strengthening antidemocratic regimes around the globe.”

It is no coincidence that we have 130,000 young men and women in Iraq right now, with at least another 25,000 on the way. It is no coincidence that we are spending more than \$100 billion dollars a year to keep those troops there, in addition to the nearly \$300 billion dollars we spend each year importing all the oil we use in the first place. Much of these funds end up in the pockets of Arab princes and potentates - who then funnel the money to Al Qaeda, Hezbollah, Hamas and other terrorist groups.

Our energy policy has compromised our economic freedom, and the American people want action because they know that the price has become much too high.

We know we cannot simply drill our way to energy independence. The United States is home to less than 3% of the world's oil reserves – but is itself the world's largest consumer and importer of oil. Last year, oil imports reached 60% - an average of 12.5 million barrels per day amounting to an annual cost of **291 billion dollars**.

While moving to renewable fuels that are grown in the soil of the Midwest rather than removed from the sands of the Middle East can help, the single biggest step we can take TODAY to curb our oil dependence and remove OPEC's leverage is to raise the fuel economy standards of our automotive fleet.

I have introduced a bill, H.R. 1506, which would require the combined car and light truck fleet to achieve 35 miles per gallon by 2018, which amounts to an average 4% a year improvement – an increase that is MANDATORY over this first 10 years. By ensuring that fuel economy standards keep pace with technological or other developments, we will move to a more and more efficient fleet over time instead of replicating the fuel economy stagnation of the past 2 decades.

By 2022, this bill would bill backs out the equivalent of every drop of oil that we currently import from the Persian Gulf, and by 2030, as the fleet becomes more fuel efficient, it backs out almost 40% of our projected highway oil needs. It also reduces global warming pollution from the transportation sector a similar amount. I look forward to hearing from the witnesses this morning about the role they believe stronger fuel economy standards should play in addressing our oil dependency and reducing global warming pollution.

From the most recent scientific evidence, it is clear we must act now to address the threat that carbon emissions from cars and other sources poses to the environment.

At the beginning of February, the world's top scientists, as part of the United Nations' Intergovernmental Panel on Climate Change (IPCC), provided a scientific smoking gun that human activities were unequivocally responsible for global warming. Two weeks ago, their second report told us what happens when the climatic bullet hits. The developing world will bear the brunt of the collateral damage from our historic global warming emissions, but the United States will experience its own self-inflicted wounds, including threats to our national security and military readiness.

Today we will hear the first Congressional testimony on this critical issue.

Generals and Admirals who have spent a lifetime on battlefields are telling us that global warming is a major strategic weakness. So today I am introducing the "Global Climate Change Security Oversight Act" which authorizes a National Intelligence Estimate (NIE) to assess the security implications of global warming to the United States and its military. My bill, the House companion to legislation already introduced by Senator Durbin and Senator Hagel, will provide a crucial planning and risk-assessment tool as the Congress seeks innovative solutions to global warming. Developed to assess the most serious threats to the United States, NIEs are the most authoritative intelligence judgments concerning national security issues. This legislation will also fund research by the Defense Department into the consequences for U.S. military operations posed by global warming.

But U.S. military leaders are not the only ones concerned about the security implications of global warming, yesterday the UN Security Council held a historic debate on energy, climate and security. Representatives of 55 countries discussed global warming's implications for peace and security around the world.

Hercules eventually vanquished the two-headed Orthus, and as we will hear today, we have the tools, the technology and know-how to accomplish our own Herculean task of overcoming both oil dependence and global warming pollution.

And now I would like to recognize the Ranking Member of the Committee, the gentleman from Wisconsin, Mr. Sensenbrenner.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman. And I want to welcome everyone to this first-ever oversight hearing of the House Select Committee on Energy Independence and Global Warming. Contrary to some press reports, this is not a new issue. As the former Chairman of the House Science Committee, I held numerous hearings on this topic. During that time, I heard my fair share of extreme predictions, dire forecasts, and gloomy outlooks. This committee has no legislative jurisdiction. And if we are to find a workable solution to climate change problems, I believe we need to be realistic and talk about commonsense ideas and commonsense solutions. Unfortunately, this debate has not been characterized by common sense. It has been characterized by extremism. While this extremism hasn't done anything to produce effective solution, it has created a lot of hot air, which isn't good for Congress' carbon footprint.

But extremism has produced a lot of fear. Take this story from Monday's Washington Post as an example. The headline reads, quote, "Climate Change Scenarios Scare and Motivate Kids," unquote. In this story one 9-year-old student foresees an Earth 20 years from now that will have no oxygen. There is no credible scientific evidence to support such a cataclysmic fear, but with all the scary news that we all have read on this issue, how can you blame children for being afraid?

I know that this is an area where the science seems to be the most skewed, and politicians and pundits aren't doing very much to clarify it. While science has taught us many things about climate change and greenhouse gas, one area there is no scientific consensus, contrary to popular belief, is the effects of climate change. Perhaps nowhere is this divergence more evident than in some of the claims made by former Vice President Al Gore. In his movie he predicts a 20-foot rise in sea levels. But what does the U.N. Intergovernmental Panel on Climate Change predict? A 23-inch rise in sea levels. And data was submitted yesterday to a Science Committee hearing that I attended that showed that there has been less than a 3-inch rise in sea levels in the 42-year span between 1961 and 2003. There is a world of difference between 20 feet, 23 inches, and less than 3 inches, and no wonder why the poor child who was interviewed by The Washington Post is scared. In fact, many scientists have questioned Mr. Gore's doomsday scenarios.

A recent article in The New York Times chronicled several scientists' call to cool the hype. One scientist said Mr. Gore was, quote, "overselling our certainty about knowing the future." One thing that is certain is that some of the solutions proposed by extremists would have devastating effects on our economy. Europe has adopted these so-called solutions. The results: soaring electricity rates, factories slowing down because they are too expensive to power, and jobs moving to countries like China that aren't subject to regulations.

Will Europe's environment benefit from the slowdown of its economy? I doubt it. The Republican members of this committee care about both the environment and the economy. And Republicans on this committee know that we can protect both in addressing this problem.

I will have many questions about why global warming has suddenly become an issue of national defense. I do agree that as a country we need to reduce our dependence on foreign oil. We especially need to reduce our energy dependence on countries that do not share our democratic values. New technology, along with wind and solar power, can help us reduce that dependence. So can nuclear power. If done right, we can implement these new power sources and reduce our carbon output and dependence on foreign oil without devastating our economy, throwing people out of work, and outsourcing jobs to Third World countries.

These are the types of solutions that my Republican colleagues and I will be seeking, and I thank the gentleman for the time.

The CHAIRMAN. The gentleman's time has expired.

Now under the rules, each of the members can make a 3-minute opening statement. I will reserve their time and add it to their 5 minutes to question the witnesses, thereby having 8 minutes to question the witnesses. It is within the discretion of each member.

The Chair recognizes the gentleman from Oregon, Mr. Blumenauer.

Mr. BLUMENAUER. Thank you, Mr. Chairman. I appreciate both the provocative statements that we have heard. My preference would be to get to our witnesses as soon as possible. So I will defer.

The CHAIRMAN. The gentleman reserves his time. The gentleman from Washington State, Mr. Inslee.

Mr. INSLEE. Yeah, I would like to say a couple things. First of all, it may seem unusual to say that we are lucky here this morning. But I think we are lucky for two reasons. The first reason, I think it will become very apparent to us that we are going to have a way to solve both—two horses of the Apocalypse by taking the same actions, and we are going to be able to unite Americans around a solution to these two problems of energy security and global warming. And I think it is important to say that because while this has kicked up a lot of storm and controversy, ultimately this country is going to be united for a solution to these two problems. I consider us lucky in that regard.

And secondly, most importantly, the reason why I consider us lucky, I believe it is America's destiny to lead the world into the technological solutions to these twin problems. And I just want to share an observation about why I think global warming has been controversial. It has been surprising to me that people who use a microwave oven that depends on quantum mechanics, and a cell phone that depends on quantum mechanics, have refused to recognize the scientific consensus on global warming. And I think their reason is fear.

My friend, Mr. Sensenbrenner, related fear of some grade-school children. I think there is a lot of fear in Congress. I think there is a lot of fear that we aren't smart enough to develop the technologies to deal with this problem. And the anecdote to fear is confidence.

And I just want to note a meeting we had last Friday in Seattle, Washington, where we brought together some companies that are dealing with the technologies, the American technologies to solve this problem. The Ramgen Company has developed a way to compress CO₂ that could help us have clean coal. The Verdiem Com-

pany that has figured out a way to save 30 percent of your electricity in your computer system. The Imperial Energy Company that is going to build the largest biodiesel plant in the Western Hemisphere. The Finavera Company has figured out a way to get energy from wavepower. The Prometheus Energy Company has figured out a way not to vent methane but to develop electricity. The MagnaDrive Company that has developed electrical generating motors that can save 30 to 40 percent of the energy costs associated with them.

I suggest that this problem and these two problems are the largest economic opportunity America has ever had. And America does well when there is economic and technological transition, and we are going to do well here. And I just hope that when we adopt the new Apollo Energy Act, which I will be introducing shortly, that we will get Members to support the idea of confidence and optimism. That is what we are going to take out of these meetings. Thank you.

The CHAIRMAN. The gentleman's time has expired.

The gentleman from Arizona, Mr. Shadegg.

Mr. SHADEGG. Thank you, Mr. Chairman, for holding this hearing. In recognition that today's hearing is the first of this select committee, I want to say that I welcome this debate on climate change and hope that this committee, along with other committees in the House, will investigate the matter, weighing the science as well as the costs and benefits of various policy options.

I agree that the United States should consider the risk of climate change as a potential national security concern. However, I also believe that extreme poverty in developing nations is also a potential national security concern, and limiting human freedom around the world is a potential national security concern, and policies that damage the world's economy are potential national security concerns. Indeed there are countless potential national security concerns, many of them related to our need for energy. Worst-case scenarios should be considered and assessed, but that does not mean they should be the cornerstones of U.S. policy. There are many tools at our disposal, including adaptation that can be effective in addressing the potential impacts of a warming climate.

President Klaus of the Czech Republic, in writing to the Energy and Commerce Committee several weeks ago, expressed his view that while discussing climate, we are not witnessing so much a clash of views about the environment but a clash of views about human freedom. Regarding developing nations he wrote: They will not be able to cope with the limits and standards imposed on the world by irrational environmental policies. Their products will have difficult access to the developed markets. And as a result, the gap between the developing nations and the developed world will widen.

President Klaus' language should give us a sense of how difficult it will be to get these nations to join us in a quest to reduce carbon, and of the importance of pursuing energy alternatives that will not limit or damage the economies of developing nations or the world's economy. These developing nations are faced with a moral question. Do they restrain the growth of their energy supply demand

in their economies considering that hundreds of millions of their citizens live in dire poverty?

We have heard testimony in the Energy and Commerce Committee that over 300 million Indians live on less than \$1 per day; 700 million live on less than \$2 per day. Facing this economic reality, can we expect policymakers in India or China or other developed nations to limit their nation's economic growth? Or must we help these nations grow their economies and raise standards of living through alternative energy sources and efficiency gains so that environmental and adaptation concerns are manageable problems rather than global crises?

History has shown that countries that can afford to care about the environment do. Put another way, as former Indian Prime Minister Indira Gandhi once said, the ultimate polluter is poverty.

These are difficult questions, Mr. Chairman, and I thank you for holding this hearing that will hopefully help us begin to resolve them. I yield back.

The CHAIRMAN. Okay. Thank you. The gentleman's time has expired.

The Chair recognizes the gentleman from Connecticut, Mr. Larson.

Mr. LARSON. Thank you, Mr. Chairman. And let me commend you and also the leadership of Speaker Pelosi for having the vision to understand the need to get both sides of the aisle to come together and coalesce around the vitality of ideas that can deal with this very important issue.

I am looking forward to the testimony of our panelists, and I truly believe that we are in a race between catastrophe and cooperation. And I think to the extent that this committee can come together and have a robust exchange of ideas and not end up being central casting for *Inherit the Wind*, part 2, I think we will be able to move forward in a manner in which the Nation will be well served.

And I yield back.

The CHAIRMAN. The gentleman's time has expired.

The gentleman from Oregon, Mr. Walden.

Mr. WALDEN. Thank you very much, Mr. Chairman. I appreciate the opportunity to hear from our witnesses today. And I spent most of the April break touring around my district, meeting with people who are developing alternative energy, a lot of which was prompted by passage and enactment of the 2005 Energy Policy Act for America which is spurring development of wind energy. I toured a 100-megawatt wind energy facility out of North Power, Oregon, out of Union that is set to go online. I toured a 40-million-gallon-a-year ethanol plant that should open this July at the Port of Morrow in Boardman, Oregon. I met with the pollen grain growers and talked about their ability to produce biodiesel fuels.

And I am a big advocate of renewable energy, but I grow somewhat perplexed at those who say we have become so reliant on foreign oil—and I, frankly, agree with them, and that is a bad thing for our Nation's security and economy at times. But then also they are doing everything they can to stop us from developing our own resources available here in the United States, whether that is oil or natural gas.

I spent a lot of time in this Congress over the last few years chairing the Subcommittee on Forests and Forest Health. I worked closely with my colleague from South Dakota, Representative Herseth, on legislation to try to clean up her forests. One forest in Oregon that burned in 2003, the B&B fire, in a matter of a couple weeks put twice as much carbon into the atmosphere in Oregon and other greenhouse gases as the entire State of Oregon emits in a year combined. In a year.

And yet there are those who are advocating for us to do everything we can to address this issue of global warming and climate change, and I think there are a lot of things we can do, and I am actually excited about some of the opportunities. But there are also the very people who don't want us to do anything to manage our forests.

And yet overseas, we read in The Washington Post, the illegal logging that is going on is eliminating the forests in China and Indonesia and other Asian countries, so we can import that wood here at a time when we have forests that are overstocked, overgrown, subject to catastrophic fire and emitting enormous amounts of loads of carbon and other greenhouse gases into the atmosphere, and we refuse to do anything about it.

So I think there are opportunities here to improve management of our Federal forestlands, to encourage and incent development of renewable and low-polluting new sources of energy, to encourage conservation efforts and more efficiencies.

And I look forward to our hearings and the testimony from our witnesses. And thank you, Mr. Chairman.

The CHAIRMAN. The gentleman's time has expired.

The gentlelady from South Dakota, Ms. Herseth.

Ms. HERSETH. Thank you, Mr. Chairman. I will reserve my time so that we can get to the testimony. And as a matter of personal privilege, a couple colleagues and I will have to go to a short markup in the Veterans' Affairs Committee, but we will return promptly to hear the testimony of our distinguished panelists today. Thank you.

The CHAIRMAN. The gentlelady's time is reserved. The gentleman from Missouri, Mr. Cleaver.

Mr. CLEAVER. I reserve my time also, Mr. Chairman. Thank you.
[The statement of Mr. Cleaver follows:]

U.S. Representative Emanuel Cleaver, II
5th District, Missouri
Opening Statement
House Select Committee on Energy Independence and Global Warming Hearing
“Geopolitical Implications of Rising Oil Dependence and Global Warming”
Wednesday, April 18, 2007

Chairman Markey, Ranking Member Sensenbrenner, other Members of the Select Committee, good morning.

To our distinguished panel of experts, I would like to join my colleagues in welcoming you to the Select Committee on Energy Independence and Global Warming. I look forward to listening to your testimony today and hearing any insights you can share on the effects of oil dependence and global warming on national security.

Thank you Mr. Chairman, for the privilege of being a part of the Select Committee and for the opportunity to address an issue of great importance to me, my constituents of Missouri’s Fifth District, and to individuals across this country. For decades, our country has become increasingly reliant on foreign energy sources. Not only is this an issue of national security, but this is an issue of environmental security. The last five years have been the hottest on record, and the effects of global warming are impacting communities and wildlife like never before witnessed. We have put our planet in real danger, and it is long past time for our nation to act in response to this crisis.

As a former Mayor of the largest city in Missouri, Kansas City, I know how the local policies of a growing metropolitan area can serve as a model for the rest of the country when attempting to reverse the effects of global warming. In 1978, the Kansas City area was designated non-attainment with respect to the one-hour ozone standard. However, by 1991 the area had improved its level of emissions, and it demonstrated that it had attained the standard necessary for attainment. I am proud to say that I was Mayor of Kansas City during this progressive step, despite record population growth in the metropolitan area. Regardless of Kansas City’s improvements, there remains far to go, especially on a national scale. Our country must roll up its sleeves and get to work on the issue of global warming. The catalyst for this change will be action by Congress, and the Select Committee enables us Members to bring this pressing issue to the forefront. Like many of colleagues, constituents of my district approach me often urging a feasible and effective solution to the climate crisis.

Global warming is just that – global. A change in the earth’s climate affects all parts of the globe, and the areas that are most heavily influenced are often those that are least responsible for climate change. Because of increased temperatures, poor and unstable parts of the world will be more prone to conflict because of diminishing resources like drinking water, and thus there a greater need for international intervention will exist. It is my expectation that this Committee will serve its intended purpose as a fact-finding panel, and uncover the real effects of global warming. Many of these truths are known, as the International Panel on Climate Change has reported this year.

Protecting our global environment has been a passionate concern of mine for years. I firmly believe that a nation’s government should lead by example, and Congress should act by its own suggestion. In this sentiment, I am looking forward to hearing our witnesses this morning, and any insights they might have for Congress for reasonable and effective policy will be appreciated.

Thank you.

The CHAIRMAN. The gentleman from New York, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman, Mr. Ranking Member and distinguished panel. I am proud to be named to this committee. I am eager for the committee to get to work. The subject matter for our first hearing could not be more appropriate.

Our dependence on foreign oil and our changing environment constitute nothing less than significant threats to our national security that must be met with swift aggressive action. Reliance on imported fossil fuels already sends hundreds of billions of dollars overseas each year, damages our economy with energy prices that burden family budgets and creates public health risks by spewing pollution into the environment. Left unchecked, our growing dependence on foreign sources of energy will leave our Nation increasingly vulnerable to the whims of OPEC and the upheaval in the world's most unstable regions.

At the same time, the widespread impacts of climate change will enhance the threat of severe weather disasters and create global instability.

Meeting our national security threats posed by the dependence on foreign oil and climate change will require a concerted national effort. For too long, too little has been done by our national leadership to mobilize the American people to meet this challenge. Finding the solutions necessary will require commitment and difficult choices, but I believe that just as the Nation pulled together to support the war effort through World War II, just as we rose to meet the challenge that President Kennedy gave us of going to the Moon in 10 years—which we actually accomplished in 9—we can unite now to do what is necessary to combat climate change and energy insecurity. And, at the same time, those same actions will help to reduce asthma and emphysema, especially among our children in our inner cities, and to reduce acid rain and to reduce oil spills and to reduce mercury contamination and to reduce our—to balance the trade deficit and to reduce our difficulties in securing oil in parts of the world where they are unstable or unfriendly regimes.

And maybe most importantly, if and when we win this particular battle, we meet this particular challenge, I believe it will give us as a Nation a psychological boost, not just an economic boost, because I believe a lot of these jobs will be created in the new industries we are talking about here, and that is certainly my hope, but it will give us an emotional boost that this country sorely needs.

So I am excited to be here and look forward to your testimony. And thank you, Mr. Chairman. I yield back.

The CHAIRMAN. The gentleman's time has expired.

The gentlelady from Michigan, Mrs. Miller.

Mrs. MILLER. Thank you very much, Mr. Chairman. I am delighted to be a member of this committee. I think both of our leaderships on both sides have done an outstanding job of picking a very diverse group of our colleagues here, and I look forward to working on an issue that has no partisan barriers, of course, and that is advocating for our environment and being environmentally sensitive.

And as I understand the purpose of the committee, it really is to seek government policy solutions to the problem of global climate change. And so I think it is entirely appropriate that our first hear-

ing be about the geopolitical implications of oil dependence and climate change, because I truly believe that energy security and energy independence equals national security. And I also sit on the House Armed Services Committee, so I really believe this very much.

And, of course, as the President has said and as has been said here today, we are a Nation addicted to oil. And just like drug abusers, we buy the product that we are addicted to from some very unsavory characters from across the globe. We buy energy from nations like Venezuela and Hugo Chavez, who is openly hostile to America. We buy energy from some of the Middle East where funds are sometimes siphoned off to support those who hate America. And let's face it, many of these countries would be much less interesting if we did not need that oil.

There has to be a better way, and do I believe that there is. In fact, I represent a district in southeast Michigan which is home, as you might all know, to the domestic auto industry, which is under a microscope for environmental sensitivity. And wouldn't it be better for America if we produced automobiles that got not only higher fuel economy, but ran on much different types of fuel than oil-based gasoline, fuels like ethanol or biodiesel or hydrogen? That day is coming and it is coming if we stand up and give our domestic auto industry a helping hand instead of hitting it with a hammer.

Wouldn't it be better for America if we could produce automobiles that we could plug in to charge in a battery in our garage and never have to use the gas engine on a short trip? That day is coming if we share the vision with our incredible scientists.

In fact, Mr. Chairman, let me take this opportunity to formally ask the committee to consider having a field hearing in Detroit, in southeast Michigan, at the home of the domestic auto industry where we can actually see all of these exciting new technologies and how they are being utilized in the future.

This technology is coming. The only question is whether or not America will lead the way, as we have throughout the Industrial Revolution. The geopolitical implications of energy independence are clear. In America, where we are not forced to fund our enemies but instead support the betterment of our own society, that should be the primary focus of our energy policy, one that supports American enterprise and ingenuity that drives our economy forward. And I think if this goal is accomplished, America and the world will be a much better place.

Thank you, Mr. Chairman. I will reserve the balance of any remaining time that I may have. Thank you.

The CHAIRMAN. Great.

[The statement of Mrs. Miller follows:]

Congresswoman Candice Miller
Energy Security Equals National Security

Thank you Mr. Chairman.

The purpose of this committee is to seek government policy solutions to the problem of global climate change. And while that is an admirable aim, I believe that it is appropriate that our first hearing be about the geopolitical implications of oil dependence and climate change.

This is because I truly believe that energy security equals national security.

Today we are a nation addicted to oil. And just like drug abusers we buy the product that we are addicted to from some unsavory characters from across the globe.

We buy energy from nations like Venezuela and Hugo Chavez who is openly hostile to America.

We buy energy from some in the Middle East where funds are sometimes siphoned off to support those who hate America.

There must be a better way, and I believe there is.

Wouldn't it be better for America if we produced automobiles that only got higher fuel economy, but ran on a vastly different fuel than oil based gasoline?

Fuels like ethanol, bio-diesel or hydrogen. That day is coming if we stand up and give our domestic industry a helping hand instead of hitting it with a hammer.

Wouldn't it be better for America if we produced automobiles that we could plug in to charge a battery in our garage and never even use a gas engine for short trips?

That day is coming if we share the vision with our incredible scientists.

This technology is coming the only question is whether America will lead the way as we have throughout the industrial revolution.

The geopolitical implications of energy independence are clear.

An America where we are not forced to fund our enemies, but instead support the betterment of our own society.

That should be the primary focus of our energy policy. One that supports American enterprise and ingenuity. That drives our economy forward.

If this goal is accomplished America and the world will be a better place.

The CHAIRMAN. And the Chair recognizes the gentleman from California, Mr. McNerney.

Mr. MCNERNEY. Thank you, Mr. Chairman. Today we have a rare opportunity to unite our great Nation to develop a national mandate to educate and mobilize our country with a great national purpose, much like Sputnik mobilized the prior generation.

This committee can be the focus for that change and mobilization, and I look forward to participating in that transformation. I reserve the balance of my time.

The CHAIRMAN. And the Chair recognizes the gentleman from Oklahoma, Mr. Sullivan.

Mr. SULLIVAN of Oklahoma. Thank you, Mr. Chairman. And thank you for holding this historic first hearing of the Select Committee on Energy Independence and Global Warming. I look forward to hearing from our witnesses on the geopolitical implications of rising oil dependence and global warming. It is an honor to be at the epicenter of the debate on climate change.

Protecting the environment is neither a Democrat nor a Republican issue but a bipartisan issue that all Americans should discuss and address. Our country has become too dependent on foreign energy resources, especially oil that is produced in a volatile part of the world. I believe the answer to this problem comes from increased U.S. energy independence. We can achieve this by expanding our domestic refining capacity and expanding our domestic energy production both on and offshore.

It is also important that we look at alternative fuels as a viable option for Americans' energy needs. I welcome the debate on this issue and commit to this process with an open mind. I believe we can work together to find workable solutions, commonsense regulations, and address the issue of climate change without destroying the American economy or losing American jobs.

Thank you, Mr. Chairman, and I yield back the remainder of my time.

The CHAIRMAN. The gentleman's time has expired.

The gentlelady from California, Ms. Solis.

Ms. SOLIS. Thank you, Mr. Chairman. And I also want to commend you and Speaker Pelosi for allowing me the opportunity to serve on this very prestigious select committee, and knowing that this is our first hearing how important it is to hear from our witnesses, so I want to thank them for also being here this morning.

Two months ago I spoke at the Helsinki Commission, on behalf of the United States delegation, to address energy security and climate change. Parliamentarians from across Europe agreed that we must address the issue of security and climate change together. Many oil-producing countries lack the political will or social framework for good governance in the energy sector. Producing countries such as Iran and Russia may use energy reserves to attain political objectives and increase political influence. In the United States, as we know, we are home to less than 3 percent of the world's reserves and more than 60 percent of the oil consumed in the U.S. is imported, costing our Nation more than \$290 billion annually.

The dependency on oil makes us subject to the international risks associated with unpredictable and unstable nations. The report titled "National Security and the Threat of Climate Change"

underscored the connection between security, energy use and climate change, and clearly outlined the risks of inaction. It concluded that climate change is a threat multiplier for instability in some of the most volatile regions in the world, resulting in already weak and failing governments being pushed toward authoritarianism and radical ideologies.

Globally, food security, transport industry, and human health will be impacted, all issues at the root of instability and conflict. Failure to take action may result in the United States being drawn more frequently into conflict situations.

And yesterday the Secretary General of the United Nations stated and, I quote, "Compared to the cost of conflict and its consequences, the cost of prevention is far lower in financial terms, but, most importantly, in human lives and life quality." and I agree with this.

The risks associated with inaction are far too great. The impacts of global warming, such as heat waves, would disproportionately affect low-income and underrepresented communities here in the United States. And just this week Latino, religious, African American leaders highlighted the risks of inaction to the health of vulnerable communities and populations.

Military advisors have also highlighted the risks in terms of national security. The development of domestic policies that reduce oil consumption and emissions are critical to increasing options for protecting our interests abroad and here at home. Simply put, we need aggressive action to curtail our thirst for energy.

I look forward to discussing these policy issues with you, and thank the witnesses for being here. Thank you.

The CHAIRMAN. The gentlelady's time has expired.

The gentlelady from Tennessee, Mrs. Blackburn.

Mrs. BLACKBURN. Thank you, Mr. Chairman. I appreciate the opportunity to serve on the committee and I am looking forward to a healthy and judicious debate over the issue of climate change.

As we look at the causes of climate change, I think it is imperative that we look at the whole problem, but we must not base our decisions on half truths, inconclusive science or media hype. The discussion must be based on testimony on science, not on political party or special interest agenda items.

And I want to welcome our guests, and we look forward to your testimony that you will share with us.

We all should be aware that the U.S. currently has several existing threats to its national security, such as proliferation of weapons of mass destruction and transnational terrorism. A question we should ask is, does climate change rise to the level of this immediate danger? Another question that we should ask, we should ask if it would be unwise for us to devote significant time and resources to speculative dangers; should we instead focus on the current dangers to our national security? It is possible if these are not addressed that the global warming issue would be a moot issue.

I do agree that competition for oil resources in the future, especially for the U.S., is going to increase and U.S. domestic policies need to address our current and future dependence on oil imports, because we are vulnerable to supply interruptions and price increases and because much of this revenue is going to countries that

are not friendly to the United States. We must diversify our resources of oil, and we can because we have vast reserves of oil and gas on land and in the sea that are currently not being tapped.

We also have trillions of barrels of oil in shale and coal on public lands that can be converted to transportation fuel and serve our needs for a couple hundred years. And this could be accomplished with little disruption to our natural environment. Even if the Earth continues to warm and does not revert to a cooling cycle and possibly cause events that threaten national security, the predicted outcomes are at best tentative and the proposed solutions raise problems of their own.

I look forward to discussing how we should proceed and how we should appropriately use our resources as we look for energy innovation and security. Thank you, Mr. Chairman. I yield back.

The CHAIRMAN. Great. The gentlelady's time has expired.

We now turn to our exceptionally influential committee which has been assembled here this morning. We will begin with General Gordon Sullivan who is a former chief of staff of the United States Army. He has spent his life serving his country, with four tours of duty in Europe, two in Vietnam, and one in Korea, and was chief of staff to Secretary of Defense Dick Cheney in the administration of George Herbert Walker Bush. He joins us today on the heels of the release of a major report entitled "National Security and the Threat of Climate Change" which he compiled for the Center of Naval Analysis with 11 distinguished military leaders.

Thank you for all of your service, General Sullivan. Whenever you feel comfortable, please begin.

**STATEMENT OF GENERAL GORDON R. SULLIVAN, USA (RET.),
CHAIRMAN, MILITARY ADVISORY BOARD**

General SULLIVAN. Thanks, Mr. Chairman. It is an honor to be here today with you and your colleagues. As you stated, today I am here as the Chairman of the Military Advisory Board to the Center for Naval Analysis Corporation and their report on national security and the threat of climate change.

The advisory board consisted of three- and four-star flag officers of the Army, Navy, Air Force and Marine Corps. Our charge was to learn as much as we could in a relatively short time about the emerging phenomenon of global climate change, using our experience as military leaders to process our learning through a national security lens. In other words, we were asked what are the national security implications of climate change.

When I was asked to be on the Military Advisory Board, I was both pleased and skeptical. Pleased because of one simple and straightforward fact; that is that I am almost 70 years old. I have served my country for over 50 years. I took my oath as a cadet at Norwich University in Vermont in 1955, retired in 1995, and I am now the president and chief operating officer of the Association of the United States Army. So I have been in or around the defense establishment since 1955. Here I am in the later stages of my life, and I feel sometimes as if some of the sacrifices I, my soldiers, colleagues, friends and family made for America are now being overtaken by a much more powerful and significant challenge to their

health and well-being and the health and well-being of my three grandchildren and their children and the future.

Having said this, I must admit I came to the advisory board as a skeptic. There is lots of conflicting information on the subject of climate change, and like most public policy issues debated here and discussed in America, there are many opinions. It is what makes America great. It is what I served for, for over 50 years.

After listening to the leaders of scientific business and governmental communities, both I and my colleagues came to agree; and we published our report with our agreement that global climate change is and will be a significant threat to our national security, and, in a larger sense, to the lives of our grandchildren and their children.

The findings of the Military Advisory Board are as follows:

Projected climate change poses a serious threat to America's national security. Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world. Projected climate change will add to tensions even in stable regions of the world. And climate change, national security, and energy dependence are a related set of global challenges.

Our recommendations are as follows:

First, the national security consequences of climate change should be fully integrated into national security and national defense strategies. The United States should commit to stronger national and international roles to help stabilize climate changes at levels that will avoid significant disruption to global security and stability. The United States should commit to global partnerships that help less developed nations build the capacity and resiliency to better manage climate impacts.

The Department of Defense should enhance its operational capabilities by accelerating the adoption of improved business processes and innovative technologies that result in improved U.S. combat power through energy efficiency.

And last, the DOD, the government, should conduct an assessment of the impact on U.S. military installations worldwide of such events as rising sea levels, extreme weather events and possible climate change impacts over the next 30, 40, 100 years.

Climate change, national security, and energy dependence are interrelated. Simply hoping that these relationships will remain static is simply not acceptable. Hope is not a method. We can't sit here and wait to find out.

Speaking for the members of the Military Advisory Board, I am confident in stating we as individuals collectively support your legislative initiative to authorize an NIE, National Intelligence Estimate, on national security implications of climate change.

Mr. Chairman, I request my statement and the report, which I have here, be entered into the official record.

The CHAIRMAN. Without objection, it will be entered into the official record.

General SULLIVAN. Thank you, sir.

The CHAIRMAN. I thank you, General Sullivan.

[The statement of General Sullivan follows:]



**NATIONAL SECURITY
AND THE THREAT OF
CLIMATE CHANGE**

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TESTIMONY OF
GENERAL GORDON R. SULLIVAN, USA (Ret.)
Chairman, Military Advisory Board
To The CNA Corporation Report
“NATIONAL SECURITY AND THE THREAT OF CLIMATE CHANGE”
BEFORE THE
SELECT COMMITTEE ON ENERGY INDEPENDENCE
AND GLOBAL WARMING
U.S. HOUSE OF REPRESENTATIVES
APRIL 18, 2007

Thank you, Mr. Chairman, for inviting me to testify in front of your committee this morning.

My name is Gordon Sullivan. I have served America as a Soldier since 1955. My last duty position was as Army Chief of Staff – 1991 to 1995. I retired from Active service in 1995 and have been the President of the Association of the United States Army – Army’s professional Association – since 1998. Thus, I have been in or involved with the Army for over 50 years.

Today I am here as Chairman of the Military Advisory Board to The CNA Corporation report on National Security and the Threat of Climate Change. The Advisory Board consists of 3 and 4 star Flag Officers from the Army, Navy, Air Force and Marine Corps. Our charge was to learn as much as we could in a relatively short period about the emerging phenomenon of global climate change using our experience as military leaders to process our learning through a

National Security lens. In other words what are the National Security implications of climate change?

Subsequent to my retirement, I co-authored a book- "Hope is Not a Method".

The title telegraphs the guiding principle of my experiences as a leader. Simply stated if all you do is hope good things will happen and bad things will not happen you and your organization could be doomed to failure. If on the other hand, you and your team assess your environment – understand your mission, your capabilities, your tasks, and know how to organize – train and equip your forces to succeed you must do something – you simply cannot hope for a successful future.

When I was asked to be on the Military Advisory Board, I was both pleased and skeptical. Pleased because of one simple and straightforward fact – I am almost 70 years old, I have served my country for over 50 years in both peace and war and now in the late stages of my life I feel as if the sacrifices I and my soldiers, colleagues, friends and my family made for America are now being overtaken by a much more powerful and significant challenge to the health and well-being of my 3 grandchildren and their children.

Having said this, I must admit I came to the Advisory Board as a skeptic. There is lots of conflicting information on the subject of climate change and like most public policy issues in America, many opinions, which is what makes America great.

After listening to leaders of the scientific, business, and governmental communities both I and my colleagues came to agree that Global Climate Change is and will be a significant threat to our National Security and in a larger sense to life on earth as we know it to be.

Findings of the Military Advisory Board

- First, projected climate change poses a serious threat to America's national security;
- Second, climate change acts as a threat multiplier for instability in some of the most volatile regions of the world;
- Third, projected climate change will add to tensions even in stable regions of the world; and
- Fourth, climate change, national security and energy dependence are a related set of global challenges.

Recommendations of the Military Advisory Board

- First, the national security consequences of climate change should be fully integrated into national security and national defense strategies;
- Second, the U.S. should commit to a stronger national and international role to help stabilize climate changes at levels that will avoid significant disruption to global security and stability;
- Third, the U.S. should commit to global partnerships that help less developed nations build the capacity and resiliency to better manage climate impacts;

- Fourth, the Department of Defense should enhance its operational capability by accelerating the adoption of improved business processes and innovative technologies that result in improved U.S. combat power through energy efficiency; and
- Fifth, DoD should conduct an assessment of the impact on U.S. military installations worldwide of rising sea levels, extreme weather events, and other possible climate change impacts over the next 30 to 40 years.

Climate change, National Security and energy dependence are inter-related. Hoping that these relationships will remain static is simply not acceptable given our training and experience as military leaders. Speaking for the members of the Military Advisory Board, I am confident in stating we as individuals and collectively support your legislative initiative to authorize a National Intelligence Estimate on the National Security Implications of Climate Change.

Mr. Chairman, I request my statement and the report to be entered into the record. Again, I thank you for the invitation to discuss this critical issue to our nation's security.



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- General Anthony C. "Tony" Zinni, USMC (Ret.)

To the reader,

During our decades of experience in the U.S. military, we have addressed many national security challenges, from containment and deterrence of the Soviet nuclear threat during the Cold War to terrorism and extremism in recent years. Global climate change presents a new and very different type of national security challenge.

Over many months and meetings, we met with some of the world's leading climate scientists, business leaders, and others, studying climate change. We viewed their work through the lens of our military experience as strategists, planners, and leaders. Our discussions have been lively, informative, and very sobering.

Carbon dioxide levels in the atmosphere are greater now than at any time in the past 650,000 years, and average global temperature has continued a steady rise. This rise presents the prospect of significant climate change, and while uncertainty exists and debate continues regarding the science and future extent of projected climate changes, the trends are clear.

The nature and pace of climate change being observed today and the consequences projected by the consensus scientific opinion are grave and pose equally grave implications for our national security. Moving beyond the arguments of cause and effect, it is important that the U.S. military begin planning to address these potentially devastating effects. The consequences of climate change can affect the organization, training, equipping, and planning of the military services. The U.S. military has a clear obligation to determine the potential impacts of climate change on its ability to execute its missions in support of national security objectives.

Climate change can act as a threat multiplier for instability in some of the most volatile regions of the world, and it presents significant national security challenges for the United States. Accordingly, it is appropriate to start now to help mitigate the severity of some of these emergent challenges. The decision to act should be made soon in order to plan prudently for the national security. The increasing risks from climate change should be addressed now because they will almost certainly get worse if we delay.

*Admiral Frank Bowman
General Gordon R. Sullivan
Admiral Joseph W. Frazier
Vice Admiral Richard M. Trigg
General Charles F. West
General Anthony C. Zinni*

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We thank the following persons for briefing the Military Advisory Board: Dr. James Hansen, lead climate scientist and director, NASA Goddard Institute for Space Studies; Dr. Anthony Jannetos of the H. John Heinz III Center for Science, Economics and the Environment; Dr. Richard Moss, senior director, Climate and Energy, United Nations Foundation, formerly director of the U.S. Global Change Research Program; Office: Mr. Justin Mundy, senior advisor to the Special Representative on Climate Change, UK Foreign and Commonwealth Office; Maj. Gen. Richard Engel, USAF (Ret.), deputy national intelligence officer for science and technology; National Intelligence Council; Mr. Randy Overby, former president, Alcoa Primary Metals Development; Mr. Kenneth Colburn, of the Center for Climate Strategies; and Dr. Robert Socolow of Princeton University.

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EXECUTIVE SUMMARY

The purpose of this study is to examine the national security consequences of climate change. A dozen of the nation's most respected retired admirals and generals have served as a Military Advisory Board to study how climate change could affect our nation's security over the next 30 to 40 years—the time frame for developing new military capabilities.

The specific questions addressed in this report are:

1. What conditions are climate changes likely to produce around the world that would represent security risks to the United States?
2. What are the ways in which those conditions may affect America's national security interests?
3. What actions should the nation take to address the national security consequences of climate change?

The Military Advisory Board hopes these findings will contribute to the call President Bush made in his 2007 State of the Union address to "...help us to confront the serious challenge of global climate change" by contributing a new voice and perspective to the issue.

FINDINGS

Projected climate change poses a serious threat to America's national security. The predicted effects of climate change over the coming decades include extreme weather events, drought, flooding, sea level rise, retreating glaciers, habitat shifts, and the increased spread of life-threatening diseases. These conditions have the potential to disrupt our way of life and to force changes in the way we keep ourselves safe and secure.

Projected climate change will add to tensions even in stable regions of the world. The U.S. and Europe may experience mounting pressure to accept large numbers of immigrant and refugee populations as drought increases and food production declines in Latin America and Africa. Extreme weather events and natural disasters, as the U.S. experienced with Hurricane Katrina, may lead to increased migrations for a number of U.S. agencies, including state and local governments, the Department of Homeland Security, and our already stretched military, including our Guard and Reserve forces.

Climate change, national security, and energy dependence are a related set of global challenges. As President Bush noted in his 2007 State of the Union speech, dependence on foreign oil leaves us more vulnerable to hostile regimes and terrorists, and clean domestic energy alternatives help us confront the serious challenge of global climate change. Because the issue is linked, solutions to one affect the other. Technologies that improve energy efficiency also reduce carbon intensity and carbon emissions.

RECOMMENDATIONS OF THE MILITARY ADVISORY BOARD:

1. The national security consequences of climate change should be fully integrated into national security and national defense strategies.

As military leaders, we know we cannot wait for certainty. Failing to act because a warning isn't precise enough is unacceptable. The intelligence community should incorporate climate consequences into its National Intelligence Estimate. The National Security Strategy should directly address the threat of climate change to our national security interests. The National Security Strategy and National

Defense Strategy should include appropriate guidance to military planners to assess risks to energy and future missions caused by projected climate change. The next Quadrennial Defense Review should examine the capabilities of the U.S. military to respond to the consequences of climate change, in particular, preparedness for natural disasters from extreme weather events, pandemic disease events, and other related missions.

2. The U.S. should commit to a stronger national and international role to help stabilize climate change at levels that will avoid significant disruption to global security and stability.

Managing the security impacts of climate change requires two approaches: mitigating the effects we can control and adapting to those we cannot. The U.S. should become a more constructive partner with the international community to help build and execute a plan to prevent destabilizing effects from climate change, including setting targets for long term reductions in greenhouse gas emissions.

3. The U.S. should commit to global partnerships that help less developed nations build the capacity and resiliency to better manage climate impacts.

As President Bush noted in his State of the Union speech, "Our work in the world is also based on a simple truth: To whom much is given, much is required." Climate forecasts indicate countries least able to adapt to the consequences of climate change are those that will be the most affected. The U.S. government should use its many instruments of national influence, including its regional commanders, to assist nations at risk build the capacity and resiliency to better cope with the effects of climate change. Doing so now can help avert humanitarian disasters later.

4. The Department of Defense should enhance its operational capability by accelerating the adoption of improved business processes and innovative technologies that result in improved U.S. combat power through energy efficiency. Numerous Department of Defense studies have found that combat forces would be more capable and less vulnerable by significantly reducing their fuel demand. Unfortunately, many of their recommendations have yet to be implemented. Doing so would have the added benefit of reducing greenhouse gas emissions.

5. The Department of Defense should conduct an assessment of the impact on U.S. military installations worldwide of rising sea levels, extreme weather events, and other projected climate change impacts over the next 30 to 40 years. Many critical defense installations are located on the coast, and several strategically important ones are on low-lying Pacific islands. Sea level rise and storm surges will threaten these facilities. Planning and action can make these installations more resilient. Lack of planning can compromise them or cause them to be inundated, compromising military readiness and capability.

ABOUT THE REPORT

To better inform U.S. policymakers and the public about the threat to national security from global climate change, the CNA Corporation, a nonprofit national security analysis organization, convened a panel of retired senior military officers and national security experts and conducted an assessment of the national security implications of global climate change. In this context, we define national security to refer to the influence of climate change on geo-strategic balances and world events that could likely involve U.S. military forces or otherwise affect U.S. strategic interests anywhere in the world.

The Military Advisory Board consisted of retired flag and general officers from all four services, including service chief and some who served as regional combatant commanders (a regional combatant commander is a four-star officer who commands all U.S. forces in a given region of the world). The Military Advisory Board and the study team received briefings from the U.S. intelligence community, climate scientists, and business and state leaders. They also traveled to the United Kingdom to meet with high-level government and business leaders to learn what actions the United Kingdom is taking to address the threat of climate change.

Members of the Military Advisory Board also presented their own views, based on experience, of the security effects of climate change on various regions of the world.

This report documents the results of that effort. We start with a discussion of the geo-strategic implications of climate change in the general sense—that is, how climate change can foster instability and affect international security. We then apply this background to

address specific regional security challenges in Africa, Asia, the Middle East, Europe, and the Americas. That is followed by a discussion of the challenge from climate change that can have a direct impact on military systems and operations. We conclude with a set of findings and recommendations related to mitigation, adaptation, and preparation—specific actions the U.S. government should take in response to the challenges presented by climate change.

Appendices provide background on members of the Military Advisory Board, and very briefly summarize the science of climate change and ways in which the earth's environment may potentially change.

CLIMATE CHANGE AND THE SCOPE OF THIS STUDY

Although there is a great deal of agreement among the world's climate scientists regarding the overall picture of a changing climate, there is also some disagreement about the extent of future changes.

Regardless of this continuing discussion, the board's view is quite clear: The potential consequences of climate change are so significant that the prudent course of action is to begin now to assess how these changes may potentially affect our national security and what courses of action, if any, our nation should take.

This approach shows how a military leader's perspective often differs from the perspectives of scientists, policymakers, or the needs. Military leaders see a range of estimates and tend not to see it as a stark disagreement, but as evidence of varying degrees of risk. They don't see the range of possibilities as justification for inaction. Risk is at the heart of their job. They

VOICES OF EXPERIENCE

GENERAL GORDON R. SULLIVAN, USA (Ret.)
Chairman, Military Advisory Board | Former Chief of Staff, U.S. Army

ON RISK

Former U.S. Army Chief of Staff Gordon Sullivan enjoys a good debate. But he also knows there are times when debate must stop and action must begin. With respect to climate change, he says that time has arrived.

"We seem to be stalling by and, frankly, asking for performance in science," Gen. Sullivan said. "People are saying they want to be convinced perfectly. They want to know the climate science projections with 100 percent certainty. Well, we know a great deal, and even with that, there is still uncertainty. But the trend line is very clear."

"We never have 100 percent certainty," he said. "We never have it. If you wait until you have 100 percent certainty, something bad is going to happen on the battlefield. That's something we know. You have to act with

"We never have 100 percent certainty. We never have it. If you wait until you have 100 percent certainty, something bad is going to happen on the battlefield."

incomplete information. You have to act based on the trend line. You have to act on your intuition sometimes."

In discussing how military leaders manage risk, Gen. Sullivan noted that significant attention is often given to the low probability/high consequence events. These events rarely occur but can have devastating consequences if they do. American families are familiar with these calculations. Serious injury in an auto accident is, for most families, a low probability/high consequence event. It may be unlikely, but we do all we can to avoid it.

During the Cold War, much of America's defense efforts focused on preventing a Soviet missile attack—the very definition of a low probability/high consequence event. Our effort to avoid such an unlikely event was a central organizing principle for our diplomatic and military strategies.

When asked to compare the risks of climate change with those of the Cold War, Gen. Sullivan said, "The Cold War was a specter, but climate change is inevitable. If we keep on with business as usual, we will reach a point where some of the worst effects are inevitable."

"If we don't act, this looks more like a high probability/high consequence scenario," he added. Gen. Sullivan shifted from risk assessment to risk management.

"In the Cold War, there was a concerted effort by all leadership—political and military, national and international—to avoid a potential conflict," he said. "I think it was well known in military circles that we had to do everything in our power to create an environment where the national command authority—the president and his senior advisers—were not forced to make choices regarding the use of nuclear weapons."

"The situation, for much of the Cold War, was stable," Gen. Sullivan continued. "And the challenge was to keep it stable, to stop the catastrophic event from happening. We spent billions on that strategy."

"Climate change is exactly the opposite. We have a catastrophic event that appears to be inevitable. And the challenge is to stabilize things—to stabilize carbon in the atmosphere. Back then, the challenge was to stop a particular action. Now, the challenge is to inspire a particular action. We have to act if we're to avoid the worst effects."

assess and manage the many risks to America's security. Climate change from the Military Advisory Board's perspective presents significant risks to America's national security. Before explaining some of those risks, we touch on an important scientific point.

A global average temperature increase of 1.3F (plus or minus 0.3F) occurred over the twentieth century. But the temperature change on its own is not what shapes this security assessment. Rather, it is the impact that temperature increases can have on natural systems, including:

- Habits
- Precipitation patterns
- Extreme weather events
- Ice cover
- Sea level

Throughout this report, we do not attempt to tie our findings regarding security implications to any one particular projection of future temperature changes, precipitation changes, or sea level rise, whether due to ocean expansion or ice sheet breakup. Rather, our goal is to articulate the possible security implications of climate change and to consider mitigating steps the nation could take as part of an overall national security plan.

GEO-STRATEGIC IMPLICATIONS OF CLIMATE CHANGE

GEO-STRATEGIC IMPLICATIONS OF CLIMATE CHANGE

One reason human civilizations have grown and flourished over the last five millennia is that the world's climate has been relatively stable. However, when climates change significantly or environmental conditions deteriorate to the point that necessary resources are not available, societies can become stressed, sometimes to the point of collapse [1].

For those concerned about national security, stability is a primary goal. Maintaining stability within and among nations is often a means of avoiding full-scale military conflicts. Conversely, instability in key areas can threaten our security. For these reasons, a great deal of our national security efforts in the post-World War II era have been focused on protecting stability where it exists and trying to install it where it does not.

This brings us to the connection between climate change and national security.

As noted, climate change involves much more than temperature increases. It can bring with it many of the kinds of changes in natural systems that have introduced instability among nations throughout the centuries.

In this chapter, we consider some of the ways climate change can be expected to introduce the conditions for social destabilization. The sources of tension and conflict we discuss here are certainly not solely due to climate change; they have been discussed by the national security community for many years. However, climate change can exacerbate many of them [2].

For example:

- Some nations may have impaired access to food and water.
- Violent weather, and perhaps land loss due to rising sea levels and increased storm surges, can damage infrastructure and uproot large numbers of people.

- These changes, and others, may create large numbers of migrants. When people cross borders in search of resources, tensions can arise.

When climates change significantly or environmental conditions deteriorate to the point that necessary resources are not available, societies can become stressed, sometimes to the point of collapse.

- Many governments, even some that look stable today, may be unable to deal with these new stresses. When governments are ineffective, terrorism can gain a foothold.

- While the developed world will be far better equipped to deal with the effects of climate change, some of the poorest regions may be affected most. This gap can potentially provide an avenue for extremist ideologies and create the conditions for terrorism.

THE DESTABILIZING IMPACTS OF CLIMATE CHANGE

REDUCED ACCESS TO FRESH WATER

Adequate supplies of fresh water for drinking, irrigation, and sanitation are the most basic prerequisites for human habitation. Changes in rainfall, snowfall, snowmelt, and glacial melt have significant effects on fresh water supplies, and climate change is likely to affect all of those things. In some areas of the Middle East, tensions over water already exist.

- Mountain glaciers are an especially threatened source of fresh water [3]. A modest rise in temperature of about 2° to 4°F in mountainous

VOICES OF EXPERIENCE

VICE ADMIRAL RICHARD H. TRULY, USN (Ret.)

Former NASA Administrator, Shuttle Astronaut and the first Commander of the Naval Space Command
ON DRAWING HIS OWN CONCLUSIONS

Retired Vice Adm. Richard H. Truly was a space shuttle commander and NASA administrator and a member of the National Academy of Engineering. When he began service as director of the Department of Energy's National Renewable Energy Laboratory in 1997, he reminded his staff that he would be confronted with a new set of issues.

"I told them that I was unincumbered with experience or knowledge of the energy business, and that I would need their help," Adm. Truly said. "I had a pretty steep learning curve."

One of the first issues he was asked to consider was the extent to which fossil fuel emissions were affecting the climate.

"I wasn't convinced by a person or any interest group—it was the data that got me."

"I was a total agnostic," Truly said. "I had spent most of my life in the space and aeronautics world, and hadn't really wrestled with this. I was open-minded."

"Over the course of the next few years, I started really paying attention to the data. When I looked at what energy we had used over the past couple of centuries and what was in the atmosphere today, I knew there had to be a connection. I wasn't convinced by a person or any interest group—it was the data that got me. As I looked at it on my own, I couldn't come to any other conclusion. Once I got past that point, I was utterly convinced of the connection between the burning of fossil fuels and climate change. And I was convinced that if we didn't do something about this, we would be in deep trouble."

Adm. Truly noted an ironic twist about his path to this conclusion. "I was NASA administrator when

regions can dramatically alter the precipitation mix by increasing the share falling as rain while decreasing the share falling as snow. The result is more flooding during the rainy seasons, a shrinking snow/ice mass, and less snowmelt to feed rivers during the dry season [4]. Forty percent of the world's population derives at least half of its drinking water from the summer melt of mountain glaciers, but these glaciers are shrinking and some could disappear within decades. Several of Asia's major rivers—the Indus, Ganges, Mekong, Yangtze, and Yellow—originate in the Himalayas [4]. If the massive snow/ice sheet in the Himalayas—the third-largest ice sheet in the world, after those in Antarctica and Greenland—continues to melt, it will dramatically reduce the water supply of much of Asia.

Most corners in the Middle East and northern Africa are already considered water scarce, and the International Water Resource Management Institute projects that by 2025, Pakistan, South Africa, and large parts of India and China will also be water scarce [5]. To put this in perspective: the U.S. would have to suffer a decrease in water supply that produces an 80 percent decrease in per capita water consumption to reach the United Nations definition of "water scarce." These projections do not factor in climate change, which is expected to exacerbate water problems in many areas.

IMPAIRED FOOD PRODUCTION

Access to vital resources, primarily food and water, can be an additional causative factor of conflicts, a number of which are playing out today in Africa. Probably the best known is the conflict in Darfur between herders and farmers. Long periods of drought resulted in the loss of both farmland and grazing land to the desert. The failure of their grazing lands compelled the nomads to migrate southwest in search of water and herding ground, and that in turn led to conflict with the farming tribes occupying those

lands. Coupled with population growth, tribal, ethnic, and religious differences, the competition for land turned violent. Probably more than any other recent conflict, Darfur provides

In some areas of the Middle East, tensions over water already exist.

a case study of how existing marginal situations can be exacerbated beyond the tipping point by climate-related factors. It also shows how lack of essential resources threatens not only individuals and their communities but also the region and the international community at large.

Worldwide food production will be affected by climate change in a variety of ways. Crop ecologists estimate that for every 1.8°F rise in temperature above historical norms, grain production will drop 10 percent [6].

Most of the world's growth in food demand is occurring on the Indian subcontinent and in sub-Saharan Africa, areas already facing food shortages [6]. Over the coming decades, these areas are expected to become hotter and drier [7].

HEALTH CATASTROPHES

Climate change is likely to have major implications for human health. While some impacts, such as reduced deaths from cold temperatures in some areas, will be positive, the World Health Organization estimates that the overall impact will be negative [8].

The major concern is significant spreading of the conditions for vector-borne diseases, such as dengue fever and malaria, and food-borne diseases, such as salmonellosis [8]. The decline in available fresh water in some regions will also have an impact, as good health and adequate supplies of clean water are inextricably linked.

A health emergency involving large numbers of casualties and deaths from disease can quickly expand into a major regional or global security

SECURITY CONSEQUENCES OF THESE DESTABILIZING EFFECTS

GREAT POTENTIAL FOR FAILED STATES AND THE GROWTH OF TERRORISM

Many developing countries do not have the government and social infrastructures in place to cope with the types of stressors that could be brought on by global climate change.

When a government can no longer deliver services to its people, ensure domestic order, and protect the nation's borders from invasion, conditions are ripe for turmoil, extremism and terrorism to fill the vacuum. Lebanon's experience with the terrorist group Hezbollah and the Brazilian government's attempts to reign in the drug gang First Capital Command [12] are both examples of how the central government's inability to provide basic services has led to strengthening of these extra-governmental entities.

MASS MIGRATIONS ADD TO GLOBAL TENSIONS

The reasons for mass migrations are very complex. However, when water or food supplies shift or when conditions otherwise deteriorate (as from sea level rise, for example), people will likely move to find more favorable conditions [13]. Although climate change may force migrations of workers due to economic conditions, the greatest concern will be movement of asylum seekers and refugees who due to ecological devastation become settlers.

By 2025, 40 percent of the world's population will be living in countries experiencing significant water shortages [14]. Over the course of this century, sea level rise could potentially cause the displacement of tens of millions of people from low-lying areas such as Bangladesh [15]. Migrations in themselves do not necessarily have negative effects, although taken in the context of global climate change a net benefit is highly unlikely. These types of migration patterns occur.

LAND LOSS AND FLOODING: DISPLACEMENT OF MAJOR POPULATIONS

About two-thirds of the world's population lives near coastlines [10], where critically important facilities and infrastructure, such as transportation routes, industrial facilities, port facilities, and energy production and distribution facilities are located. A rise in sea level means potential loss of land and displacement of large numbers of people. Even in our own nation, Hurricane Katrina showed the social upheaval and tensions that can result from land loss and displaced populations. But while the impact of inundation from one-time occurrences such as Hurricane Katrina is temporary, even as it is devastating, inundation from climate change is likely to be permanent on the scale of human lifetimes. Rising sea levels will also make coastal areas more vulnerable to flooding and land loss through erosion.

Storm surges will also take a greater toll on coastal communities and infrastructure as sea levels rise. According to a Pacific Institute study, a six-inch rise in the water level of San Francisco Bay would mean a fairly routine one-in-ten-year storm would wreak as much damage as a far more serious "hundred-year storm" would have caused before the sea level rise [11]. In the U.S., we may be able to cope with such a change, but poorer nations would be greatly challenged.

Most of the economically important major rivers and river deltas in the world—the Niger, the Mekong, the Yangtze, the Ganges, the Nile, the Rhine, and the Mississippi—are densely populated along their banks. As sea levels rise and storm surges increase, saline water can contaminate groundwater, inundate river deltas and valleys, and destroy croplands.

ADMIRAL T. JOSEPH LOPEZ, USN (Ret.)

Former Commander-in-Chief, U.S. Naval Forces, Southern Europe

ON CLIMATE CHANGE AND THE CONDITIONS FOR TERRORISM

Some Americans believe we don't need to worry about climate change for decades. They say the issue isn't as urgent as the war on terror. Adm. Lopez, the retired top NATO commander in Bosnia, has a different take. He sees a strong connection between the two.

"Climate change will provide the conditions that will extend the war on terror," Adm. Lopez said. "You have very real changes in natural systems that are most likely to happen in regions of the world that are already fertile ground for extremism," Adm. Lopez said. "Droughts, violent weather, ruined agricultural lands—those are the kinds of stresses we'll see more of under climate change."

Those changes in nature will lead to changes in society. "More poverty, more forced migrations, higher unemployment. Those conditions are ripe for extremists and terrorists."

In the controversial war on terrorism, Adm. Lopez noted, there is general agreement on at least one thing: It's best to stop terrorism before it develops. "In the long term, we want to address the underlying conditions that terrorists seek to exploit. That's what we'd like to do, and it's a consensus issue—we all want to do that. But climate change prolongs those conditions. It makes them worse."

"Dealing with instability and how you mitigate that leads to questions about the role U.S. security forces can play," Adm. Lopez added. "What can we do to alleviate the problems of instability in advanced? And keep in mind this will all be under a challenged resource situation. This is very complicated. Of course, the military can be a catalyst for making this happen, but it can't do it all. This is also about economics, politics, and diplomacy."

"Climate change will provide the conditions that will extend the war on terror."

Outside economists or life-threatening, out-of-the-box business people in fits, you get shortchanged."

He also said the U.S. "can't empty that well out of all alone. We need to make sure we don't give that impression. The same forces of economics, business, politics, diplomacy, and military and security interests can function to build coalitions in order to maintain stability when challenged by dramatic climate change."

The greatest concern will be movement of asylum seekers and refugees who due to ecological devastation become settlers...

Some migrations take place within countries, adding to a nation's political stress, causing economic upheaval—positive and negative—and distracting from other issues. As a developed nation, the U.S. was able to absorb the displacement of people from the Gulf Coast in the wake of Hurricane Katrina without suffering economic or political collapse, but not without considerable turmoil.

Some migrations cross international borders. Environmental degradation can fuel migrations in less developed countries, and these migrations can lead to international political conflict. For example, the large migration from Bangladesh to India in the second half of the last century was due largely to loss of arable land, among other environmental factors. This affected the economy and political situation in the regions of India that absorbed most of this population shift and resulted in violence between natives and migrants [16].

A third form of migration involves not only crossing international borders but moving across vast regions while doing so. Since the 1960s, Europe has experienced this kind of "south to north" migration, with an influx of immigrants from Africa and Asia. The shift in demographics has created racial and religious tensions in many European countries, as evidenced in the 2005 civil unrest in France.

POTENTIAL ESCALATION OF CONFLICTS OVER RESOURCES

To live in stability, human societies need access to certain fundamental resources, the most important of which are water and food. The lack, or mismanagement, of these resources can undercut the stability of local populations; it can affect regions on a national or international scale.

Disputes over key resources such as water do not automatically trigger violent outcomes, and no recent wars have been waged solely over water resources. In areas with a strong government and societal cohesiveness, even tense disputes and resource crises can be peacefully overcome. In fact, in recent years, arguments have been made that multinational cooperation over precious water resources has been more an instrument of regional peace than of war [17].

Nevertheless, resource scarcity always has the potential to be a contributing factor to conflict and instability in areas with weak and weakly supported governments [19]. In addition, there is always the potential for regional fighting to spread to a national or international scale. Some recent examples include: the 1994 genocide in Rwanda that was fueled by violence over agricultural resources; the situation in Darfur, Sudan, which had had land resources at its root and which is increasingly spilling over into neighboring Chad; the 1970s downfall of Ethiopian Emperor Haile Selassie through his government's inability to respond to food shortages; and the 1974 Nigerian coup that resulted largely from an insufficient response to famine [19].

Whether resource scarcity proves to be the impetus for peaceful cooperation or an instigator of conflict in the future remains to be seen.

Regions that we already water scarce (such as Korea, Jordan, Israel, Rwanda, Somalia, Algeria, and Kenya) may be forced to confront this choice as climate change exacerbates their water scarcity.

REGIONAL IMPACTS OF CLIMATE CHANGE

REGIONAL IMPACTS OF CLIMATE CHANGE

AFRICA

VULNERABLE TO CLIMATE CHANGE IMPACTS

Africa's importance to U.S. national security can no longer be ignored. Indeed, with the recent establishment of a U.S. African Command, the U.S. has underscored Africa's strategic importance. Its weak governments and the existing presence of terrorist groups make Africa important to the fight against terrorism. Moreover, Africa is also of strategic value to the U.S. as a supplier of energy: by 2035, it will supply 25 to 40 percent of our oil, and it will also be a supplier of strategic minerals such as chrome, platinum, and manganese.

Such changes will add significantly to existing tensions and can facilitate weakened governance, economic collapses, massive human migrations, and potential conflicts.

Reductions in soil moisture and further loss of arable land may be the most significant of the projected impacts of climate change in Africa. At the same time, extreme weather events are likely to increase. These expected changes portend reduced supplies of potable water and food production in key areas. Such changes will add significantly to existing tensions and can facilitate weakened governance, economic collapses, massive human migrations, and protracted conflicts. In Somalia, for example, alternating droughts and floods led to migrations of varying size and speed and prolonged the instability on which warlords capitalized.

Increased political instability in Africa potentially adds additional security requirements for the U.S. in a number of ways. Stability operations, ranging from humanitarian direct delivery of goods and the protection of relief workers, to the establishment of a stable and reconstituted state, can place heavy demands on the U.S. military. While the nature of future stability operations is a matter of speculation, historically some stability operations have involved significant military operations and casualties. Political instability also makes access to African trade and resources, on which the U.S. is reliant for both military and civilian uses, a riskier proposition.

UNSTABLE GOVERNMENTS AND TERRORIST HAVENS

Africa is increasingly crucial in the ongoing battle against civil strife, genocide, and terrorism. Numerous African countries and regions already suffer from varying degrees of famine and civil strife. Darfur, Ethiopia, Eritrea, Somalia, Angola, Nigeria, Cameroon, Western Sahara—all have been hit hard by tensions that can be traced in part to environmental causes. Struggles that appear to be tribal, sectarian, or nationalistic in nature are often triggered by reduced water supplies or reductions in agricultural productivity.

The challenges Africa will face as a result of climate change may be massive, and could present serious threats to even the most stable of governments. Many African nations can

VOICES OF EXPERIENCE

GENERAL CHARLES F. "CHUCK" WALD, USAF (Ret.) Former Deputy Commander, Headquarters U.S. European Command (USEUCOM) ON CLIMATE CHANGE IN AFRICA

"That's the situation today. Even in a time of relative stability, there is very little civil governance, and very little ability to serve huge numbers of people with basic things like electricity, clean water, health care, or education."

"If you add rising coastal waters and more extreme weather events, you then have millions of people who could be displaced. There really is no controlled place for them to go, no capacity for an organized departure, and no capacity to make new living situations. When you add in the effects of climate change, it adds to the matter, because part of our security depends on remaining true to our values."

"My view is that we'll be drawn into the politics of Africa, to a much greater extent than we have in the past."

"There are exotic minerals found only in Africa that have essential military and civilian uses." Gen. Wald continued, "We import more oil from Africa than the Middle East—probably a shock to a lot of people—and that share will grow. Africa could become a major exporter of food."

"My view is that we'll be drawn into the politics of Africa to a much greater extent than in the past. A lot of Americans today would say Africa is an optional engagement. I don't think that's the case, even today, but it certainly won't be in the future."

"To show how climate change can worsen conditions that are already quite desperate, Gen. Wald described a trip to Nigeria."

"We landed in Lagos late in the afternoon," Gen. Wald said, "This is a city, now, with roughly 17 million people. The best way to describe our drive from the airport to the hotel is that it reminded me of a 'Mad Max' movie. There were massive numbers of people on the roads, just milling around. There were huge piles of trash. There were fires along the roadside and in the distance—huge fires. It was just short of apocalyptic."

"Culturally, you have a country that is split geographically between Muslims and Christians. If migrations occur, you put real pressure on that exasperate that situation with climate change effects. It's not hard to postulate on the dangers."

VICE ADMIRAL PAUL G. GAFFNEY II, USN (Ret.)
Former President, National Defense University, Former Chief of Naval Research and Commander, Navy Meteorology and Oceanography Command

ON MILITARY RESEARCH AND CLIMATE SCIENCE

The Department of Defense and the intelligence community have in the past used their immense remote sensing experts. They worked with scientists at NASA's Jet Propulsion Lab to unlock the secrets of El Niño, using airborne altimetry data and low numerical ocean circulation models. The mission was a military one, but it ultimately played a role in helping us understand more about the climate."

Throughout the Cold War, the U.S. and the Soviet Union each collected data in the Arctic, for thickness and sub-ice ocean conditions affecting acoustics were critical security issues.

"The mission was a military one, but it ultimately played a role in helping us understand more about the climate."

After the breakup of the Soviet Union, many saw that that data could be used to determine temperature and ice condition changes over time. The two sides collaborated on ways to share and reconcile the data, and in 1996 released the Arctic Ocean Atlas to the world's scientific community. The data have advanced understanding of climate change in significant ways.

"I think there's another component to this," said Adm. Gaffney. "Defense employees [military and civilian] actually have a responsibility to the nation when they have a certain skill. They have a responsibility to share that with the public and the nation, as long as security is not compromised. They've done this in the past. And I'd love to see them able to do this more often in the future."

kilometers (sixty-two miles) of the coast, and six of Africa's ten largest cities are on the coast. Nigeria and Mozambique are particularly vulnerable to the effects of sea level rise and storm surges. Two typhoons in 2000 displaced 500,000 people in Mozambique and caused 950,000 people to require some form of humanitarian assistance [25]. The Niger Delta accounts for about 7.5 percent of Nigeria's land area and a population of 20 million people.

In light of the potential magnitude of the human crisis that could result from major weather-related natural disasters and the magnitude of the response and recovery efforts that would be required, stability operations carried out by international militaries will likely occur more frequently.

HEALTH CHALLENGES WILL CONTINUE TO ESCALATE

Severe and widespread continental health issues complicate an already extremely volatile environment. Climate change will have both direct and indirect impacts on many diseases endemic to Africa such as malaria and dengue fever [24]. Increases in temperature can expand the latitude and altitude ranges for malaria, and flooding from sea level rise or severe weather events can increase the population of malaria vectors. For example, a temperature rise of 2°F can bring a malaria epidemic to Kenya. Excessive flooding is also conducive to the spread of cholera.

best be described as failed states, and many African regions are largely ungoverned by civil institutions. When the conditions for failed states increase—as they most likely will over the coming decades—the chaos that results can be an incubator of civil strife, genocide, and the growth of terrorism.

LESS EFFECTIVE GOVERNANCE AND POTENTIAL MIGRATIONS

More than 30 percent of the world's refugees and displaced persons are African. Within the last decade, severe food shortages affected twenty-five African countries and placed as many as 200 million people "on the verge of calamity" [20].

Expected future climate change will exacerbate this problem. The Sahara desert is spreading [21], and the sub-Saharan region is expected to suffer reduced precipitation [22]. As climate changes and agricultural patterns are disrupted, the geopolitics of the future will increasingly be the politics of scarcity. Potential

...the chaos that results can be an incubator of civil strife, genocide, and the growth of terrorism.

rainfall decreases in North Africa would likely exacerbate the problem of migration to Europe. Reduced rainfall and increasing desertification of the sub-Saharan region will likely also result in migrations to Europe, as well as migrations within the African continent.

LAND LOSS AND WEATHER DISASTERS

Sea level rise could also result in the displacement of large numbers of people on the African continent, as more than 25 percent of the African population lives within 100

ASIA

CLIMATE CHANGE CAN AFFECT IMPORTANT U.S. STRATEGIC INTERESTS

Most climate projections indicate increasing monsoon variability, resulting in increases in both flood and drought intensity in temperate and tropical Asia [24]. Almost 40 percent of Asia's population of nearly 4 billion lives within forty-five miles of its nearly 130,000-mile-long coastline. Sea level rise, water availability affecting agricultural production, and increased effects of infectious disease are the primary climate effects expected to cause problems in Asia.

SEA LEVEL RISE MAY THREATEN MILLIONS

Some of the most vulnerable regions in the world to sea level rise are in southern Asia, along the coasts of Pakistan, India, Sri Lanka, Bangladesh, and Burma; and Southeast Asia, along the coasts between Thailand and Vietnam, including Indonesia and the Philippines.

Asia, where hundreds of millions of people rely on waters from vanishing glaciers on the Tibetan plateau, could be among the hardest hit regions.

Steady glaciers backed by densely populated, low-lying plains make the Southeast Asian region particularly vulnerable to inundation. Coastal Malaysia, Thailand, and Indonesia could all be threatened with flooding and the loss of important coastal farmlands.

The location and topography of Bangladesh make it one of the most vulnerable countries in the world to a rise in sea level. Situated at

the northeastern region of South Asia on the bay of Bengal, it is about the size of Iowa with a population of almost 150 million. It is very flat and low-lying except in the northeast and southeast regions, and has a coastline exceeding 3100 miles. About 10 percent of Bangladesh is within three feet of mean sea level. Over the next century population rise, land scarcity, and frequent flooding coupled with increased storm surge and sea level rise could cause millions of people to cross the border into India. Migration across the border with India is already such a concern that India is building a fence to keep Bangladeshis out.

India and Pakistan have long, densely populated and low-lying coastlines that are very vulnerable to sea level rise and storm surge. Coastal agriculture, infrastructure and offshore oil exploration are at risk. Possible increases in the frequency and intensity of storm surges could be disproportionately large in heavily developed coastal areas and also in low-income rural areas, particularly such low-lying cities such as Mumbai, Dhaka and Karachi.

WATER STRESS AFFECTS ASIA'S ABILITY TO FEED ITS PEOPLE

By 2050 regions dependent on glacial melting for water may face serious consequences. Asia, where hundreds of millions of people rely on waters from vanishing glaciers on the Tibetan plateau, could be among the hardest hit regions.

Climate change has the potential to exacerbate water resource stresses in most regions of Asia [7]. Most countries in Asia will experience

VOICES OF EXPERIENCE

ADMIRAL JOSEPH W. PRUEHER, USN (Ret.)

Former Commander-in-Chief of the U.S. Pacific Command (PACOM) and Former U.S. Ambassador to China

ON CLIMATE CHANGE IN THE PACIFIC

In a discussion of climate change issues in the Pacific region, retired Adm. Joseph Prueher first considered the issue from a singular perspective: the impact climate change may have on the region's governments and their relative stability.

Using Singapore as an example, he said, "It's a democracy, but with a very strong leadership. They've prospered, but owing to lack of space they have many restrictions we do not have. If one looks ahead to the effects of climate change, you start with the understanding that Singapore, low-lying and very hot, will face more storms and more moisture. It will face coastal impacts. Those kinds of changes, in a crowded nation, create a whole set of issues that affect not just the economy and culture, but the security dynamic as well."

Adm. Prueher then shifted the conversation to the region's governments in general.

"It may well be that in very crowded nations, a stronger government is necessary in order to avoid instability," he said. "In Asia, one sees a whole line of countries with governments exercising very firm control. But when you look to the future to consider the kinds of impacts we may see—flooding, extreme weather events, real disruptions—you also have to consider some steps that we in the U.S. would think of as offensive. Those are steps those governments may feel they need to take in order to avoid chaos."

Referencing low-lying regions where, as he noted, will be lost, he said, "You see mass displacement in countries where the government is not robust. When people can't cope, governing structures break down."

Adm. Prueher noted that how a government responds presents a new set of issues for American political and military leaders.

"Most of our security forces are for protecting our nation from outside, but that's not necessarily the case in the rest of the world," Adm. Prueher said. "Military personnel elsewhere are

often directed internally. They focus on keeping internal order. There might be cases where the U.S. military might be in a position to help deal with the effects of climate change—with floods or the migrations that might result from them. The immediate goal would be to relieve suffering, not to pressure governments. But, if you're partnering with a nation's army keeping domestic order, that can be a real challenge."

When asked about China, Adm. Prueher noted that the European Union is working to identify ways of cooperating with the Chinese on the development of clean coal technologies. And he cautioned against those in the U.S. who oppose any kind of technology exchange with China.

"Yes, China is focused heavily on growth. Yes, there is what I think is a real, remote possibility of future military conflict. And, yes, it is a real challenge to negotiate with them; one can count on their own national interest," he said. "Reasonable enough. But on the issue of carbon emissions, it doesn't help to solve our problem if China doesn't solve theirs. And that means we need to engage them on many fronts. Issues of great importance to our world will not get solved without U.S.-Chinese cooperation. I happen to be dealing with the Chinese. You may not, or you may be suspicious of them, but we need to cooperate."

"They have 1.3 billion people, 200 million of whom are under-employed or unemployed," Adm. Prueher said. "They have a great deal of pride and see themselves as a great nation. Most of what we say to influence environmental progress in China is seen by them as a way to stop them from continuing economic growth."

"Not talking to the Chinese is not an option."

VOICES OF EXPERIENCE

LIEUTENANT GENERAL LAWRENCE P. FARRELL JR., USAF (Ret.)

Former Deputy Chief of Staff for Plans and Programs, Headquarters U.S. Air Force

ON CLIMATE, ENERGY AND BATTLEFIELD READINESS

Retired Air Force Lt. Gen. Larry Farrell sees a great deal of uncertainty about climate change and appears willing to engage any credible scientist in discussions of discrepancies among climate models.

"You might say I'm from Missouri on this issue—you have to show me," he said. "And there is still much uncertainty and debate on this issue." Despite this, Gen. Farrell sees indications that some change is occurring.

"Clearly, there has been some warming over the past 100 years and some climate change. These changes have been accompanied by fairly significant increases in the greenhouse gases carbon dioxide and methane. If there is a connection between warming trends and greenhouse gases, our use of energy may be playing a part in this. If these trends continue into the future, the changes could well exacerbate existing social and political instabilities and create new ones. The military has the obligation to assess the potential military implications of these trends." Gen. Farrell's preference is to focus on solutions.

"If you advocate intelligent energy solutions, you'll solve this problem," Gen. Farrell said, before walking through a long list of reasons for a focus on energy.

A key concern for Gen. Farrell: battlefield readiness.

"Seventy percent of the tonnage on the battlefield is fuel," he said. "That's an amazing number. Between fuel and water, it's almost everything we take to the battlefield. Food and ammo are really quite small in comparison."

"Delivering that fuel requires secure lines of communication," Gen. Farrell said. "If you have bases nearby, you may be able to deliver it with much less risk, but that's a supply line issue. And we see in Iraq how dangerous it can be to transport fuel."

"The military should be interested in fuel economy on the battlefield," he said. "It's a readiness issue. If you can move your men and materiel more quickly, if you have less tonnage but the same level of protection and firepower, you're more efficient on the battlefield. That's a life and death issue."

Gen. Farrell talked about the challenge of focusing on long-term issues.

"Climate change is not something people can recognize," he said. "In geologic time, it's quick. But in human terms, it's still very slow. It's hard to get all of us to do something about it. And that leads me to believe we should deal with other things that are a problem today but that also get us to the heart of climate change. That's, where I get to the issue of smart energy choices."

"Focus on conservation and on energy sources that aren't based in carbon. Move toward a hydrogen economy in part because you know it will ultimately give you efficiency and, yes, profit. When you pursue these things, you build alliances along the way. That's safety. It's a benefit we see right now."

He suggested another reason as well: There are military impacts that come from our energy use.

"We're forced to be interested in parts of the world because of our energy consumption," he said. "Solving the energy problem solves a real security problem. You get to choose your points of engagement. It's like one of the things your grand mother told you. 'Don't go looking for trouble. If you find trouble, you have to deal with it—but don't go looking for it.' Well, when we go looking for oil, we're really looking for trouble."

substantial declines in agricultural productivity because of higher temperatures and more variable rainfall patterns (25). Net cereal production in South Asia, for example, is projected to decline by 4 to 19 percent by the end of this century under the most conservative climate change projections.

But the problem isn't just water scarcity—too much water can also be a problem. By 2050, snow melting in the high Himalayas and increased precipitation across northern India are likely to produce flooding, especially in catchments on the western side of the Himalayas, in northern India, Nepal, Bangladesh, and Pakistan.

RIISING SPREAD OF INFECTIOUS DISEASE

Climate change is expected to increase the geographic range of infectious diseases such as malaria, dengue fever, and schistosomiasis and increase the risk of water-borne disease. Climate projections indicate the Asia/Pacific region as a whole is likely to become warmer

and wetter in the coming decades, creating conditions more conducive to disease vectors such as mosquitoes. With the exception of east central China and the highland of west China, much of the Asia/Pacific region is exposed to malaria and dengue or has conditions suitable for their spread. This region will continue to be a hot spot for these diseases in the decades ahead, with certain regions becoming more prone to epidemics.

EUROPE

THREATENED BY CLIMATE PROBLEMS FROM OTHER PARTS OF THE WORLD

Europe is getting warmer overall, northern Europe is getting wetter, and southern Europe is getting drier. (For the purposes of this report, Europe includes the western part of the former Soviet Union.)

The developed nations of Europe will likely be able to deal with the direct climate changes expected for their region, but some of the less developed nations (the Balkans, for instance) might be stressed. Europe has already experienced extreme weather events that brook potential climate change effects: the more than 35,000 deaths associated with the heat wave of 2003 are a reminder of the vulnerability of all nations to climate extremes (26). However, the major impact on Europe from global climate

change is likely to be migrations, now from the Maghreb (Northern Africa) and Turkey, and increasingly as climate conditions worsen, from Africa.

DIRECT IMPACTS: HOTTER TEMPERATURES AND RISING SEAS

More of Europe has experienced surface air temperature increases during the twentieth century (1.4°F on average), with the largest increases over northwest Russia and the Iberian Peninsula. Temperatures in Europe since 1990

have been the warmest since records have been kept. More heat waves across all of Europe are likely to increase stress on human health and could produce an increased risk of malaria and dengue fever in southern Europe. Agricultural zones would move north, and the Mediterranean regions, especially in Spain, would suffer a greater loss of productivity.

Precipitation is expected to increase in the north but decrease in the central and eastern Mediterranean zones and south Russia, with some water shortages projected in the Mediterranean area, especially in the summer.

MITIGATION AND ADAPTATION TO CLIMATE CHANGE IN EUROPE

The capacity for adaptation to these changes is very high in most of prosperous, industrial Europe, but less so in lesser-developed places like the Balkans, Moldova, and the Caucasus.

With its shortages of water, the Mediterranean area could experience considerable strain. In northern Europe, countries may build higher dikes, as they have done in the past, but at a certain point that may not be sufficient, and much port and other coastal infrastructure would have to be moved further inland, at great expense. Some northern migration within Europe might be expected—the Italians already face a large Albanian immigration, and others may press north from the Balkans.

THE PRIMARY STRATEGIC CONCERN OF EUROPEANS: MASSIVE MIGRATIONS TO EUROPE

The greater threat to Europe lies in migration of people from across the Mediterranean, from the Maghreb, the Middle East, and sub-Saharan Africa. Environmental stresses and climate change are certainly not the only factors driving migrations to Europe. However, as more people migrate from the Middle East because of water shortages and loss of their already marginal agricultural lands (as, for instance, if the Nile Delta disappears under the rising sea level), the social and economic stress on European nations will rise.

It is possible that Europeans, given their long and proximate association with the sub-Saharan African countries, may undertake more stability operations, as they have in Sierra Leone and Côte d'Ivoire. Their militaries, and in particular their navies and coast guards, would also have to increase their activities in securing their borders and in intercepting migrants moving by sea, as is now going on through the Canary Islands.

MIDDLE EAST

ABUNDANT OIL, SCARCE WATER AND INTERNATIONAL CONFLICT

The Middle East has always been associated with two natural resources: oil (because of its abundance) and water (because of its scarcity). The Persian Gulf contains more than half (57 percent) of the world's oil reserves, and about 45 percent of the world's natural gas reserves. And because its production costs are among the world's lowest, the Persian Gulf region is likely to remain the world's largest oil exporter for the foreseeable future. At the end of 2003, Persian Gulf countries produced about 32 percent of the world's oil. Because of its enormous oil endowment, the Middle East is one of the most strategically significant regions of the world. The security impacts of climate change on the Middle East are greatly magnified by its historical and current levels of international conflict and competition for increasingly scarce resources that may exacerbate the level of conflict. This is the region of the world in which the U.S. is most engaged militarily.

WATER: INCREASING STRESS ON AN EXISTING SHORTAGE

In this region, water resources are a critical issue; throughout history, cultures here have flourished around particular water sources. With the population explosion underway, water will become even more critical. Of the countries in the Middle East, only Egypt, Iran, and Turkey have abundant fresh water resources. Roughly two-thirds of the Arab world depends on sources outside their borders for water. The most direct effect of climate change to be felt in the Middle East will be a reduction in precipitation. But the change will not be uniform across the region.

The flows of the Jordan and Yarmouk rivers are likely to be reduced, leading to significant water stress in Israel and Jordan, where water demand already exceeds supply. Evaporation of water damages in those two countries and in Oman, Egypt, Iran, and Iraq are likely to threaten conventional crop production, and salinization of coastal aquifers could further threaten agriculture in those regions.

SEA LEVEL RISE

Sea level rise combined with increased water demand from growing populations are likely to exacerbate saltwater intrusion into coastal fresh water aquifers, already a considerable problem for the Gaza Strip. Salinization of coastal aquifers could further threaten agriculture in these regions. Additional loss of arable land and decreases in food security could encourage migration within the Middle East and Africa, and from the Middle East to Europe and elsewhere.

INFLAMING A REGION OF POLITICAL INSTABILITY

Climate change has the potential to exacerbate tensions over water as precipitation patterns change, declining by as much as 60 percent in some areas. In addition, the region already suffers from fragile governments and infrastructures, and as a result is susceptible to natural disasters. Overlaying this is a long history of animosity among countries and religious groups. With most of the world's oil being in the Middle East and the industrialized and industrializing nations competing for this resource, the potential for escalating tensions, economic disruption, and armed conflict is great.

VOICES OF EXPERIENCE

GENERAL ANTHONY C. "TONY" ZINNI, USMC (Ret.) Former Commander-in-Chief of U.S. Central Command (CENTCOM)

ON CLIMATE CHANGE, INSTABILITY AND TERRORISM

A starting point in understanding this connection might be to "look at how climate change effects could drive populations to migrate," Gen. Zinni said. "Where do these people move? And what kinds of conflicts might result from their migration? You see this in Africa today with the flow of migrations. It becomes difficult for the neighboring countries. It can be a huge burden for the host country, and that burden becomes greater if the international community is overwhelmed by these occurrences."

"You may also have a population that is traumatized by an event or a change in conditions triggered by climate change," Gen. Zinni said. "If the government there is not able to cope with the effects, and if other institutions are unable to cope, then you can be faced with a collapsing state. And these end up as breeding grounds for instability, for insurgencies, for warlords. You start to see real extremism. These places act like Petri dishes for extremism and for terrorist networks."

In describing the Middle East, the former CENTCOM commander said, "The existing situation makes this place more susceptible to problems. Even small changes may have a greater impact here than they may have elsewhere. You already have great tension over water. These are cultures often built around a single source of water. So any stresses on the rivers and aquifers can be a source of conflict. If you consider land less, the Nile Delta region is the most fertile ground in Egypt. Any losses there could cause a real problem, again because the region is already so fragile. You have mass migrations within the region, going on for many decades now, and they have been very destabilizing politically."

Gen. Zinni reiterated the inevitability of climate change, with global temperatures sure to increase. But he also stressed that the intensity of these changes could be reduced if the U.S. helps lead the way to a global reduction in carbon emissions. He urged action now, even if the costs of action seem high.

"It's not hard to make the connection between climate change and instability, or climate change and terrorism."

"We will pay for this one way or another," he said. "We will pay to reduce greenhouse gas emissions today, and we'll have to take an economic hit of some kind. Or we will pay the price later in military terms. And that will involve human lives. There will be a human toll."

"There is no way out of this that does not have real costs attached to it. That has to hit home."

THE WESTERN HEMISPHERE RISKS FOR THE UNITED STATES AND OUR NEIGHBORS

Latin America includes some very poor nations in Central America and in the Caribbean, and their ability to cope with a changing climate will present challenges for them and those for the U.S. Global climate change can lead to greater intensity of hurricanes as sea surface temperatures rise, with enormous implications for the southeastern U.S., Central America, and Caribbean nations. Loss of glaciers will mean water supply in several areas, particularly Peru and Venezuela. Rising sea levels will threaten all coastal nations. Caribbean nations are especially vulnerable in this regard, with the combination of rising sea levels and increased hurricane activity potentially devastating to some island nations.

The primary security threats to the U.S. arise from the potential demand for humanitarian aid and a likely increase in immigration from neighbor states. It is important to remember that the U.S. will be dealing with its own climate change issues at the same time.

INCREASING WATER SCARCITY AND GLACIAL MELT

The melting of glaciers at an accelerated rate in Venezuela and the Peruvian Andes is a particular concern because of the direct reliance on these glaciers for water supplies and hydroelectric power. The Peruvian plains, northeast Brazil, and Mexico, already subject to drought, will find that droughts in the future will last longer. This would lead to further land degradation and loss of food production—a blow to

Latin America, which is particularly dependent on food production for subsistence and to Brazil, whose economy is fueled by food exports.

Drought and decreased rainfall is projected to also affect the central southern U.S. That could have significant impact on food production and sources of water for millions. The High Plains (or "Ogallala") aquifer underlies

much of the semi-arid west-central U.S. The aquifer provides water for 27 percent of the irrigated land in the country and supplies about 30 percent of the groundwater used for irrigation. In fact, three of the top grain-producing states—Texas, Kansas, and Nebraska—each get 70 to 90 percent of their irrigation water from the Ogallala aquifer (27). Human-induced stresses on this groundwater have resulted in

water table declines greater than 100 feet in some areas (28). This already difficult situation could be greatly exacerbated by a decrease in rainfall predicted for the region. Similarly, a recent study by the National Research Council

on the Colorado River basin (the river is the main water source for tens of millions of people in the Southwest) predicted substantial decreases in river flow based on higher population coupled with the climate change affects (29).

STORMS AND SEA LEVEL RISE

In looking at the relationship between warmer temperatures and storm intensity, a report conducted by the World Meteorological Organization concluded: "It is likely that some increase in tropical cyclone peak wind speed and rainfall

VOICES OF EXPERIENCE

ADMIRAL DONALD L. "DON" PILLING, USN (Ret.)

Former Vice Chief of Naval Operations

ON OPERATIONAL CHALLENGES OF CLIMATE CHANGE

Retired Adm. Donald L. Pilling, former vice chief of naval operations, highlighted one of the reasons government agencies have been slow to respond to the issue of climate change. "One of the problems in talking about this issue is that no one can give you a date by which many of the 'worst effects' will be occurring," Adm. Pilling said. "If it's 2050, there isn't a guy in uniform today who will be wearing a uniform then. The Pentagon talks about future year plans that are six years down the road."

Still, Adm. Pilling was able to talk about the issue and the planning challenges it might offer. He enumerated a list of operational impacts, starting with the assumption that there would be increased instances of large migrations—people fleeing homelands that have felt the impacts of climate change.

"This is key because it's easy to see how our allies can be consumed by this," Adm. Pilling said. "They won't have time to participate in exercises at sea because all their assets will be focused on protecting the border and beaches. Europe will be focused on its own borders. There is potential for fracturing some very strong alliances based on migrations and the lack of control over borders."

"Open seas at the Arctic means you have another side of this continent exposed," he said. "Between the Canadians and us, there are a handful of ships oriented for the northern latitudes. But there is not much flexibility or depth there."

He said that an increase in the frequency or intensity of hurricanes could have a destabilizing effect on maintenance and the stability of ships and fleets. "It may cause you to move the north to avoid hurricanes. It's a ship's captain's choice in the middle of hurricane season. We're going to get out—get away from port. It impacts maintenance

schedules and impacts operational structures. And that doesn't factor in the damage that hurricanes can do to our ports and maintenance facilities. We spent a few billion to restore Pascagoula after Hurricane Katrina—and we're not done yet. But at least that's an impact you can see. People can get their hands around that."

"There is potential for fracturing some very strong alliances based on migrations and the lack of control over borders."

Over time, some of the operational issues related to climate change would be increasingly difficult to resolve.

"As headquarters, they would need to be much more thoughtful about investment decisions," he said. "Why invest significant resources in bases that are in low-lying regions? Why invest in bases that may continue to be flooded? These are tough questions to ask, but I'd ask them."

GENERAL PAUL J. KERN, USA (Ret.)
Former Commanding General, U.S. Army Materiel Command

ON WEATHER, LOGISTICS, AND THE CAUSES OF WAR

In 1989, Gen. Kern commanded a brigade based at Fort Stewart, Georgia, and was preparing to send men and material to Turkey in advance of NATO training exercises. Those plans were interrupted by Hurricane Hugo, which appeared headed to Savannah, the port of departure for the mission.

"We were all ready to go, but the ships involved in transport had to be sent to Norfolk," Gen. Kern said. "So we broke down the shipments that had already been assembled for delivery. We then moved our aviation assets out and moved base families into shelters. Ultimately, the hurricane hit Charleston, and did major damage to the airbase there. That meant one of my military battalions was obligated to Charleston to help with the recovery there."

"These weren't immenses challenges for us—they were things we could handle," Gen. Kern adds. But the planned training mission—preparing to do our core military mission—preparing to do what we were trained to do—was a very different matter. It is a realizable. Extreme weather can affect your readiness."

Looking ahead, Gen. Kern now retired from active duty, discussed wider global trends that the military must address to achieve an optimal state of readiness. He believes "the critical factors for economic and security stability in the twenty-first century are energy, water, and the environment. These three factors need to be balanced for people to achieve a reasonable quality of life. When they are not in balance, people live in poverty, suffer high death rates, or move toward armed conflict."

The need for water illustrates the consequences of imbalance. "When water is scarce, people move until they can find adequate supply," he said. "As climate change causes shifts in accessibility to water, we observe large movements of refugees and migration."

He said Africa offers prime examples of this.

Gen. Kern also cited the late Nobel Laureate, Dr. Rick Smalley, of Rice University, who often lectured on the world's top 10 problems. Smalley listed energy, water, food, and the environment at the top of his list.

"While the military community has not focused on these issues, we often find ourselves responding to a crisis created by the loss of these staples, or by a conflict over claims to one or more."

"Military planning should view climate change as a threat to the balance of energy access, water supplies, and a healthy environment, and it should require a response."

Gen. Kern said, "In my view, therefore, military planning should view climate change as a threat to the balance of energy access, water supplies, and a healthy environment, and it should require a response. Responding after the fact with troops—after a crisis occurs—is one kind of accessibility to water, we observe large movements of refugees and migration."

U.S. military was also heavily involved in the response to Hurricane Katrina. Climate change will likely increase calls for this type of mission in the Americas in the future.

INCREASED MIGRATION/REFUGEE FLOWS INTO THE U.S.

The greater problem for the U.S. may be an increased flow of migrants northward into the U.S. Already, a large volume of south to north migration in the Americas is straining some states and is the subject of national debate. The migration is now largely driven by economics and political instability. The rate of immigration from Mexico to the U.S. is likely to rise because the water situation in Mexico is already marginal and could worsen with less rainfall and more droughts. Increases in weather disasters, such as hurricanes elsewhere, will also stimulate migrations to the U.S. [32].

will occur if the climate continues to warm. Model studies and theory project a 3-5% increase in wind speed per degree Celsius increase of tropical sea surface temperatures [30]. Warming seas and their link to storm energy are especially worrisome for Central American and small Caribbean island nations that do not have the social infrastructure to deal with natural disasters.

Flooding could increase with sea level rises, especially in the low-lying areas of North America— inundation models from the University of Arizona project that a sea level rise of three feet would cause much of Miami, Fort Myers, a large portion of the Everglades, and all of the Florida Keys to disappear [31].

In the past, U.S. military forces have responded to natural disasters, and are likely to continue doing so in the foreseeable future [32]. The military was deployed to Central America after Hurricane Mitch in 1998 and to Haiti following the rains and mudslides of 2004. The

DIRECT IMPACTS ON MILITARY SYSTEMS, INFRASTRUCTURE, AND OPERATIONS

DIRECT IMPACTS ON MILITARY SYSTEMS, INFRASTRUCTURE, AND OPERATIONS

Climate change will stress the U.S. military by affecting weapons systems and platforms, bases, and military operations. It also presents opportunities for constructive engagement.

WEAPONS SYSTEMS AND PLATFORMS

Operating equipment in extreme environmental conditions increases maintenance requirements—at considerable cost—and dramatically reduces the service life of the equipment. In Iraq, for instance, sandstorms have delayed or stopped operations and induced tremendous damage to equipment. In the future, climate change—whether hotter, drier, or wetter—will add stress to our weapons systems.

A stormier northern Atlantic would have implications for U.S. naval forces [34]. More storms and rougher seas increase transit times, contribute to equipment fatigue and hanger flight operations. Each time a hurricane approaches the U.S. East Coast, military aircraft move inland and Navy ships leave port.

Warmer temperatures in the Middle East could make operations there even more difficult than they are today. A Center for Naval Analysis study showed that the rate at which U.S. carriers could launch aircraft was limited by the endurance of the flight deck crew during extremely hot weather [34].

BASES THREATENED BY RISING SEA LEVELS

During the Cold War, the U.S. established and maintained a large number of bases throughout the world. U.S. bases abroad are assumed to provide a worldwide presence and maximize

our ability to move aircraft and personnel. Climate change could compromise some of those bases. For example, the highest point of Diego Garcia, an atoll in the southern Indian Ocean that serves as a major logistics hub for U.S. and British forces in the Middle East, is only a few feet above sea level. As sea level rises, facilities there will be lost or will have to be relocated. Although the consequences to military readiness are not insurmountable, the loss of some forward bases would require longer range lift and strike capabilities and would increase the military's energy needs.

Closer to home, military bases on the eastern coast of the United States are vulnerable to hurricanes and other extreme weather events. In 1992, Hurricane Andrew ravaged Homestead Air Force Base in Florida so much that it never reopened; in 2004 Hurricane Ivan knocked

our Naval Air Station Pensacola for almost a year. Increased storm activity or sea level rise caused by future climate change could threaten or destroy essential base infrastructure. If key military bases are degraded, so, too, may be the readiness of our forces.

Climate change—whether hotter, drier, or wetter—will add stress to our weapons systems.

MILITARY OPERATIONS

Severe weather has a direct effect on military readiness. Ships and aircraft operations are made more difficult; military personnel themselves must evacuate or seek shelter. As retired

DEPARTMENT OF DEFENSE ENERGY SUPPLIES ARE VULNERABLE TO EXTREME WEATHER

The DoD is almost completely dependent on electricity from the national grid to power critical missions at fixed installations and on petroleum to sustain combat training and operations. Both sources of energy and their distribution systems are susceptible to damage from extreme weather.

The national electric grid is fragile and can be easily disrupted. Witness the Northeast Blackout of 2003, which was caused by trees falling onto power lines in Ohio. It affected 50 million people in eight states and Canada, took days to restore, and caused a financial loss in the United States estimated to be between \$4 billion and \$10 billion [36]. People lose water supplies, transportation systems, and communications systems (including intercom and cell phones). Exercises shut down, and looting occurred.

As extreme weather events become more common, so do the threats to our national electricity supply.

One approach to securing power to DoD installations for critical missions involves a combination of aggressively applying energy efficiency technologies to reduce the critical load (more mission, less energy); deploying renewable energy sources and "stanching" the installation from the national grid. Stanching allows power generated on the installation to flow two ways—onto the grid when there is excess production and from the grid when the load exceeds local generation. By pursuing these actions to improve resiliency of mission, DoD would become an early adopter of technologies that would help transform the grid, reduce our load, and expand the use of renewable energy.

For deployed systems, the DoD pays a high price for high fuel demand. In Iraq, significant combat forces are dedicated to moving fuel and protecting fuel supply lines. The fuel delivery situation on the ground in Iraq is so limited

that the Army has established a "Power Sustainment Task Force" to help commanders of forward operating bases cut the number of fuel convoys by using energy more efficiently. Maj. Gen. Richard Zilmer, USMC, commander of the multinational force in the Anbar province of Iraq, asked for help in August 2006. His request was for renewable energy systems.

According to Gen. Zilmer, reducing the military's dependence on fuel for power generation could reduce the number of road-bound convoys ... Without this solution, [renewable energy systems], personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success... Along a similar vein, Lt. Gen. James Mattis, while commanding general of the First Marine Division during Operation Iraqi Freedom, urged: "Unless we from the theater of fuel."

Energy efficiency technologies, energy conservation practices and renewable energy sources are the tools forward bases are using to stem their fuel demand and reduce the "target signature" of their fuel convoys.

Numerous DoD studies dating from the 2001 Defense Science Board report "More Capable Warfighting Through Reduced Fuel Burden" have concluded that high fuel demand by combat forces detracts from our combat capability, makes our forces more vulnerable, diverts combat assets from offense to supply line protection, and increases operating costs. Nowhere are these problems more evident than in Iraq, where every day 2.4 million gallons of fuel is moved through dangerous territory, requiring protection by armored combat vehicles and attack helicopters [37].

DoD planners estimate that it costs \$15 to deliver one gallon of fuel from its commercial supplier to the forward edge of the battlefield and about \$26 to deliver a gallon of fuel from an airborne tanker, not counting the tanker

aircraft cost. Furthermore, DoD's procedures for determining the types of systems it needs do not take these fuel burden considerations into account. DoD should require more efficient combat systems and should include the actual cost of delivering fuel when evaluating the advantages of investments in efficiency [38, 39].

... reducing the military's dependence on fuel for power generation could reduce the number of road-bound convoys ...

DoD should have an incentive to accurately account for the cost of moving and protecting fuel and to invest in technologies that will provide combat power more efficiently.

Deploying technologies that make our forces more efficient also reduces greenhouse gas emissions. The resulting technologies would make a significant contribution to the vision President Bush expressed in his State of the Union speech when he said, "America is on the verge of technological breakthroughs that will ... help us to confront the serious challenge of global climate change."

Given the human and economic cost of delivering fuel to combat forces and the almost total dependence on the electric grid for critical missions, DoD has strong operational economic incentives to aggressively pursue energy efficiency in its combat systems and its installations. By investing at levels commensurate with its interests, DoD would become an early adopter of innovative technologies and could stimulate others to follow.

ENGAGEMENT OPPORTUNITIES

Climate change threats also create opportunities for constructive engagement such as stability operations and capacity building. The U.S. military helped deliver relief to the victims of

Army Gen. Paul Kern explained of his time dealing with hurricanes in the U.S. Southern Command: "A major weather event becomes a distraction from your ability to focus on and execute your military mission."

In addition, U.S. forces may be required to be more engaged in stability operations in the future as climate change causes more frequent weather disasters such as hurricanes, flash floods, and extended droughts.

THE ARCTIC: A REGION OF PARTICULAR CONCERN

A warming Arctic holds great implications for military operations. The highest levels of planetary warming observed to date have occurred in the Arctic, and projections show the high northern latitudes warming more than any other part of the earth over the coming century. The Arctic, often considered to be the proverbial "canary" in the earth climate system, is showing clear signs of stress [33].

The U.S. Navy is concerned about the retreat and thinning of the ice canopy and its implications for naval operations. A 2001 Navy study concluded that an ice-free Arctic will require an "increased scope of naval operations" [35]. That increased scope of operations will require the

As extreme weather events becomes more common, so do the threats to our national electricity supply.

Navy to consider weapon system effectiveness and various other factors associated with operating in this environment. Additionally, an Arctic with less sea ice could bring more competition for resources, as well as more commercial and military activity that could further threaten an already fragile ecosystem.

VOICES OF EXPERIENCE

ADMIRAL FRANK "SKIP" BOWMAN, USN (Ret.)

Former Director, Naval Nuclear Propulsion Program; Former Deputy Administrator, Naval Reactors, National Nuclear Security Administration

ON CLIMATE CHANGE, ENERGY, AND NATIONAL SECURITY

Adm. Bowman's more than thirty-eight years of naval service in the nuclear submarine command have led him to these thoughts: "Our nuclear submarines operate in an unforgiving environment. Our Navy has recognized this environment and has mitigated the risk of reactor and underway operations through a combination of: a) careful selection of motivated, intelligent people whom we train and qualify to the highest standards; b) rigorous quality assurance of component design and manufacturing; c) veteran commanders with strict rules of operation; d) thorough supervision of all aspects of reactor operations; and, e) constant training and sharing of the lessons learned from the process. These crews are well trained to the point in depth to deal with a very low probability, but high consequence event. We should begin planning for a similar approach in dealing with potential climate change effects on our national security."

Adm. Bowman notes that today, a rapid debate is underway over a potential set of climate-induced global changes that could have a profound impact on America's national security interests. Our Military Advisory Board has heard the arguments, some depicting near-dominant scenarios of severe weather and oceanic changes exacerbated by man-made emissions of greenhouse gases to our environment, others depicting a much less severe outcome as merely one in many observed cyclic weather patterns over time, with virtually no man-made component. Adm. Bowman concludes that regardless of the probability of the occurrence, the predicted weather-driven global events could be dire and could adversely affect our national security and military options significantly. He therefore argues that the prudent course is to begin planning, as we have in submarine operations, to develop a similar defense in depth

climate change problems: cross borders, it could also promote regional communication and cooperation. If the frequency of natural disasters increases with climate change, future military and political leaders may face hard choices about where and when to engage. Deploying troops affects readiness elsewhere; choosing not to may affect alliances. And providing aid in the aftermath of a catastrophic event or natural disaster can help retain stability in a nation or region, which in turn could lead off U.S. military engagement in that region at a later date.

the 2005 Indian Ocean tsunami because it is the only instrument capable of rapidly delivering personnel and materiel anywhere in the world on relatively short notice. DoD Directive 3000.05, issued in 2006, provides the mandate to conduct military and civilian stability operations in peacetime as well as conflict to maintain order in states and regions. The Combatant Command's Theater Security Cooperation Program, which seeks to engage regional states, could be easily focused on climate change mitigation and executed in concert with other U.S. agencies through U.S. embassy country teams. The objective would be to build the host nation military's capabilities and capacity to support civilian government agencies. It also enhances good governance and promotes stability, making failed states and terrorist incursion less likely. Because many

decisions made over the past decade to build cheap gas generation placed an unsustainable demand on natural gas and has resulted in hundreds of thousands of U.S. jobs moving offshore."

"Our nuclear submarines operate in an unforgiving environment. Our Navy has recognized this environment and has mitigated the risk. . . . We should begin planning for a similar approach in dealing with potential climate change effects on our national security."

Adm. Bowman warns that this interdependence between energy policy and national security must be viewed over the long haul as the country addresses global climate change. "Coal and nuclear electricity generation remain the obvious choices for new U.S. generation, however, to meet the demands of our measured and misjudged increases in CO₂ emissions in our atmosphere and the potential effects on our national defense. As a matter of national interest, must developing technologies to capture and sequester CO₂ from coal generation. This technology is not available today to a commercial scale and the lead time for its development is measured in tens of years, not months."

Therefore, Adm. Bowman argues, we should begin developing plans to store up our own defenses against the potentially serious effects of climate, regardless of the probability of that occurrence, while making more resilient those countries ill-prepared to deal with that potential due to disposal, poor sanitation, lack of clean water, inefficient electricity, and large coastal populations. In doing so, these plans must recognize the interdependency of energy and security.

The demand for energy will grow, so whose values are not at odds with our own. As our economy and GDP have grown, so have our energy needs. This demand for energy attains available supplies; energy sources used for one purpose, such as electricity generation, are not available for other needs. Natural gas used for electricity is not available as feedstock for many industries that depend on it, like the chemical industry, the fertilizer industry, and the plastics industry. Short-term

WEATHER AND WARFARE

An increase in extreme weather can make the most demanding of tasks even more challenging. Increases in global temperatures will increase the likelihood of extreme weather events, including temperature extremes, precipitation events, and intense tropical cyclone activity (7).

With this in mind, we ask the obvious: How does extreme weather affect warfare?

The impacts are significant. There are countless historical examples of how weather events have affected the outcome of a conflict.

- Typhoons (Divine Wind) twice saved Japan from invasion by Kublai Khan and his Mongol horde.

- North Sea gales badly battered the Spanish Armada in 1588 when Sir Francis Drake defeated it, saving England from invasion.

An increase in extreme weather can make the most demanding of tasks even more challenging.

- The severe and unpredictable Russian winter has defeated three invading armies: Charles XII of Sweden in 1708, Napoleon in 1812 and Hitler in 1941.

- During the American Revolution, George Washington would have been surrounded at the Battle of Long Island had adverse winds not prevented the British from landing and cutting him off.

- Hardships from a severe drought in 1788 are thought to be the spark that caused the French Revolution.

- Napoleon was defeated at the Battle of Waterloo in large part because a torrential downpour obscured visibility and delayed the French attack.

Though technology allows us to overcome many obstacles, weather still poses great threat to successful military operations on the land, sea, or in the air.

- During World War II, Typhoon Cobra captured three destroyers, a dozen more ships were seriously damaged and 793 men died. This natural disaster, called the Navy's worst defeat in open seas in World War II, killed nearly a third as many as in the attack on Pearl Harbor.

- Many know that D-Day awaited the right weather before it began. Many don't know that a freak storm destroyed floating tanks shortly beforehand, almost canceling the invasion.

- During the 1991 Persian Gulf War, heavy winds prevented Saddam Hussein from launching Scud missiles at Israel and coalition forces.

- During the Persian Gulf War and the Iraq war, sandstorms delayed or stopped operations and did tremendous damage to equipment.

In March 2003, the entire invasion of Iraq was stalled for three days because of a massive sandstorm.

These examples are not meant to suggest that weather changes will put the American military at a disadvantage. They do, however, help illustrate ways in which climate change can add new layers of complexity to military operations. An increase in extreme weather can make the most demanding of tasks even more challenging.

FINDINGS AND RECOMMENDATIONS

RECOMMENDATIONS

Recommendation 1:

The national security consequences of climate change should be fully integrated into national security and national defense strategies. As military leaders, we know we cannot wait for certainty. Failing to act because a warning isn't precise is unacceptable. Numerous parts of the U.S. government conduct analyses of various aspects of our national security situation covering different time frames and at varying levels of detail. These analyses should consider the consequences of climate change.

The intelligence community should incorporate climate consequences into its National Intelligence Estimate. The National Security Strategy should directly address the threat of climate change to our national security interests. It also should include an assessment of the national security risks of climate change and direct the U.S. government to take appropriate preventive efforts now.

The National Security Strategy and the National Defense Strategy should include appropriate guidance to military planners to assess risks to current and future missions of projected climate change, guidance for updating defense plans based on these assessments, and the capabilities needed to reduce future impacts. This guidance should include appropriate revision to defense plans, including working with allies and partners, to incorporate climate mitigation strategies, capacity building, and relevant research and development.

The next Quadrennial Defense Review should examine the capabilities of the U.S. military to respond to the consequences of climate change, in particular, preparations for natural disasters from extreme weather events, pandemic disease events, and other missions the

U.S. military may be asked to support both at home and abroad. The capability of the National Guard and Reserve to support these missions in the U.S. deserve special attention, as they are already stretched by current military operations.

The U.S. should evaluate the capacity of the military and other institutions to respond to the consequences of climate change. All levels of government—federal, state, and local—will need to be involved in these efforts to provide capacity and resiliency to respond and adapt.

Scientific agencies such as the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA) and the United States Geologic Survey (USGS) should also be brought into the planning processes.

The defense and intelligence communities should conduct research on global climate and monitor global climate signals to understand their national security implications. Critical security-relevant knowledge about climate change has come from the partnership between environmental scientists and the defense and intelligence communities. That partnership, vibrant in the 1990s, should be revived.

Recommendation 2:

The U.S. should commit to a stronger national and international role to help stabilize climate changes at levels that will avoid significant disruption to global security and stability.

All agencies involved with climate science, treaty negotiations, energy research, economic policy, and national security should participate in an interagency process to develop a deliberate policy to reduce future risk to national security

from climate change. Actions fall into two main categories: mitigating climate change to the extent possible by setting targets for long-term reductions in greenhouse gas emissions and adapting to those effects that cannot be mitigated. Since this is a global problem, it requires a global solution with multiple relevant instruments of government contributing.

While it is beyond the scope of this study to recommend specific solutions, the path to mitigating the worst security consequences of climate change involves reducing global greenhouse gas emissions. Achieving this outcome will also require cooperation and action by many agencies of government.

Recommendation 3:

The U.S. should commit to global partnerships that help less-developed nations build the capacity and resiliency to better manage climate impacts.

Some of the nations predicted to be most affected by climate change are those with the least capacity to adapt or cope. This is especially true in Africa, which is becoming an increasingly important source of U.S. oil and gas imports. Already

suffering tension and stress resulting from weak governance and thin margins of survival due to food and water shortages, Africa would be yet further challenged by climate change. The Command reflects Africa's emerging strategic importance to the U.S., and with humanitarian catastrophes already occurring, a worsening of conditions could prompt further U.S. military engagement. As a result, the U.S. should focus on enhancing the capacity of weak African governments to better cope with societal needs and to resist the overtures of well-funded extremists to provide schools, hospitals, health care, and food.

The U.S. should target its engagement efforts, through regional military commanders

and other U.S. officials, toward building capacity to mitigate destabilizing climate impacts. For example, regional commanders have routinely used such engagement tools as cooperation on disaster preparedness to help other nations develop their own ability to conduct these efforts.

Cooperative engagement has the potential to reduce the likelihood of war fighting. As Gen. Anthony C. (Tony) Zinni (Ret.) has said:

"When I was commander of CENTCOM I had two missions: engagement and war fighting. If I do engagement well, I won't have to do war fighting." The U.S. cannot do this alone; nor should the military be the sole provider of such cooperative efforts. But the U.S. can lead by working in cooperation with other nations. Such efforts promote greater regional cooperation, confidence building and the capacity of all elements of national influence to contribute to making nations resilient to the impacts of climate change.

Recommendation 4:

The Department of Defense should enhance its operational capability by accelerating the adoption of improved business processes and innovative technologies that result in improved U.S. combat power through energy efficiency.

DoD should require more efficient combat systems and should include the actual cost of delivering fuel when evaluating the advantages of investments in efficiency. Numerous DoD studies dating from the 2001 Defense

Science Board report "More Capable Warfighting Through Reduced Fuel Burden" have concluded that high fuel demand by

combat force detracts from our combat capability makes our forces more vulnerable, diverts combat assets from offense to supply line protection, and increases operating costs.

Nowhere are these problems more evident than

in Iraq, where every day 2.4 million gallons of fuel is moved through dangerous territory, requiring protection by armored combat vehicles and attack helicopters.

Deploying technologies that make our forces more efficient also reduce greenhouse gas emissions. DoD should invest in technologies that will provide combat power more efficiently. The resulting technologies would make a significant contribution to the vision President Bush expressed in his State of the Union when he said, "America is on the verge of technological breakthroughs that ... will help us to confront the serious challenge of global climate change."

Recommendation 5:

DoD should conduct an assessment of the impact on U.S. military installations worldwide of rising sea levels, extreme weather events, and other possible climate change impacts over the next 30 to 40 years.

As part of prudent planning, DoD should assess the impact of rising sea levels, extreme weather events, drought, and other climate impacts on its infrastructure so its installations and facilities can be made more resilient.

Numerous military bases, both in the U.S. and overseas, will be affected by rising sea levels and increased storm intensity. Since World War II, the number of overseas bases has diminished, and since the Base Realignment and Closure process began the number of stateside bases has also declined. This makes those that remain more critical for training and readiness, and many of them are susceptible to the effects of climate change. For example, the British Indian Ocean Territory island of Diego Garcia, an atoll in the southern Indian Ocean, is a major logistics hub for U.S. and British forces in the

Middle East. It is also only a few feet above sea level at its highest point. The consequences of the losing bases like Diego Garcia are not insurmountable, but are significant and would require advance military planning. The Kwajalein is a low-lying atoll, critical for space operations and missile tests. Guam is the U.S. gateway to Asia and could be moderately or severely affected by rising sea levels. Loss of some forward bases would require us to have longer range lift and strike capabilities and possibly increase our military's energy needs.

Military bases on the eastern coast of the U.S. are vulnerable to hurricanes and other extreme weather events. In 1992, Hurricane Andrew virtually destroyed Homestead Air Force Base in Florida. In 2004 Hurricane Ivan knocked out Naval Air Station Pensacola for almost a year. Most U.S. Navy and Coast Guard bases are located on the coast, as are most U.S. Marine Corps locations. The Army and Air Force also operate bases in low-lying or coastal areas. One meter of sea level rise would inundate much of Norfolk, Virginia, the major East Coast hub for the U.S. Navy. As key installations are degraded, so is the readiness of our forces.

APPENDICES

APPENDIX 1:

BIOGRAPHIES, MILITARY ADVISORY BOARD MEMBERS

ADMIRAL FRANK "SKIP" BOWMAN, USN (Ret.)

*Former Director, Naval Nuclear Propulsion Program;
Former Deputy Administrator, Naval Reactors, National Nuclear Security Administration*

Admiral Skip Bowman was director, Naval Nuclear Propulsion, Naval Sea Systems Command. Prior assignments include deputy administrator for naval reactors in the Naval Nuclear Security Administration, Department of Energy, chief of naval personnel, and director for Polaris Military Affairs and deputy director of naval operations on the Joint Staff.

He was commissioned following graduation in 1956 from Duke University. In 1973, he completed a dual master's program in nuclear engineering and naval architecture/engineering at the Massachusetts Institute of Technology and was elected to the Society of Sigma Xi. Admiral Bowman has been awarded the honorary degree of Doctor of Humana Letters from Duke University.

In 2005, Admiral Bowman was named president and CEO of the Nuclear Energy Institute, NEI is the policy organization for the commercial nuclear power industry. In 2006, Admiral Bowman was made an Honorary Knight Commander of the Most Excellent Order of the British Empire in recognition of his commitment in support of the Royal Navy submarine program.

LIEUTENANT GENERAL LAWRENCE P. FARRELL, JR., USAF (Ret.)

Former Deputy Chief of Staff for Plans and Programs, Headquarters U.S. Air Force

Prior to his retirement from the Air Force in 1988, General Farrell served as the deputy chief of staff for plans and programs, Headquarters U.S. Air Force, Washington, D.C. He was responsible for planning, programming and resource allocation within the corporate Air Force and for integrating the Air Force's main plans and requirements to support national security objectives and military strategy.

Previous positions include vice commander, Air Force Reliance Command, Wright Patterson Air Force Base, Ohio, and deputy director, Defense Logistics Agency, Arlington, Virginia. He also served as deputy chief of staff for plans and programs at Headquarters U.S. Air Force in Europe. A command pilot with more than 3,000 flying hours, he flew 156 missions in southeast Asia and commanded the 201st Tactical Fighter Wing, Tammam Air Base, Spain. He was also the system program manager for the F-4 and F-16 weapons systems with the Air Force Logistics Command, Hill Air Force Base, Utah.

General Farrell is a graduate of the Air Force Academy with a bachelor's degree in engineering and an MBA from Auburn University. Other education includes the National War College and the Harvard Program for Executives in National Security.

General Farrell became the president and CEO of the National Defense Industrial Association in September 2007.

VICE ADMIRAL PAUL G. GAFFNEY II, USN (Ret.)

*Former President, National Defense University; Former Chief of Naval Research and Commanding
Navy Meteorology and Oceanography Command*

Admiral Gaffney has been the Naval Research Laboratory commander and worked in a number of other science and cosmology administration assignments. He served as the 10th president of the National Defense University, and before that as chief of naval research. He also was the senior national oceanography specialist in the Navy, having served as commander of the Navy Meteorology and Oceanography Command from 1994 to 1997. He was appointed by President George W. Bush to the Ocean Policy Commission and served during its full tenure from 2001 to 2004. He served in Japan, Vietnam, Spain, and Indonesia, and traveled extensively in official capacities.

He has been recognized with a number of military decorations: the Navy War College's J. William Middendorf Prize for Strategic Research, the Outstanding Public Service Award from the Virginia Research and Technology Consortium, and the Promote Institute's Navigator Award. He has served on several boards of higher education and was a member of the Ocean Studies Board of the National Research Council from 2002 to 2005. He has been selected to be a public trustee for the New Jersey Consortium and chaired the Governor's Commission to Protect and Enhance New Jersey's Military Bases.

He graduated from the U.S. Naval Academy in 1968 and has a master's degree in mechanical engineering (osam) from Catholic University and a master's of business administration from Jacksonville University.

Admiral Gaffney is currently the president of Portsmouth University in West Long Branch, New Jersey.

GENERAL PAUL J. KERN, USA (Ret.)

Former Commanding General, U.S. Army Materiel Command

General Kern was commanding general, Army Materiel Command from 2001 to 2004, and senior advisor for Army Research, Development, and Acquisition from 1997 to 2001.

General Kern has three combat tours. Two were in Vietnam as a platoon leader and troop commander. His third was as commander of the Second Brigade of the 24th Infantry in Desert Shield/Desert Storm. The Second Brigade played a pivotal role in the historic attack on the Jebel Arak, which allowed the Twenty-Four Infantry Division to secure key objectives deep inside of Iraq. He also served as the assistant division commander of the division after its redeployment to Fort Stewart, Georgia.

General Kern's assignments included color military assistant to Secretary of Defense William Perry during that period, the second period Secretary Perry in more than 70 countries, meeting numerous heads of state, foreign ministers, and international defense leaders. He participated in U.S. operations in Haiti, Rwanda, Zaire, and the Balkans, and helped pioneer military relations in Central and Eastern Europe, South America, China, and the Middle East.

General Kern received the Defense and Army Distinguished Service Medal, Silver Star, Defense Superior Service Medal, Legion of Merit, two Bronze Star Medals for valor, three Bronze Star Medals for service in combat, and three Purple Hearts. He has been awarded the Society of Automotive Engineers' Fleeter Award, the Alumni Society Medal from the University of Michigan, and the Gurnea Cross of Honor of the Federal Armed Forces (EGd).

A native of West Orange, New Jersey, General Kern was commissioned as an armor lieutenant following graduation from West Point in 1967. He holds master's degrees in both civil and mechanical engineering from the University of Michigan, and he was a Senior Security Fellow at the John F. Kennedy School of Government at Harvard University.

He is an advisor to Battelle Memorial Institute and holds the Chair of the Class of 1960 for Advanced Technology at the United States Military Academy.

General Kern is a member of the Cohen Group, which provides strategic advice and guidance to corporate clients.

ADMIRAL T. JOSEPH LOPEZ, USN (Ret.)*Former Commander in Chief, U.S. Naval Force Europe east of Allied Forces, Southern Europe*

Admiral Lopez's naval career included tours as commander in chief of U.S. Naval Force Europe and commander-in-chief, Allied Forces, Southern Europe from 1990 to 1998. He commanded all U.S. and Allied Borneo Peace Keeping Forces in 1995. He served as deputy chief of naval operations for resources, warfare operations and assessments in 1994 to 1996, commander of the U.S. Sixth Fleet in 1992 to 1993, and senior military assistant to the secretary of defense in 1990 to 1992.

Admiral Lopez was awarded numerous medals and honors, including two Defense Distinguished Service Medals, two Navy Distinguished Service Medals, three Legion of Merit, the Bronze Star (Combat V), three Navy Commendation Medals (Combat V) and the Combat Action Ribbon. He is one of just two flag officers in the history of the U.S. Navy to achieve four star rank after direct commission from enlisted service.

He holds a bachelor's degree (sum laude) in international relations and a master's degree in management. He has been awarded an honorary doctorate degree in humanities from West Virginia Institute of Technology and an honorary degree in information technology from Polytechnic State College of West Virginia University.

Admiral Lopez is president of Information Manufacturing Corporation (IMC), an information technology services integrator with major offices in Manassas, Virginia, and Rocket Center, West Virginia.

ADMIRAL DONALD L. "DON" PILLING, USN (Ret.)*Former Vice Chief of Naval Operations*

Admiral Pilling assumed duties as the 57th vice chief of naval operations, the Navy's chief operating officer and second ranking officer, from November 1997 until his retirement from active service in October 2000.

Ashore, he was assigned to a variety of defense resource and planning billets. In his earlier career, he served four years in program analysis and evaluation in the Office of the Secretary of Defense. As a more senior officer, he served as a Federal Executive Fellow at Brookings Institution in 1985-86. A member of the National Security Council staff from 1989 until 1992, Admiral Pilling was selected to flag duty in 1990 while serving there. From 1993 to 1995, he was the director for programming on the staff of the Chief of Naval Operations, and later served as the Navy's chief financial officer from 1996 to 1997.

Admiral Pilling also commanded a warship, a destroyer squadron, a cruiser destroyer group, a carrier battle group, the U.S. Sixth Fleet, and NATO's Naval Strike and Support Group-Southern Europe.

Admiral Pilling has a bachelor's degree in engineering from the U.S. Naval Academy and a doctorate in mathematics from the University of Colorado.

He served as vice president for strategic planning at Ballistic Memorial Institute and became president and CEO of LM, a nonprofit research organization, in 2002.

ADMIRAL JOSEPH W. PRUEHER, USN (Ret.)*Former Commander in Chief of the U.S. Sixth Command (PACCOM) and Former U.S. Ambassador to China*

Admiral Prueher completed thirty-two years in the United States Navy in 1999. His last command was commander in chief of the U.S. Pacific Command (PACOM), the largest military command in the world, spanning over half the earth's surface and including more than 300,000 people. Admiral Prueher also served as ambassador to China from 1999 to 2001. He served two presidencies and was responsible for defining, coordinating, and managing the activities of all United States, non-union branch activities in China.

From 1989 through 1996, Admiral Prueher served as commander in chief of the U.S. Naval Academy at Annapolis, commander of Carrier Battle Group (CAG) based in San Diego, commander of the U.S. Mediterranean Sixth Fleet and of NATO Standing Force based in Italy, and as vice chief of naval operations in the Pentagon.

Admiral Prueher graduated from Montgomery Bell Academy in Nashville, Tennessee, and then graduated with distinction in 1964 from the U.S. Naval Academy, later receiving a master's degree in international relations from George Washington University. He is also a graduate of the Naval War College in Newport, Rhode Island. In addition to co-authoring the Performance Testing manual used by naval test pilots for many years, he has published numerous articles on leadership, military readiness, and Pacific region security issues. Admiral Prueher has received multiple military awards for combat flying, as well as naval and Joint Service. The governments of Singapore, Thailand, Japan, Korea, the Philippines, Indonesia, and Australia have decorated him.

Admiral Prueher is a consulting professor at Stanford University's Institute of International Studies and senior adviser on the Proseware Defense Project. He is on the board of trustees of the Nature Conservancy of Virginia.

GENERAL GORDON R. SULLIVAN, USA (Ret.)*Chairman, Military Advisory Board**Former Chief of Staff, U.S. Army*

General Sullivan was the 23rd chief of staff—the senior general officer in the Army and a member of the Joint Chiefs of Staff. As the chief of staff of the Army, he created the vision and led the team that helped transition the Army from its Cold War posture.

His professional military education includes the U.S. Army Armor School (Basic and Advanced Courses), the Command and General Staff College, and the Army War College. During the Army career, General Sullivan also served as vice chief of staff in 1980 to 1981, deputy chief of staff for operations and plans in 1982 to 1983, commanding general, First Infantry Division (Mechanized), Fort Riley, Kansas, in 1986 to 1988, deputy commander, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, in 1987 to 1988, and assistant commander, U.S. Army Armor School, Fort Knox, Kentucky, from 1983 to 1985. His overseas assignments included four tours in Europe, two in Vietnam and one in Korea. He served as chief of staff to Secretary of Defense Dick Cheney in the administration of President George H.W. Bush.

General Sullivan was commissioned a second lieutenant of armor and awarded a bachelor of arts degree in history from Howard University in 1964. He holds a master's degree in political science from the University of New Hampshire.

General Sullivan is the president and chief operating officer of the Association of the United States Army, headquartered in Arlington, Virginia. He assumed his current position in 1996 after serving as president of Coleman Federal in Washington, D.C.

GENERAL ANTHONY C. "TONY" ZINNI, USMC (Ret)
Former Commander in Chief of U.S. Central Command (CENTCOM)

General Zinni's joint assignments included command of U.S. Central Command (CENTCOM), which is responsible for U.S. military assets and operations in the Middle East, Central Asia and East Africa.

General Zinni's joint assignments also include command of a joint task force and he has also had several joint and combined staff billets at task force and unified command levels. He has made deployments to the Mediterranean, the Caribbean, the Western Pacific, Northern Europe, and Korea. He has held numerous command and staff assignments that include joint task force, company, battalion, regimental, Marine Expeditionary Unit, and Marine expeditionary force command. His staff assignments included device operations, training, special operations, counterterrorism and manpower billets. He has also been a tactics and operations instructor at several Marine Corps schools and was selected as a fellow on the Chief of Naval Operations Strategic Studies Group.

General Zinni joined the Marine Corps in 1961 and was commissioned an infantry second lieutenant in 1965. General Zinni holds a bachelor's degree in economics from Villanova University, a master's in international relations from Salve Regina College, a master's in management and supervision from Central Michigan University, and honorary doctorates from William and Mary College and the Marine Maritime Academy.

He has worked with the University of California's Institute on Global Conflict and Cooperation, the U.S. Institute of Peace, and the Henry Dunant Centre for Humanitarian Dialogue in Geneva. He is on the International Council at the Jean E. Kroc Institute for Peace and Justice. He is also a Distinguished Advisor at the Center for Strategic and International Studies, a member of the Council on Foreign Relations. He has also been appointed as a member of the Virginia Commission on Military Ethics.

General Zinni has co-authored, with Tom Clancy, a New York Times bestseller on his career entitled *Battle Ready*. His book, *The Battle For Peace: A Frontline View of America's Power And Purpose*, was published in 2006.

VICE ADMIRAL RICHARD H. TRULY, USN (Ret)
Former NASA Administrator, Shuttle Astronaut and the first Commander of the Naval Space Command

Admiral Truly served as NASA's eighth administrator from 1989 to 1992, and his career in aviation and space programs of the U.S. Navy and NASA spanned 35 years. He retired as a vice admiral after a Navy career of more than thirty years. As a naval aviator, test pilot and astronaut, he logged over 7,600 hours and made over 300 carrier arrested landings, day and night.

Admiral Truly was the first commander of Naval Space Command from 1983 to 1986 and became the first naval component commander of U.S. Space Command upon its formation in 1984. While still on active duty following the Challenger accident, he was called back to NASA as associate administrator for space flight in 1986 to lead the accident investigation. He spearheaded the launching resulting of the space shuttle, including winning approval of President Reagan and the Congress for building of Endeavor to replace the test Challenger. In 1988, President Reagan awarded him the Presidential Citizen's Medal.

Truly's astronaut career included work in the Air Force's Manned Orbiting Laboratory program, and NASA's Apollo, Skylab, Apollo-Soyuz and space shuttle programs. He piloted the 747/Enterprise approach and landing tests in 1977, and filled off in November 1981 as pilot aboard Columbia, the test shuttle to be refueled into space, establishing a world orbital orbit altitude record. He commanded Challenger in August-September 1985, the first night launch/landing mission of the space shuttle program.

He served as vice president of the Georgia Institute of Technology and director of the Georgia Tech Research Institute (GTRI) from 1992 to 1997. Admiral Truly retired in January 2005 as director of the Department of Energy's National Renewable Energy Laboratory (NREL).

Truly is a member of the National Academy of Engineering. He has previously served on the board of visitors to the U.S. Naval Academy, the Defense Policy Board, the Army Science Board, and the Naval Studies Board. He is a member of the National Research Council Space Studies Board, a trustee of Regis University and the University Corporation for Atmospheric Research, and a member of the advisory committee to the Colorado School of Mines Board of Trustees.

GENERAL CHARLES F. "CHUCK" WALD, USAF (Ret)
Former Deputy Commander, Headquarters U.S. European Command (USEUCOM)

From 2001 to 2002 General Wald was deputy chief of staff for air and space operations at the Pentagon, and from December 2002 until his retirement in 2006 General Wald was deputy commander, Headquarters U.S. European Command, Stuttgart, Germany. USEUCOM is responsible for all U.S. forces operating across 91 countries in Europe, Africa, Russia, parts of Asia and the Middle East, and most of the Atlantic Ocean.

General Wald commanded the 31st Fighter Wing at Aviano Air Base, Italy, where on Aug. 30, 1995, he led one of the wing's initial strike packages against the ammunition depot at Pale, Bosnia-Herzegovina, in one of the first NATO combat operations. General Wald commanded the Ninth Air Force and U.S. Central Command Air Forces, Shaw Air Force Base, South Carolina, where he led the development of the Afghanistan air campaign for Operation Enduring Freedom, including the use of embedded tactical air control parties in ground support operations forces. He has combat time as an O-2A forward air controller in Vietnam and as an F-16 pilot flying over Bosnia. The general has served as a F-37 restovator pilot and F-15 flight commander. Other duties include chief of the U.S. Air Force Combat Terrorism Center, support group commander, operations group commander, and special assistant to the chief of staff for National Defense Review. He was also the director of strategic planning and policy at Headquarters U.S. Air Force, and served on the Joint Staff as the vice director for strategic plans and policy.

General Wald is a command pilot with more than 3,600 flying hours, including more than 430 combat hours over Vietnam, Cambodia, Laos, Iraq, and Bosnia. The general earned his commission through the Air Force ROTC program in 1971.

Currently, General Wald serves as president of Wald and Associates, an international management consulting and strategic planning firm, and is an adjunct lecturer at the Atlantic Council. He is also a member of the Bipartisan Policy Center, National Commission on Energy Policy, and the Securing America's Future Energy Commission.

APPENDIX 2: CLIMATE CHANGE SCIENCE—A BRIEF OVERVIEW

There is a vast amount of scientific literature on the subject of climate change, and a complete discussion on the current state of the world climate and its deviation from climatological norms could fill volumes. In this appendix we discuss the consensus of the science community on climate change, effects observed thus far, and projections about what may happen in the future.

We have drawn information from the Intergovernmental Panel on Climate Change (IPCC), peer-reviewed scientific literature, and data reports, and briefings from various respected sources, including the National Academy of Sciences, National Oceanic and Atmospheric Administration, National Air and Space Administration, and the United Kingdom's Hadley Centre for Climate Change.

CURRENT CONSENSUS

The IPCC's latest assessment report affirmed the following:

- While natural forces have influenced the earth's climate (and always will), human-induced changes in levels of atmospheric greenhouse gases are playing an increasingly dominant role.
- After considering the influences of the known causes of climate change—natural, and human-induced—the significant increase in the average global temperatures over the last half century can be attributed to human activities with a certainty of more than 95 percent [1].
- These temperature increases have already affected various natural systems in many global regions.
- Future changes in the climate are inevitable.

CHANGING GLOBAL TEMPERATURES

INCREASED CARBON MEANS INCREASED TEMPERATURES

Throughout its history, the earth has experienced oscillations between warm and cool periods. These shifts in climate have been attributed to a variety of factors, known as “climate forcings,” that include orbital variations, solar fluctuations, landmass distribution, volcanic activity, and the atmosphere's concentration of greenhouse gases, such as carbon dioxide, methane, and water vapor. The changes we see today are occurring at a more rapid rate than is explainable by known natural cycles [5].

Throughout the earth's past, temperature and greenhouse gas concentration have been closely linked through the planet's natural greenhouse effect, i.e., greenhouse gases trap heat in the atmosphere and thereby warm the earth. Throughout Earth's geologic past, global and regional cycles, atmospheric CO₂ concentration, and temperature show a high degree of correlation. Other greenhouse gases, such as methane, also show a similar relationship with temperature.

The most rapid rise in atmospheric CO₂ levels is of concern to climate scientists and policymakers. CO₂ concentrations never exceeded 300 parts per million by volume (ppmv) during previous large swings in climate conditions, but the CO₂ concentration now is about 380 ppmv [41], representing a 35 percent increase since the onset of the industrial revolution in the mid-eighteenth century. CO₂ levels are likely at their highest levels in the last 20 million years, and this current rate of increase is unprecedented during at least the last 20,000 years [41].

Thus, the current atmosphere is significantly different from its preindustrial state in a way that is compatible with increased heating.

AVERAGE GLOBAL TEMPERATURES HAVE ALREADY BEGUN TO RISE

Average global surface temperature is the most fundamental measure of climate change, and there is no dispute that the earth's average temperature has been increasing over the last century (albeit not uniformly, with an acceleration in warming over the last 50 years). Over the last century, the average surface temperature around the world has increased by 1.31° ± 0.23° F [7]. Temperatures since the 1950s were “the highest [5] any 50-year period in at least the last 1,300 years” [4]. On the hottest weeks years on record (from temperatures begin to be measured in the 1850s, when data occurred in the last twelve years [7]).

The burning of fossil fuels (such as oil, natural gas, and coal) is the main source of the rise in atmospheric CO₂ over the last two and a half centuries; deforestation and other changes in land use are responsible for a portion of the increase as well.

Human activities have also been responsible for a portion of the rise in other heat-trapping greenhouse gases, such as methane, which has risen 145 percent since preindustrial times, and nitrous oxide, which has risen 18 percent during the same period. Currently, half of the annual methane emitted is from activities such as burning fossil fuel and agricultural practices; (41) humans are responsible for about a third of nitrous oxide emissions, mainly from agriculture.

There is no known natural forcing that can account for the severity of the recent warming. For example, while claims are made that variation in the intensity of the sun is responsible, the variation in solar conditions' effect on the climate is calculated to be less than 5 percent as strong as that of human-induced greenhouse gases [7].

MORE THAN TEMPERATURE RISE: OBSERVED IMPACTS ON EARTH'S NATURAL SYSTEMS

A 1.31° increase in average global surface temperature over the last century may seem like an insignificant change, but in fact it has had a marked impact on many of the earth's natural systems.

PRECIPITATION PATTERNS HAVE CHANGED

A change in the temperatures of the atmosphere has a great impact on precipitation patterns. As air mass warms, it is able to hold more water vapor, so a warmer atmosphere can absorb more surface moisture and produce drier ground conditions. However, this increase in atmospheric content will also lead to more severe heavy rain events, when this higher water content atmosphere drops its moisture. Changes in precipitation amounts have been detected over large portions of the world. Annual precipitation has increased 5 to 10 percent over the past century across eastern North America, northern Europe, and northern and central Asia [7, 41]. The Mediterranean region experienced drying [7]. The tropics have witnessed a slightly lower increase, of 2 to 3 percent, and most of sub-Saharan Africa has shown a decrease in precipitation of 20 to 50 percent [42].

The Northern Hemisphere subtropics experience a decrease in precipitation of approximately 2 percent [41]. Some of the most notable drying occurred in the Sahel and portions of northern Asia [7]. No significant change was detected in rainfall patterns across wide areas in the Southern Hemisphere, however, precipitation was noticeably decreased in southern Africa [41].

EXTREME WEATHER EVENTS ARE MORE FREQUENT

Since 1950, cold days and nights and frost days have become less frequent, while hot days and nights and heat waves have become more frequent [7].

temperature increased about 1.3°F, and the sea level increased seven inches.

Because most of the later model studies assessed by the IPCC focus on these specific scenarios, the IPCC's 2007 report necessarily focuses mostly on the same time. The "low" scenario (i.e., the one that results in the lowest temperature increase) describes a future in which population levels come under control, the global economy moves away from a manufacturing focus, and nations work together on improvements in environmental sustainability and developing clean technologies. The "medium" scenario describes a future where the assumptions regarding population and economic growth are similar to those made in the low scenario. Moreover, in the "medium" scenario the IPCC assumes the development of efficient technologies, and the production of energy from a variety of sources other than fossil fuels. The "high" scenario is the same as the "medium" scenario except energy production remains heavily focused on fossil fuel sources.

Each of the IPCC scenarios lead to different projections for temperature change, however they all project significant global warming, with the most intense warming occurring in the Arctic and the high northern latitudes.

Some of the areas hardest hit by temperature increases will also vary fairly significantly (generally less so) by the end of the century. Domestically, the southwestern portion of the United States will very likely experience the worst combination of these factors. Decreasing precipitation and increasing temperatures will also stress northern and southern Africa and the Middle East.

While the earth's natural systems will continue to experience greater stress due to future climate changes, so will some key human systems (94):

- **Coastal populations:** Increases in flooding and inundation from rising seas and more intense storms will affect coastal populations across the world, particularly those in Bangladesh and low-lying island nations.
- **Agriculture:** Temperature increases of a few degrees and increases in atmospheric CO₂ levels

will likely reduce the world's food supply. In particular, rice yields in Asia will be reduced by 10 to 30 percent, and wheat yields in Europe will be reduced by 10 to 20 percent. In the United States, crop yields will be reduced by 10 to 20 percent. In the tropics, crop yields will be reduced by 10 to 20 percent. In the high northern latitudes, crop yields will be increased by 10 to 20 percent.

Sea level rise will also have significant impacts on coastal populations. In the United States, sea level rise will affect 10 to 20 million people. In the tropics, sea level rise will affect 10 to 20 million people. In the high northern latitudes, sea level rise will affect 10 to 20 million people.

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may help agricultural productivity in mid- and high latitudes but will surely hurt agriculture in the tropics and subtropics, where crops already exist at the top of their temperature range; higher increases in temperature, as well as heat waves, changes in precipitation, and increased pests, will hurt agricultural productivity across much of the globe.

• **Water resources:** Five billion people are expected to live in water-stressed countries by 2025 even without flooding in climate change. Expanded changes in climate will exacerbate water stress in some areas including most of Asia, Southern Africa, and the Mediterranean, while alleviating it in others (such as the United Kingdom). Areas that depend on tropical mountain glaciers for water (such as Lima, Peru), will face a precarious situation as the glaciers continue to melt and eventually disappear.

Developing nations with little capacity to manage water will be among the hardest hit.

• **Health:** Rising temperatures and heat waves will increase the number of heat-related deaths in summer months. This increase will be partially offset by decreases in cold-related winter deaths. The reach of vector-borne diseases, such as malaria and dengue fever, is expected to spread. Increasing frequency of floods will harm human health by its direct impact on populations as well as by facilitating the spread of disease to affected areas. Vital health infrastructure can be damaged, making minor and insalubrious injuries become life-threatening.

A WILD CARD: ABRUPT CLIMATE CHANGE

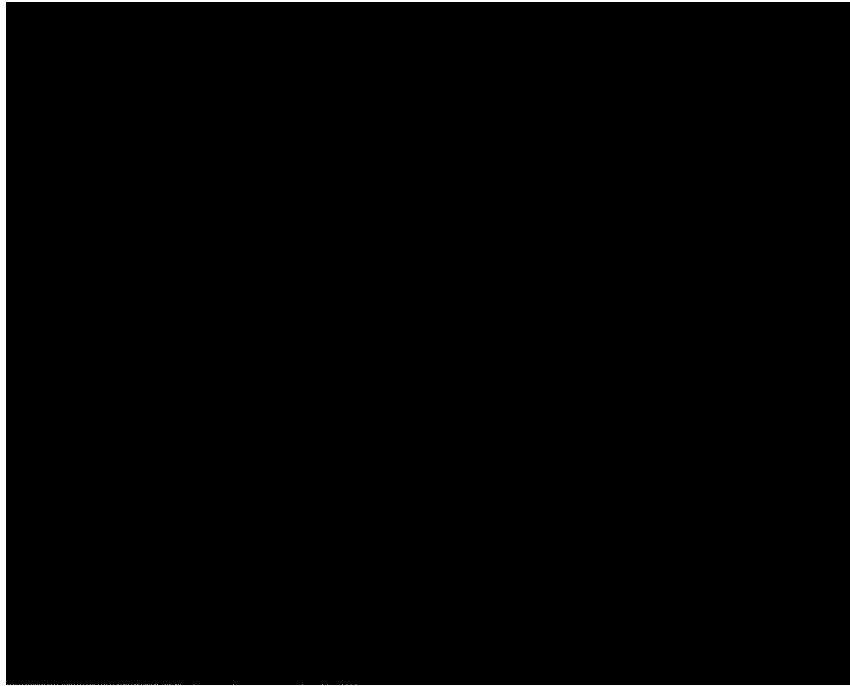
For many years it was believed that climate changes have been gradual—that the earth gradually cycles between glacial periods and warm interglacial periods. We now know this is not always the case (Fig. 10.10).

Abrupt climate changes present the most worrisome scenario for human societies because of the inherent difficulties in adapting to sudden changes.

Abrupt sea level rise is particularly worrisome. The great ice sheets along the edges of Greenland and the West Antarctic are vulnerable to sudden breakup as the edges of the sheet thaw and meltwater seeps to the ice-ground boundary, the meltwater will act as a lubricant and facilitate a slippage into the sea. This physical phenomenon is an example of a positive feedback mechanism that, once started, is difficult to reverse (13). Melting of these ice sheets would be catastrophic. The Greenland Ice Sheet could raise sea levels by nearly three feet over a millennium (14). The West Antarctic Ice Sheet would have a more immediate impact, raising sea levels more than three feet per century for five centuries (15). The probability of a collapse of the West Antarctic Ice Sheet before 2100 is estimated to be between 6 and 10 percent (1).

None of these abrupt climate changes are projected by the climate models driven by the IPCC's 2007 future scenarios. However, if temperature increases were at the high end of the ranges projected by the models, abrupt climate changes such as those discussed above are more likely to occur. Such abrupt climate changes could make future adaptation extremely difficult, even for the most developed countries.

REFERENCES



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The CHAIRMAN. Our second witness, Dr. Richard Haass, is a Rhodes scholar who has received the Presidential Citizens Medal for his contributions to implementing U.S. policy during operations Desert Shield and Desert Storm, served on the National Security Council under George Bush senior, headed the policy planning at the Department of State under Secretary of State Colin Powell, and is now head of the Council on Foreign Relations. His latest book is entitled "The Opportunity: America's Moment To Alter History's Course," which could well serve as the title for this hearing.

Dr. Haass, welcome.

STATEMENT OF RICHARD N. HAASS, PRESIDENT, COUNCIL ON FOREIGN RELATIONS

Mr. HAASS. Thank you, Mr. Chairman. And for the record, if you do choose to use the title of my book as the title of your hearing, I would pose no objection.

Thank you very much for asking me to testify today on this critical issue. Let me just note that I will be speaking here—the views I will be saying here will be my personal views and not those of the Council on Foreign Relations, simply because the Council on Foreign Relations does not take institutional positions. I will just make a few points and I ask that my full statement be inserted in the record.

America's high dependence on imported oil adversely affects our national security in a number of ways. First, it distorts American foreign policy by increasing the importance of the greater Middle East considerably above what it would be either if it did not have much oil or if oil played a less important role than it does.

Secondly, our dependence on imported oil increases the vulnerability of the U.S. economy to supply interruptions and price increases.

Thirdly, our current dependence on imported oil exacerbates our current account deficit.

And fourthly, as several of you have correctly pointed out, our importing of large amounts of oil funnels massive amounts of dollars to producers, many of whom, such as Iran and Venezuela, are carrying out foreign policies inimical to America's principles and interests, and in other cases this massive flow of resources can actually undermine markets, undermine the rule of law, and undermine democracy.

This current state of affairs is a national failure. I would go so far to say it is a national scandal that we find ourselves in this position more than three decades after the first oil shocks. Alas, there are no quick fixes nor is there any benefit to be had from further delay.

Is climate change a national security matter? Here I would associate myself with the report and remarks of my good friend, Gordon Sullivan. Climate change is a cause of both conflict and it is a cause of state failure, which in turn can breed terrorism, drug trafficking, slavery and other adverse aspects of globalization.

There is much to do. There is a large number of potential remedies. I would just say some of them include diversification of oil supplies, maintaining strategic petroleum reserves in this country and elsewhere, and instituting new sharing arrangements that

bring in India and China; increasing the resilience of the energy infrastructure and system; increasing the domestic production of oil; development of alternatives to oil, especially to reduce the use of it in the transportation sector in this country; the development of new technologies that lead to the clean burning of coal or at least the cleaner burning of coal, as well as technologies that would lead to the capture and sequestration of carbon, if possible, expanding the role of nuclear power, at a minimum, to replace retired nuclear plants down the road; and to reduce the demand, especially again in the transportation sector, and to increase efficiency of energy use more broadly; to develop an international framework for the world; to take the place of Kyoto essentially for the post-2012 world; to encourage forestation and discourage deforestation; and to change the way the United States Government deals with these issues.

Let me just use the remainder of my time to make six overarching points, and I will do it as quickly as I can.

First, the United States needs to adopt a broader definition of energy security. The traditional definition, which essentially has emphasized reliable access to affordable supplies of oil, is simply too narrow and inadequate. It fails to take into account the need to stem the flows of resources to certain governments, it fails to take into account global climate change. What we need is a new definition for energy security. Any energy security is and will be a function of our ability to manage the amount of energy produced, consumed, and imported so that the United States, one, reduces its vulnerability to supply and price fluctuations; and, two, reduces the flows of resources overseas; and, three, reduces the adverse impact on the global climate.

Secondly, we need a truly comprehensive policy. We cannot drill or conserve our way out of the current state of affairs. Neither nuclear power nor cellulosic nor anything else will by itself constitute a panacea.

Thirdly, the United States cannot do this alone. We need an American policy. We must walk the walk if we are going to persuade others when we talk the talk. But the approach must be international. Developing and developed countries must participate.

Fourthly, there will be no solution to the energy security and global climate challenges for the foreseeable future. The calls for energy independence are unrealistic or even unhelpful. The challenge is to manage this problem, not to eliminate it.

Fifth, the United States Government needs to change the way it goes about business in this area. The National Security Council, for example, needs an energy security and climate change directorate. We should look at the role and mandate of the Department of Energy, and, more generally, we should look at ways in which we can better integrate the concerns before this select committee and the broader concerns of national security.

Last, we also need to meet the challenge of integration beyond the U.S. Government. And we need to find ways to integrate not simply the executive branch and the congressional branch on this issue, but also what the Federal branch does with State and local authorities, with the private sector and with NGOs.

So let me end where I began. I applaud the creation of this select committee. I applaud your willingness to devote your time and energies to this, and I wish you well in your work because, to a large extent, the national security of this country in coming decades will depend on how well and how successfully we meet these related challenges of energy security and climate change. Thank you.

The CHAIRMAN. Thank you, Dr. Haass, very much.

[The statement of Mr. Haass follows:]

Prepared Statement of Richard N. Haass
President, Council on Foreign Relations

on the
Geopolitical Implications of Rising Oil Dependence and Global Warming

before the
Select Committee on Energy Independence and Global Warming
U.S. House of Representatives

Washington, DC
April 18, 2007

Mr. Chairman:

Let me begin by congratulating you and your colleagues on establishing this new select committee. The issues in your purview are among the most important facing this country and the world.

This is underscored by the topic of today, your first hearing. The geopolitical implications of rising oil dependence and global climate change for the United States are great and likely to become even greater with time.

Let me address each of the questions you have posed to me and my fellow witnesses.

I will begin with how ever-increasing dependence on imported oil affects U.S. national security. The short answer is that it does, in many and important ways. Four stand out:

First, American and global dependence on the Middle East for oil artificially increases the importance of this part of the world. This is not to say it would not be important even if there were no oil in the region or if the United States and the world were not dependent upon the region's oil. The United States would still have important, even vital concerns relating to terrorism, non-proliferation, conflict resolution, Israel, and so on. But there is no denying that energy makes this part of the world far more vital than it would otherwise be and reduces American willingness and ability to tolerate developments that were they to occur in other regions would provoke less of a response. And just to be clear, let me stress that this concern for oil and gas is not tied to protecting the interests of the large oil companies but rather to maintaining adequate access on acceptable terms to a vital raw material.

Second, the fact that the United States imports roughly 60% of the oil it consumes leaves the U.S. economy vulnerable to supply interruptions that even in small amounts can cause price increases and in larger amounts cause not only price increases but economic disruption. The United States would be vulnerable economically to supply interruptions (and price spikes) even if it imported far less oil given the extent to which others are vulnerable and the degree to which U.S. economic fortunes are tied to those of others.

Third, the need to pay for oil imports exacerbates the already considerable current account deficit, which in turn further weakens the dollar and makes the United States more dependent on (and vulnerable to) the decisions of other governments. Approximately one-third of the annual current account deficit, or some \$250 billion, is attributable to oil imports.

Fourth, American demand for oil contributes to upward pressures on prices and provides massive revenues to producers. One of the top five oil exporters to the United States is Venezuela, whose foreign policy is anti-American in large measure. The top two foreign sources of oil, Saudi Arabia and Russia, carry out policies at home and abroad that at times run counter to American values and interests. Iran, the world's fourth largest exporter of oil, is in large part able to conduct the problematic foreign policy it does because of high oil revenues. In addition, massive inflows of oil revenues can be as much a liability as a windfall in another way in that they often work against efforts to promote market economies and the rule of law.

The second question posed asks whether it is urgent that the United States do something about this state of affairs. It is. It is also a national failure, a bi-partisan failure, that this country is consuming and importing as much oil as it is today, more than three decades after the first oil shock that accompanied the October 1973 Middle East conflict. It is a matter of some debate as to whether U.S. energy security has actually deteriorated despite that and subsequent crises: the United States is more dependent than ever on imports, but U.S. energy intensity is down and international markets seem better able to weather disruptions. But whatever the relative judgment on energy security, it is not what it needs to be in absolute terms. That said, it has taken us decades to get to where we are today, and will take decades for the situation to change fundamentally. There is, however, no reason to delay. Every day we as a country wait to act only increases the price we pay for the current state of affairs and makes it that much more difficult and costly for us to change them.

Should climate change be treated as a national security matter? The short and clear answer is "yes." Countries are unlikely to go to war over levels of greenhouse gas emissions, but they may well go to war over the results of climate change, including water shortages and large-scale human migration. Climate change, by contributing to disease, extreme weather, challenges from insects that attack both food production and people, water shortages, and the loss of arable land, will also contribute to state failure, which in turn provides opportunities for activities such as terrorism, illegal drugs, and slavery that exploit "sovereignty deficits." Development, democracy, and life itself will not thrive amidst such conditions.

The last two questions can best be answered together, as they ask for recommendations for reducing oil dependence and greenhouse gas emissions and addressing both climate change and energy security.

Energy security is not easy to define. It is a relative concept, in the sense that it is impossible to achieve total energy security – just as it is impossible to achieve full security (or complete invulnerability) in any realm. A traditional definition of energy security would be one that emphasized minimizing U.S. vulnerability to supply interruptions and price increases. This “reliability and affordability” approach to energy security is inadequate, as it does not capture the additional rationales for reducing consumption of oil (imported or otherwise) in order to curtail the flow of resources to unfriendly governments and to reduce the adverse impact on the world’s climate. As a result, we need to adopt a broader definition of the concept. Energy security is directly related to the ability to manage the form and amount of energy produced, consumed, and imported so that the United States reduces its vulnerability to supply and price fluctuations, the flows of resources to unfriendly producer countries, and the adverse impact on the global climate.

A range of prescriptions, some familiar, some not, flows from this broader approach to energy security. One is the desirability of diversifying sources of oil and other energy supplies. Such diversification reduces the impact of losing for whatever reason access to the output of any single producer. The United States has done this in the oil realm, as only Canada provides the United States in the range of 20% of its total oil imports. 90% of U.S. crude oil imports are distributed to more than ten countries.

The United States can also help reduce its vulnerability to supply interruptions through contingency planning, including the maintenance of the strategic petroleum reserve (SPR) and various stand-by international sharing arrangements. Congress would be well-advised to assess both the adequacy and guidelines for use of the SPR. Also in need of overhaul is the International Energy Agency, which needs to be amended (or complemented by the International Energy Forum) so that major countries such as India and China are fully included in global planning.

The entire energy infrastructure – production areas, pipelines, pumps, refineries, terminals, power plants, and so on – needs to be made more robust and made more resilient. This involves better intelligence and law-enforcement cooperation, enhanced protection of critical sites, and provision for the redundancy of critical components. There is also no substitute for the ability to protect and clear critical transitways.

Supply diversification and related measures have their limits, however. The price of oil reflects global supply and demand, so the price of oil will rise if more than a negligible amount of oil is taken off the market. In addition, the United States is in principle more vulnerable to supply interruptions given the rise in terrorism and the increased role of national oil companies, who are more likely to reflect government policy when it comes to making decisions about production and sales.

Another way to increase diversification of supply is to increase domestic production, which is now below 7 million barrels a day. Expressed differently, the United States now imports some 2/3 of the oil it consumes. It is doubtful new drilling (even with new technologies that increase recovery rates) could appreciably affect this number given the falling output of many mature wells and fields and the growing domestic demand for oil. Still, the United States ought to increase the amount of exploration and development that it allows, especially in coastal areas. Again, though, no combination of diversification of external oil supplies and increased domestic production can satisfy the demands of a comprehensive energy security posture.

Alternative forms of energy, including coal, natural gas, nuclear, solar, wind, geothermal, and biofuels, are also central to any discussion of energy security. One reality to contend with though is the fact that most of the oil produced and imported is used in the transport sector—and that most of what fuels the transport sector is oil. Massive substitution is not a near-term option. In the medium and long-term, fuel-efficient “pluggable” hybrids that use electrical power appear promising. So as well does cellulosic biomass, which can substitute in significant quantities for gasoline without disrupting food supplies or requiring anything near the amount of energy to produce corn-based ethanol. One short-term step that should be taken is the removal of the tariff on ethanol imports.

Coal is and will remain the principal fuel for electricity generation. It generates half the electricity in the United States. Coal is readily available in the United States as well as in both China and India. It is also relatively inexpensive. China is building large coal-fueled plants at the rate of two per week; India is building them at a rate closer to two per month. The problem is that coal is a major contributor to greenhouse gas emissions. As the recently-released MIT study *The Future of Coal* makes readily apparent, the climate change problem will continue to worsen unless something can be done about coal. The reality, though, is that there is no realistic alternative to coal; the principal question is whether technology can be developed, proven and introduced with sufficient speed and on a sufficient scale to capture and then sequester the massive amounts of carbon dioxide existing and planned plants will produce. Governments ought to work with industry in creating an investment and regulatory environment that accelerates the emergence, testing, and fielding of such technology in the United States and around the world. In the meantime, the government should only authorize the construction of coal plants that use the most advanced, efficient and clean technologies and that are designed to incorporate emerging technologies designed to capture carbon.

Nuclear power is the ideal form of fuel for electricity production given that it adds hardly at all to climate change. Nuclear power stations now provide some 20% of U.S. electricity. There will be hurdles to maintaining, much less increasing, this percentage. Politics is one problem. The last reactor to be completed was ordered nearly four decades ago and became operational in 1996. There are currently 103 reactors operating. Even with 20 year extensions of their planned lifespan all existing reactors will be decommissioned by the middle of this century. Just replacing them will require building two reactors a year for the next fifty years. It is not clear this rate of construction in the

United States (coupled with ambitious building programs elsewhere) is sustainable. Indeed, a forthcoming study (*Nuclear Energy: Balancing Benefits and Risks*) written by Charles D. Ferguson of the Council on Foreign Relations concludes that “Nuclear energy is not a major part of the solution to further countering global warming or energy insecurity. Expanding nuclear energy use to make a relatively modest contribution to combating climate change would require constructing nuclear power plants at a rate so rapid as to create shortages in building materials, trained personnel, and safety controls.” Other analysts are more bullish about the prospects for nuclear power, although even if they are correct it will not prove transformational for decades if then. In addition, a greater emphasis on nuclear power will raise security challenges as well as demands for safe storage of spent fuel.

In short, developing alternatives will over time make a difference. But no energy security policy can be considered comprehensive without a significant emphasis on reducing the consumption of oil and oil products. The United States daily consumes some 21 million barrels of oil and oil products. The policy question is how best to slow or better yet reverse this growth.

Increasing the tax on gasoline would have the most immediate impact. U.S. taxes (18.4 cents per gallon at the federal level) are low by world standards. If politics required, an increase in the federal fuel tax could be offset by reductions or rebates in other taxes or in designating revenues for energy-related investments.

Tightening fuel efficiency standards is a good mid-term approach given the time it will take for more efficient cars and trucks to be built and to replace the existing fleet. One area deserving exploration is what might be done to accelerate the replacement of low-mileage vehicles with hybrids and relatively fuel-efficient cars and trucks.

All of the above would affect climate change. Climate change policy, however, is something different. Congress and the administration should start developing guidelines for the post-Kyoto Protocol, post-2012 world. They should work with state governments, business, and academic experts. It is essential that the United States be a full participant in any negotiations and in any resulting regime – and that it approach such negotiations with a national policy in place. Developing countries need to be a central (although not necessarily equal) participant in a post-Kyoto framework. Some sort of carbon tax or cap and trade system will likely work best. Factored into any plan should be a positive credit for forested areas that absorb carbon dioxide. Even before then, U.S. aid policy should be adjusted to provide financial incentives to discourage deforestation and encourage reforestation.

We will also need to consider whether and how future trade negotiations and the WTO process itself address climate change. Many of the innovations that will reduce emissions (such as nuclear power stations and cleaner coal plants and capture and sequestration technology) are costly. Questions such as how to treat subsidies and the role (if any) of tariffs to deal with producers who give short shrift to climate concerns require study.

I want to close with a few thoughts on this subject. Despite the formal name of this select committee, "energy independence" is beyond reach if by independence is meant an ability to do without imports of oil and gas. A recent Task Force (*National Security Consequences of U.S. Oil Dependency*) sponsored by the Council on Foreign Relations concluded "During the next twenty years (and quite probably beyond) it is infeasible to eliminate the nation's dependence on foreign energy sources." A more useful and realistic task is how to manage energy dependence or, better yet, how best to promote energy security.

Similarly, energy security cannot be promoted through any single policy or breakthrough. Rather, what is required is a family of policies. The U.S. government will need to adjust to help bring this about. The creation of this select committee is a step in the right direction; so, too, would be a directorate in the National Security council staff devoted to energy security and the inclusion of the secretary of energy more regularly and centrally in national security meetings. Energy security properly defined is now too intimately a part of overall security to be left out of the most important deliberations of our country.

The CHAIRMAN. Our next witness, Carl Pope, is one of America's most influential and effective environmental leaders. He was appointed executive director of the Sierra Club, America's oldest and largest grassroots environmental organization in 1992. He is a veteran leader in the environmental movement. Mr. Pope has been with the Sierra Club for the past 20 years. He graduated summa cum laude from Harvard and spent 2 years as a volunteer in the Peace Corps in India. Welcome, Mr. Pope. Whenever you feel ready, please begin.

STATEMENT OF CARL POPE, EXECUTIVE DIRECTOR, SIERRA CLUB

Mr. POPE. Thank you very much, Mr. Chairman, members of the committee. I am Carl Pope, the executive director of the Sierra Club, and it is an honor to appear before you today. The Sierra Club believes that this select committee can be the pivot which moves America's national government from lagger to leader on the issue of climate change.

Today we are addressing the national security implications of oil dependence and climate change. Lincoln said in the Civil War that slavery somehow caused it. I think we all know that dependence on oil somehow is related to our war in Iraq.

While oil addiction is the closest nexus between national security and global warming, global warming itself is a bigger threat than oil addiction alone, because climate change can produce insecurity in regions of the world which have no oil. Indeed, climate change has historically been one of the world's major sources of violence and instability.

For 1,700 years the drying out of the Asian steppe lands sent Ghengis Khan, Atilla the Hun, and wave after wave of nomadic invaders to topple Rome, unseat Chinese imperial dynasties, and finally topple the Arab caliphate with the sacking of Baghdad.

But today we have the solutions to solve both our addiction to oil and the threat of global warming. Indeed, replacing our reliance on oil and other fossil fuels will create a new energy economy, relieve us of dependence on unstable parts of the world, and reduce the threat of global warming pollution.

In January the Sierra Club released a report in cooperation with the American Solar Energy Society in which we capped the expertise of America's leading government scientists and researchers on energy who found that simply by exploiting existing energy efficiency and renewable technologies, we could reduce our emissions of carbon dioxide by 2 percent a year, every year between now and 2030, and be on the pathway with new technologies emerging from those national laboratories to complete the task of reducing our national emissions of global warming by 60 to 80 percent by 2050. In the Sierra Club, we called that the 2 percent solution.

We are asking the American people and the Congress to embrace that solution. It has four principle pathways and one blind alley. The first pathway, get more efficiency out of the cars and trucks that we make, whether we make them in southeast Michigan or in Tennessee. We can save consumers money, reduce oil dependence, revitalize the American auto industry by improving fuel efficiency by 4 percent a year as the President has called for. Taking this

step alone, by 2025 would save over 3 million barrels of oil, more than we import from the Persian Gulf. For this reason the Sierra Club supports the Markey-Platt CAFE legislation.

We also urge Congress to support the development of cellulosic ethanol and other renewable fuels. Ethanol and renewable fuels and auto efficiency multiply their impact. We need to do both of these things. We can't solve our transportation fuels problem with only one of the two solutions.

Next, in the utility sector we need to embrace the renewable energy possibilities so many of you mentioned. The State of Minnesota, where I was this weekend, has already adopted a very ambitious renewable energy standard, one that would achieve 30 percent renewable standards by 2025 for its largest utility. Congress should join that by adopting a 20 percent national standard by 2025.

We also need to recognize that we waste an enormous amount of the electricity that we generate. We should adopt an national energy efficiency standard that would put the Nation's electric sector on a dependable track towards greater efficiency. Utilities can and should become at least 10 percent more efficient by 2020.

The blind alley which has been suggested recently by the President is the idea that we can back out oil from—gas from oil with gasoline made from coal. If you look at the numbers, it is overwhelmingly likely that such a strategy would actually double the amount of carbon dioxide put out by the average vehicle and would also cost the taxpayers enormous sums of money for very little return. So we urge the Congress not to follow the seemingly attractive but, if you look closely at the numbers, ultimately unworkable strategy of using coal liquids.

What we should be doing instead is sequestering the carbon dioxide from electricity generated from coal and then using that electricity to plug—to plug in the hybrids that Congresswoman Miller suggested. That is a pathway to use coal responsibly to back out oil imports.

We can do this job, the American people are ready to do this job, and I want to underscore what many of you said, we must do this job in a responsible way and in a way which not only doesn't hurt the American economy. I think that is far too low a standard. I believe that this Congress has the opportunity, by designing effective energy policies which unleash American ingenuity and entrepreneurship, to actually create a new industrial revolution in this country, to add millions of new industrial jobs which we badly need to reduce our trade deficit, and to enable us to say to our children when they ask us, mommy or daddy, what did you do in the great warming, to respond with pride: We led.

Thank you very much.

The CHAIRMAN. Thank you, Mr. Pope.

[The statement of Mr. Pope follows:]



**Statement of
Carl Pope
Executive Director
Sierra Club**

**Before the
Select Committee on Energy Independence and Global Warming**

April 18, 2007

I. Introduction

Dear Mr. Chairman, members of the Committee:

I am Carl Pope, the Executive Director of the Sierra Club. The Sierra Club is America's oldest and largest grass-roots, citizen environmental organization. We represent 1.3 million members and supporters; we have been addressing issues of energy policy since 1970. Most recently we originated the petition to the Environmental Protection Agency which resulted in this month's Supreme Court decision that global warming is an environmental problem subject to the Clean Air Act.

It is an honor to appear before you today, to address one of the most important challenges facing our nation and the world; how to prevent global warming and climate change from devastating the future. I believe that the work of this Select Committee has the potential to go down as the moment when the federal government pivoted from laggard to leadership on the issue of global warming.

America has already pivoted. More state, local and grass-roots leadership is being demonstrated on a smart and secure energy future than I have seen on any environmental question since the early 1970's. But Washington has not caught up, either with the need or with the American people – that is your challenge.

II. Climate Change Has Historically Been a Major Source of Global Insecurity

Today's hearing addresses the national security implications of global warming. Lincoln said that slavery "somehow" caused the Civil War. In our hearts, we all know that our addiction to oil is "somehow" responsible for the War in Iraq.

But while oil addiction is the nexus between the causes of global warming and the threats to our national security, global warming itself is a much bigger threat to our security than oil addiction alone would be. The irony of the recent debate about whether we should take effective action to curb global warming is that one of the arguments from those who would delay is uncertainty. Uncertainty about future climate patterns should not be a reassuring argument for inaction; it should sound the alarm for urgent action. Climatic uncertainty and instability have historically been at the root of many long range threats to human security, and are again today.

Indeed, climate change has been one of the major sources of violence and instability during most of human history. From the 4th century BC until the battle of Ayn Jalut in 1260 which ended the Mongol Invasion of the Middle East, world history was dominated by climate change wars. For 1700 years the drying out of Central Asia sent wave after wave of nomads to topple the Roman Empire, unseat Chinese dynasty after dynasty, expel the Byzantine empire from Asia Minor, and finally topple the Arab Caliphate by sacking, ironically, Baghdad. Attila the Hun and Genghis Khan were propelled onto the world scene by climate change.

III. Developing a New Clean Energy Economy Would Solve Global Warming and Bolster National Security by Cutting America's Oil Dependence.

We have the solutions today to solve global warming and cut America's oil dependence. Putting this technology to work is critical. Both of these issues put America's economy, environment, and national security in jeopardy. We must, and we can, create a new clean energy economy that reduces greenhouse gas emissions by replacing our reliance on oil and other fossil fuels.

Both oil consumption and oil imports are growing. The United States consumes nearly 21 million barrels of oil per day. That will rise to over 24 million barrels per day by 2020 according to the Energy Information Administration (EIA).

We consume nearly 25 percent of the world's oil, yet we sit on just 3% of the known reserves – we can not meet our oil demand by expanding domestic drilling. As a result, we will become increasingly reliant on imported oil. According to the EIA, we are currently on a trajectory to import 64 percent of our oil by 2020.

Growing Oil Dependence Hurts Our National Security.

Increasing our oil imports puts the United States at the mercy of foreign governments – many of which are undemocratic and oppose U.S. foreign policy. Persian Gulf countries hold over 65 percent of the world's oil reserves. There is a growing sense within the national security community that America's oil dependence puts our national security at risk. This sentiment is expressed in stark terms in a study by the Strategic Studies Institute of the U.S. Army War College, "America is buying billions of dollars of oil from nations that are sponsors of, or allied with, radical Islamists who foment hatred against the United States. The dollars we provide such nations contribute materially to the terrorist threats facing America."¹

Growing Oil Dependence Also Hurts the U.S. Economy.

The U.S. currently sends \$500,000 overseas every minute to pay for oil products. According to the U.S. Department of Energy, price spikes from 1979 to 1991 cost the U.S. economy about \$4 trillion – nearly as much as we spent on national defense over the same period. Each price spike in the last three decades was followed by an economic recession.

America Must Avert the Impacts of Global Warming.

Even the US Supreme Court now recognizes that global warming is a reality that must be confronted. The science is clear that we are causing global warming. Human activity is responsible for the earth's rising temperature. Burning fossil fuels like oil, coal, and natural gas is putting heat-trapping gases into the atmosphere.

¹ Kraemer, Thomas D. "Addicted to Oil: Strategic Implications of American Oil Policy." U.S. Army War College. March 15, 2006.

We are already seeing the impacts of global warming. 19 of the hottest 20 years on record have all occurred since 1980. The recent IPCC report made it clear that we are experiencing climate change, which is disrupting communities.

In order to avert the worst impacts of climate change, scientists tell us that we must reduce global warming emissions 80 percent below 1990 levels by 2050. Unless we begin to act now to address global warming, we will face serious consequences.

Global Warming Puts Our Economy at Risk.

According to the recently released report by Sir Nicholas Stern (Head of the UK Government Economic Service and former World Bank Chief Economist) the total cost to the global economy if we fail to address rising global warming emissions is \$3.68 trillion. Further, the Stern report stated that we can stabilize the climate at a cost of about one per cent of annual global output by 2050. If no action is taken, climate change will reduce global consumption per head by between five and 20 per cent. In other words, \$1 invested now can save \$5 later. Solving global warming will create markets for new clean energy technology, spurring economic investment and job creation.

Global Warming Puts Our Environment at Risk.

According to the recent IPCC report, 20-30 percent of assessed plant and animal species on Earth are at risk of extinction if the increase in global average temperature exceeds 2.3-4.1°F (1.3-2.3°C). The IPCC report also warns that extreme weather events such as heat waves, droughts, fires, wildfires, floods, and severe storms will become more intense and/or frequent and we can expect a host of impacts on human health and economic well-being. Rising sea levels threaten coastal communities and island nations. Finally, the World Health Organization has reported that global warming is leading to at least 5 million additional cases of illness and more than 150,000 premature deaths each year.

Global Warming Threatens National Security

Climate change and disruption will put pressure on populations with scarce resources, creating competition for those resources and sparking conflict. At the same time, decreasing crop yields, drought, rising sea levels and other climate impacts will create new refugee populations, further destabilizing already vulnerable regions. Over 200 million people live in coastal cities and low-lying countries which would be affected by rising sea levels.

This was recently summarized in a report for the military prepared by Peter Schwartz of the Global Business Network, who warned that greater climatic variability – regardless of its details – would create enormous instability in societies already under stress. “Just look at Somalia in the early 1990s. You had disruption driven by drought, leading to the

collapse of a society, humanitarian relief efforts, and then disastrous U.S. military intervention. That event is prototypical of the future.”²

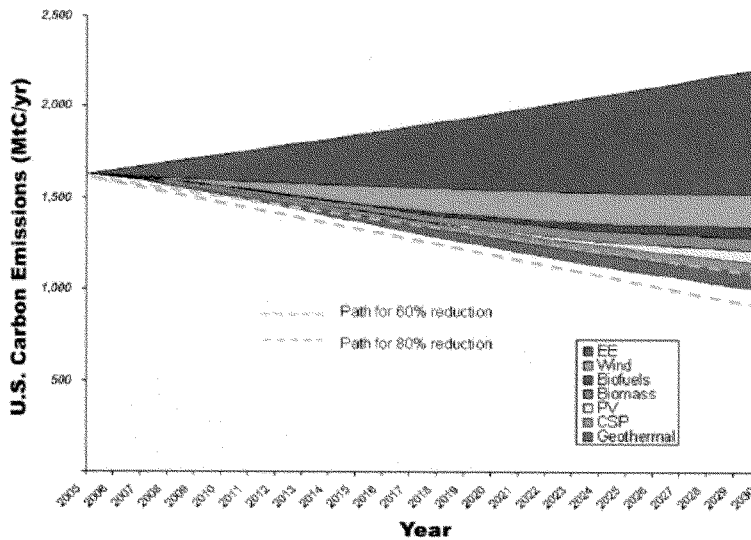
IV. We Have the Smart Energy Solutions Needed to Meet this Challenge

We can address global warming and cut America’s oil dependence by increasing the fuel economy of American vehicles, expanding energy efficiency, investing in renewable energy and clean, renewable fuels, and by setting a national cap on global warming emissions.

We Have a Road Map for How to Respond.

In January, the Sierra Club released a report in cooperation with the American Solar Energy Society that laid out the possibilities for aggressively pursuing energy efficiency and renewable energy to displace carbon emissions. Written by many of America’s leading researchers at our national laboratories and universities, it found that, simply by exploiting existing efficiency and renewable energy technologies, we can be well on our way by 2030 to a 60-80 percent reduction in global warming emissions that are needed.

Figure 1: Potential carbon reductions in 2030 from energy efficiency and renewable technologies and paths to achieve reductions of 60% and 80% below today’s emissions value by 2050.³



² Andrew C. Revkin and Timothy Williams. “Global Warming Called Security Threat.” *New York Times*. April 15, 2007

³ Charles F. Kutscher, Ed. “Tackling Climate Change in the U.S.” American Solar Energy Society. January 2007. http://www.ases.org/climatechange/climate_change.pdf

Transportation – Fuel Economy & Clean Fuels

The greatest opportunity to simultaneously reduce global warming emissions and cut America's oil dependence comes in the transportation sector. Transportation accounts for 60 percent of U.S. oil consumption and one-third of U.S. global warming pollution.

Specifically, most of the progress can be made with passenger vehicles. Making our cars and trucks go farther on a gallon of gas is the biggest single step we can take to cutting our oil dependence, curbing global warming, and saving consumers money at the gas pump. The technology exists today to make all vehicles – from sedans to SUVs to pickup trucks – go farther on a gallon of gas.

According to a 2002 report by the National Academy of Sciences, the technology exists today to raise fuel economy by at least 4 percent per year over the next ten years. Taking this step would save over 3 million barrels of oil per day by 2025 – more oil than we currently import from the entire Persian Gulf. It would also keep 523 billion metric tons of global warming pollution out of the atmosphere each year, while saving consumers \$31 billion dollars per year in reduced gasoline costs.

We know that raising fuel economy standards is an effective tool to reduce U.S. oil consumption. When Corporate Average Fuel Economy (CAFE) standards were first adopted in 1975, they doubled the fuel economy of new vehicles within ten years. According to the National Academy of Sciences, had Congress not taken this step, today the United States would consume an additional 2.8 million barrels of oil per day, making CAFE the nation's most successful oil savings law ever passed.

The Sierra Club urges Congress to raise CAFE standards by at least 4 percent per year. Specifically, the Sierra Club supports the Markey-Platts CAFE legislation, H.R. 1506.

In addition to improving fuel economy, we have an opportunity to expand the use of renewable fuels, such as cellulosic ethanol. If produced correctly, cellulosic or 'non-food' ethanol releases 85 percent less global warming pollution than conventional gasoline. However, we should aggressively work through the significant economic and technological barriers that remain to converting to cellulosic ethanol and develop realistic targets for how large a role ethanol can play in reducing U.S. oil consumption. Increasing fuel economy helps buy time to allow cellulosic ethanol to progress. It also will ensure that U.S. vehicles maximize the benefit of each gallon of ethanol by using it more efficiently. The Sierra Club urges Congress to support development of cellulosic ethanol and other low-carbon fuels.

Renewable Energy and Energy Efficiency

In addition to the gains that can be made in the transportation sector, we can create new clean energy sources by shifting electricity production towards greater production of

clean renewable energy sources, like wind and solar power. At the same time, we need to ensure that our economy becomes more energy efficient.

Over a third of US global warming emissions come from electricity production. Coal-fired power plants are the largest source of global warming pollution in the US. While less than 2 percent of electricity production is generated with oil, a clean and efficient electrical grid would allow technologies such as plug-in hybrid vehicles to play a significant role in reducing oil consumption when the technology becomes ready for the market.

We recommend that Congress adopt a national Renewable Energy Standard requiring that 20 percent of U.S. electricity come from renewable energy sources by 2020. Already, 22 states have adopted these standards, including Texas under Governor George W. Bush. Some of these states have requirements that exceed what has been proposed in Congress. Minnesota recently adopted a 30% Renewable Energy Standard by 2020, while New Jersey has a 22.5% by 2020 requirement and New York is poised to get 24% of its electricity from renewable sources by 2013.

Developing renewable energy sources not only reduces global warming emissions, it also spurs economic development and new jobs. The Sierra Club supports the Udall-Platts Renewable Energy Standard (H.R. 969)

Finally, the cheapest, cleanest, and quickest way to reduce global warming emissions from the utility sector is through energy efficiency programs. Just like renewable energy, many states are leading the way on energy efficiency programs. The Sierra Club supports the adoption of a nation energy efficiency resource standard (EERS) that puts the nation's electric sector on a dependable track toward greater efficiency, mandating that utilities become at least 10 percent more energy efficient by 2020.

Comprehensive Global Warming Legislation

The United States must enact a comprehensive global warming policy that combines a declining greenhouse gas emissions cap with aggressive standards for high-emission sectors. Scientists have singled out the coming decade as a critical period in which the nation and the world need to reverse the growth of global warming emissions and begin to make net reductions. We believe that aggressive regulatory measures to make vehicles more fuel efficient, accelerate the penetration of renewable energy technologies, and spur efficiency gains in the electric and natural gas sectors are critical to responding to that short term scientific challenge.

The Sierra Club supports a gradually declining cap on global warming emissions to achieve an 80% reduction in emissions below 1990 levels by 2050. The U.S. government should auction off these emission credits in order to provide an equitable and market based mechanism to distribute allowances.

Comprehensive legislation would send a strong message to capital markets and the industry that there will be real constraints on carbon, helping to shift investment into low-carbon energy technology. It is important to understand that a declining economy wide carbon emission cap and steadily increasing performance standards in each energy sector are both essential and mutually complementary. As General Electric's Jeffrey Immelt has said "the market does not work in energy."⁴

The lack of innovation in the energy sector is the result of systematic market failure within sectors, as well as the lack of appropriate internalization of the cost of pollution emissions economy wide. Those who design and manufacture automobiles do not pay the gas bills; those who construct houses do not pay the utility bills; in many cases electrical utilities are allowed to pass on to the ratepayers and even make profits from the costs of inefficiency or fossil fuel dependence, but are prohibited from making a profit from efficiency or renewables.

We need both sector by sector reform and an economy wide carbon cap.

Liquid Coal – The Wrong Way to Go

The Bush Administration last week announced that it favored substituting coal based motor fuels for those based on oil. Alexander Karsner, assistant secretary for renewable energy at the Energy Department told the Senate, "The President is the one who has a National Security Council report every morning that is driving his thinking on the urgency of displacing gasoline consumption. America should throw all of its resources at this problem."⁵

Producing motor fuel from coal may look attractive to many as a way to reduce imports of foreign oil, but its costs far outweigh its benefits. We cannot solve a problem by making it worse. Widespread use of liquid coal will send us hurtling in the wrong direction on global warming – most likely doubling the emissions from every car that uses coal liquids.

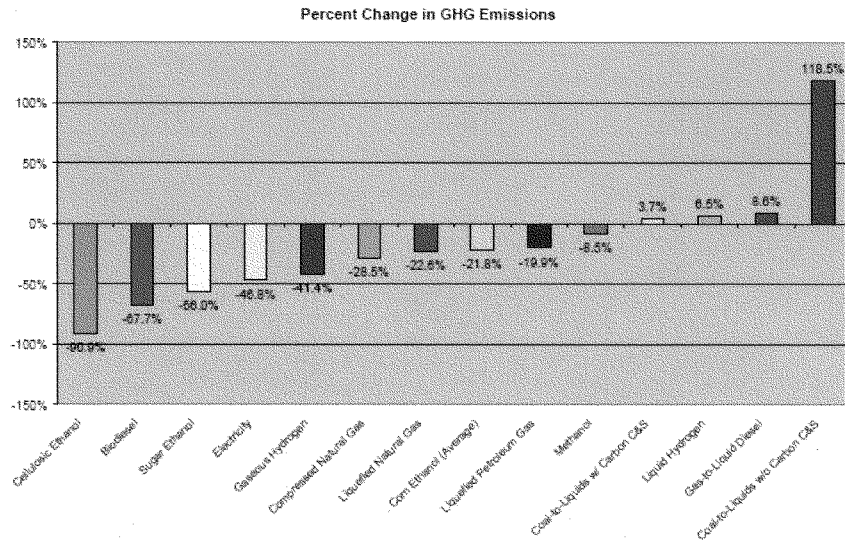
While the Sierra Club has serious concerns that carbon capture and sequestration is technically feasible, even if it were mandated and worked for any and every liquid coal plant, production and use of the fuel would result in a 4-15 percent increase in global warming gases over and above that emitted in the current petroleum fuel cycle.

⁴ Friedman, Thomas L. "The Power of Green." *The New York Times*. April 15, 2007.

⁵ Efstathiou Jr., Jim. "Bush Presses for Coal Liquids to Cut Gasoline Use" *Bloomberg*. April 12, 2007.

Without mandatory and effective carbon capture and storage from day one at liquid coal plants, the technology is a global warming nightmare.

Figure 2 – Comparative Greenhouse Gas Emissions by Fuel Type⁶



In addition to taking the country backwards on global warming emissions, liquid coal does not make economic sense. According to the Department of Energy, an individual liquid coal plant would cost approximately \$7 billion. As a result, creating a commercial scale liquid coal industry would be incredibly expensive. Since the industry is already looking to Congress for loan guarantees and guaranteed markets, liquid coal would end up costing American taxpayers billions and billions of dollars. This is an irresponsible use of taxpayer dollars when there are cleaner, cheaper, and more effective solutions to America's oil dependence.

If coal is used to generate electricity, and the carbon emissions from the power plant are captured and sequestered, then indeed by being used in a fleet of plug-in hybrids America's coal reserves – if responsibly mined and cleanly burned – can become part of the solution to both global warming and oil imports. But not by being turned into coal liquids.

⁶ U.S. EPA. Office of Transportation and Air Quality. *Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuels Use*. EPA420-F-07-035 April 2007

V. Conclusion

Congress has an important role to play in developing policies that will cut America's oil dependence and curb global warming. This Committee has the opportunity to lead Congress in carrying out that role.

Congress should act now to raise fuel economy standards, invest in renewable energy and energy efficiency, move forward on clean, renewable fuels, and adopt economy-wide caps on global warming emissions.

When I was growing up I used to ask my father – repeatedly, “Daddy, what did you do in the war?” Children borne today may turn to us and ask, “What did you do in the Warming?” I urge this Committee to lead us all towards an answer that we can give with pride – that America led the world back from the precipice of climate collapse and climate conflict.

The CHAIRMAN. Next we are going to hear from Vice Admiral Dennis McGinn who served in the United States Navy for 35 years, where he commanded aviation squadrons in the Coral Sea, the aircraft carrier USS *Ranger* in the Western Pacific and the Indian Ocean, and rose to become commander of the U.S. Third Fleet in the Pacific.

In 2000 Admiral McGinn became the Pentagon's first deputy chief of Naval Operations, Warfare Requirements and Programs. Upon retirement he joined Battelle as Vice President for Strategic Planning. Welcome, Admiral. Whenever you are ready, please begin.

STATEMENT OF VICE ADMIRAL DENNIS MCGINN, USN, (RET)

Admiral MCGINN. Thank you, Mr. Chairman, Mr. Sensenbrenner, members of the committee. It is an honor for me to appear along with my fellow witnesses at this inaugural hearing of this very, very important panel. I believe that our dependence on oil in general and, in particular, imported oil from unstable areas of the world does in fact constitute a national security threat and one that is growing every day.

Our Nation uses 25 percent of the world oil supply on an annual basis. We have, a best estimate, about 3 percent of the oil reserves in the world. If we were to make a sudden discovery of a new oil reserve tomorrow and doubled that reserve to 6 percent, we wouldn't be much better off.

So when we start looking for solutions that try to get us other sources of oil from domestic sources, we have got to recognize that it is only a very, very marginal improvement in the situation of our dependence on oil.

If you consider that in October of this year our Nation's population passed 300 million, the world's population passed 6.5 billion, and those numbers are going up. If you multiply those numbers by per-capita energy consumption, particularly in emerging areas of the world like China and India where they have a very understandable expectation of a higher quality of life and a higher economic outcome, it is not a sustainable situation for us to continue to use oil and hydrocarbon-based energy at the rate that we have been during this very successful age of oil that has brought us to today.

Additionally, in addition to our concern from a national security perspective on dependence on foreign oil and our nonsustainable consumption rate of oil based against reserves, the production of the byproducts of oil, greenhouse gases, does in fact constitute a national security threat. It is one that we are seeing today in certain manifestations and it is one that I can guarantee will get greater and greater with each passing year. It is only a matter of time.

Taken in combination, the fact that we have a national security threat due to oil dependence and the fact that we have a national security threat that exists today and will grow inevitably in coming years makes this a very, very great challenge for the American people. It is a challenge that has been described as one fitting a solution like the Apollo Program or the Manhattan Project or the New Deal. I believe that there are aspects of all of those programs that

could be applied to meeting America's energy challenge and environmental challenge.

But I think that we need to get started now and we need to do that in a very, very balanced way. There is no silver bullet solution. There is not any specific form of renewable energy that is going to lead us out of this dependence on oil. There is no energy-efficiency technology, taken in and of itself, that will suddenly reduce our greenhouse gas production nationally and globally.

It is the right kind of technologies, the right kinds of solutions, taken in combination with the right kinds of national leadership and policy that will allow us to meet this challenge. And it isn't a challenge that I view negatively; it is a challenge that I think has tremendous potential for great outcomes.

It isn't zero sum; if we solve our dependency problem, then we must lower our economic standard of living. If we suddenly reduce our emission of greenhouse gases, we must accept a reduction in our quality of life. It is in fact an opportunity, a challenge that creates enormous opportunities for our economy in producing different forms of energy and renewable, different technologies and different procedures for squeezing every bit of good economic output out of every unit of electric energy or liquid fuel for transportation, and it is a challenge that creates the opportunity for true global leadership.

The United States has been very, very blessed by the age of oil. The age of oil is not sustainable. We can lead into the next age of clean and abundant energy which will solve enormous challenges not just in our own borders but throughout the world.

Mr. Chairman, I would like to submit my written testimony for the record and I look forward to your questions.

The CHAIRMAN. Without objection, it will be included in the record. I thank you, Admiral, very much.

[The statement of Admiral McGinn follows:]

Statement of Vice Admiral Dennis McGinn, USN, Retired,
House Select Committee on Energy Independence and Global Warming

Hearing on the Geopolitical Implications of Rising U.S. Dependence on Imported Oil and Rising
Global Temperature. Washington, DC, April 18, 2007

Mr. Chairman, Members of the Committee, Ladies and Gentlemen, it is an honor to appear before you today to discuss these critically important topics of energy independence and global warming. Thank you for the opportunity to share my views which are based on over thirty-five years of service to the Nation in the United States Navy and as a senior executive involved on a daily basis with the science and technology of energy, transportation and the environment.

The rationale and urgency for holding this important hearing was clearly underscored by the world's leading scientists earlier this month in their warning to the world that we have ten years to change our collision course with global warming catastrophe.

Today, I'd like to talk about the national security impacts of our oil dependency right now, and not just in ten years.

Our continued dependence on oil constitutes a clear and present danger to our national security — economically, militarily and diplomatically.

- Data from the Energy Information Administration indicates that we imported about 60 percent of our oil and other petroleum products in 2006. Last year alone, our net imports were more than 12 million barrels per day.
- The United States consumes 25 percent of the world's annual petroleum production and depends on oil to supply 97 percent of its transportation fuels. Yet the U.S. holds only 3 percent of the world's oil reserves, while two-thirds of reserves are situated in that core of global instability, the Persian Gulf.
- As a key member of the global economic community, we must rely on foreign energy sources, with many of them hostile and in unstable regions, to provide us with our economic lifeblood and quality of life.
- Our burgeoning demand for oil weakens U.S. diplomatic leverage around the globe, burdens our armed forces and leaves the U.S. vulnerable to unstable or hostile regimes.

U.S. oil dependency weakens U.S. leverage, undermines foreign policy and leaves us vulnerable to unstable or hostile regimes.

- According to a new Rice University study, 77 percent of the world's 1.148 trillion barrels of proven reserves are in the hands of the national companies; 14 of the top 20 oil-producing companies are state-controlled.ⁱ

- With oil at \$60 a barrel, \$500,000 a minute is flowing out of our country, increasing our trade deficit, and putting money into the hands of some regimes that are hostile to our interests.
- Last year Iran's supreme leader, Ayatollah Ali Khomeini warned that "if the Americans make a wrong move toward Iran, the shipment of energy will definitely face danger and the Americans would not be able to protect energy supply in the region."ⁱⁱ
- In the southern hemisphere, we seem to be on a collision course with Venezuela's President Hugo Chavez over access to some of the most coveted energy resources outside the Middle East. Chavez represents a direct threat to the advances of democracy and free markets in our Hemisphere. The false promises of his populist appeal in Latin America have been compared with the pan-Arabism of Col. Muammar el-Qaddafi of Libya two decades ago.ⁱⁱⁱ
- Terrorist networks have openly called for and carried out attacks on the global oil infrastructure because they know oil is the economic lifeblood of the U.S.

U.S. oil dependency burdens our military forces and exacts a huge price tag in protecting sea-lanes, military bases of operations and maintaining continuous high level of forward presence

- Our fine men and women in the Armed Forces serve our nation with honor, protecting American interests throughout the globe. The major focus of their activities for nearly thirty years has centered in the Middle East, a region from which so much of the instability, strife, root causes of terrorism and Arabian Gulf oil flow.
- The October, 2000 terrorist attack on the USS Cole, while on a refueling stop in Yemen, was a tragic reminder of the convergence of oil, instability, terrorism and the need for ever vigilant presence by American servicemen and women who are forward deployed.
- Recent energy-market disruptions and increasing awareness of the vulnerability and insecurity of supplies world-wide have added urgency to the U.S. military's efforts to curb its use of oil and other fuels.^{iv}
- One study estimates that in peacetime the "true" cost of oil in a given year is \$800 billion dollars, assuming 2004 oil prices.
- Retired Air Force General Charles Wald estimates that if the true cost of military security were incorporated into the price of gasoline, we would be paying between \$6.50 and \$7 a gallon.

The economic impact of our oil dependency threatens national security

- We lose \$25 billion from our economy every month, and oil imports now account for nearly a third of the national trade deficit. Our economy is exposed on a daily basis to oil price shocks and supply disruptions.
- Every event overseas – Iran’s capture of British soldiers, Nigeria rebels warn of attacks on oil industry – causes our stock market to roil.
- There are nightmare scenarios – likely more than conjecture at this point – that are already having an impact on our economy. The Wall Street Journal recently wrote about oil traders’ concern over an obstruction of oil traffic through the Persian Gulf. Under the scenario, Iran, in a bid to preempt or respond to U.S. military action, closes the Strait of Hormuz, the Persian Gulf chokepoint through which 20 percent of the world’s oil supply passes. The consequence would be swift: by most experts’ reckoning, oil prices would soar to \$100 a barrel and even higher, potentially plunging the world economy into a depression.^v
- A Wall Street Journal survey of economists found strong support for government intervention in the transition away from fossil fuels. When asked to pick the greater geopolitical threat to the economy, by nearly a 3-to-1 margin the economists chose a disruption in crude oil supplies caused by tensions in the Mideast over the impact on spending and confidence that could follow a major terrorist attack.^{vi}

Our oil consumption puts money in pocket of terrorists

- Former Republic National Committee Director of Communications Clifford D. May wrote, “Every time we fill the tanks of our cars with gasoline we put money in the pockets of terrorists intent on killing Americans.”^{vii} (SHNS) *Diversity can Pave 1/25/07*

There is great urgency to reverse our dependence on oil

The urgency is two-fold. As a result of our increasing oil consumption: 1) Our dependency on unfriendly regimes is increasing not decreasing; 2) The impacts of global warming emissions, if not swiftly and significantly reduced, will have profoundly negative national security impacts.

The world oil supply is tightening as demand surges leaving little elasticity in a very volatile market and creating increased U.S. reliance on the Middle East.

- Energy analysts expect global oil-demand growth to surge this year to an additional 1.39 million barrels a day from growth of 800,000 bpd in 2006, according to a new Reuters’ poll. OPEC’s biggest producer, Saudi Arabia, may be incapable of raising its production any time soon.^{viii}
- Government data shows U.S. crude and gasoline stockpiles are much lower than analysts had forecast.^{ix}

- Oil analysts say that the market has not fully recognized the constraints on oil supply in Venezuela, Iran and Kazakhstan. Other factors favoring higher prices: rapidly rising demand in China and India, and the location of much of the world's oil reserves in politically volatile and unstable countries. ^x
- Mexico's oilfield Cantarell -- one of the largest offshore oil fields ever found -- is dying, losing a staggering one-fifth of its production, with daily output falling to 1.6 million barrels from two million within the last year. Cantarell, which currently produces one of every 50 barrels of oil on the world market, is fading so fast analysts believe Mexico may become an oil importer in eight years. ^{xi}
- The continued deterioration of the world's second-biggest field by output puts pressure on prices on the global oil market, where supplies are barely keeping up with growing demand as it is. **Our growing dependence would leave the U.S. even more dependent on Middle Eastern supplies -- and that much more vulnerable to political tumult in that region.** ^{xii}
- Some predict we will reach peak of oil production within a few years, others say peak oil won't arrive until 2030 or later. In either case, our demand is going in the opposite direction while oil is getting harder and more expensive to extract.
- OPEC, which added Angola as its newest member this year, will likely see its clout reinforced in coming years as it is poised to control more than 50 percent of the oil market in coming years, up from 35 percent today. ^{xiii}

The threat of climate change is a national security matter

Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world.

- The Center for Naval Analysis (CNA) this week released a report contracted by the federal government warning that in the national and international security environment, climate change threatens to add new hostile and stressing factors. On the simplest level, it has the potential to create sustained natural and humanitarian disasters on a scale far beyond those we see today. The consequences will likely foster political instability where societal demands exceed the capacity of governments to cope. ^{xiv}
- Not only will global warming disrupt the environment, but its effects will shift the world's balance of power and money. ^{xv}
- The world's leading scientific panel on climate change -- including more than 200 scientists and officials from more than 120 countries and the U.S. -- released its most detailed portrait on the impacts of human induced climate change, predicting widening droughts in southern Europe and the Middle East, sub-Saharan Africa, the American Southwest and Mexico, and flooding that could imperil low-lying islands and the crowded river deltas of southern Asia. ^{xvi}

- Without action to curb carbon emissions, man's livable habitat will shrink starkly, said Stephen Schneider, a Stanford scientist and IPCC report author. "Don't be poor in a hot country, don't live in hurricane alley, watch out about being on the coasts or in the Arctic, and it's a bad idea to be on high mountains with glaciers melting." "We can fix this," by investing a small part of the world's economic growth rate, said Schneider. "It's trillions of dollars, but it's a very trivial thing." ^{xvii}
- James Hansen, a pioneering climate researcher at NASA's Goddard Institute and at Columbia University, says, "If human beings follow a business-as-usual course, continuing to exploit fossil fuel resources without reducing carbon emissions or capturing and sequestering them before they warm the atmosphere, the eventual effects on climate and life may be comparable to those at the time of mass extinctions." ^{xviii}

Ignoring global warming undermines U.S. international leadership and influence

- The United States will emit about 20 percent more greenhouse gases by 2020 than it did in 2000, according to a draft report that the Bush administration was scheduled to submit to the United Nations a year ago. ^{xix}
- The harmful effects of global warming on daily life are already showing up, and within a couple of decades hundreds of millions of people will not have enough water, according to the authoritative IPCC. "Things are happening and happening faster than we expected," said Patricia Romero Lankao of the National Center for Atmospheric Research, a report co-author. ^{xx}

Climate change, national security, and energy dependence are an interrelated set of global challenges. As President Bush noted in his 2007 State of the Union speech, dependence on foreign oil leaves us more vulnerable to hostile regimes and terrorists, and clean domestic energy alternatives help us confront the serious challenge of global climate change. Because the issues are linked, solutions to one affect the other. Technologies that improve energy efficiency also reduce carbon intensity and carbon emissions. ^{xxi}

Without swift and serious legislative action and investment, the U.S. will continue barreling headlong toward the catastrophic national security, economic and human suffering effects of climate change.

Key principles for reducing oil dependence and greenhouse gas emissions

First and foremost, the size and speed of the solution must match the size and speed of the problem.

We must solve our oil dependency problem within the context of global warming – to do otherwise would be at the risk of our national security.

The solution must include market and mandates. We cannot do one without the other

- Key players in the global market are already responding to their perception of regulation certainty. The right kind of regulations can create certainty and spur the market to a much more stable and productive future. Leading international businesses, investors and industry sectors recognize this fact and are asking for market certainty through an effective, long-term cap on emissions.
- The Electric Power Supply Association, representing one-third of U.S. power generation and some of the biggest global warming pollution emitters, concluded it is likely to get hit with a U.S. emissions cap whether it wants it or not and that it behooves it to try to shape eventual policy. ^{xxii}
- ConocoPhillips recently became the first U.S.-based oil company to join ten of the nation's largest companies, including GE, DuPont and Duke Energy, to call for mandatory cuts in global warming emissions. Such action likely means higher costs for these companies, but they fear the Administration's failure to engage will leave them with a hodgepodge of state and foreign restrictions. ^{xxiii}
- A well-structured cap and trade system would have modest economic impacts, but would create new industries and jobs and put the U.S. on the cutting edge of what will become a multi-billion dollar clean energy and environmental technology market.

The solution must include upstream and downstream performance standards for cars and trucks, whether by CAFE or by tailpipe emissions standards. Significantly improved standards are good for reducing oil dependency AND greenhouse gas emissions, as well as for improving consumer value and automakers' competitiveness.

- Vehicles are the source of 20 percent of U.S. greenhouse gas emissions and 40 percent of our oil dependency
- By mid-century, the world's vehicle population is expected to reach 2 billion, almost triple the current figure. To keep global vehicle emissions near today's levels, the average fuel economy of cars and trucks would have to rise to about 60 mpg in 50 years or less, according to calculations by the Carbon Mitigation Initiative at Princeton University, a research effort funded in part by Ford. ^{xxiv}
- In addressing this challenge, we must include performance standards for fuels BUT also must include vehicle performance standards – whether fuel economy or greenhouse gas tailpipe emissions standards – for both the oil industry AND the auto industry.

Corporate Average Fuel Economy Standards (CAFE) work.

- After Congress set fuel economy standards for vehicles in 1975, our dependence on oil imports decreased very quickly from 46 percent in 1977 to 27 percent in 1985, while consumers saved billions at the pump.
- Ten years of CAFE saved the U.S. billions in oil and money. Without standards that forced automakers to increase fuel economy from the 1975 level to today's 25 mpg, we

would be using an additional 80 billion gallons of gasoline on top of the 140 billion gallons we will use this year. That would represent an increase in oil demand by 5.2 million barrels of oil per day, or a 25 percent increase in our oil addiction. At today's average price for regular gasoline, about \$2.50 per gallon, that represents \$200 billion dollars saved.

- Even today, these standards continue to save nearly 3 million barrels of oil per day, according to the National Academies of Sciences. Since 1985, however, fuel economy has been stagnant and our imports have grown.
- IF CAFE hadn't stalled, the U.S. would have saved billions more in oil and dollars, especially in light of tremendous advances in technology available to improve fuel economy.
- The United States is falling behind other nations pushing for better fuel economy as concerns mount over global warming. Even China, oft touted as the reason why the U.S. shouldn't act, has tougher fuel economy standards.^{xxv}

Voluntary action does not work.

- Because the automakers did not meet voluntary agreements to reduce greenhouse gas emissions, the European Commission in Brussels is moving mandate automakers to limit carbon-dioxide emission to an average of 130 grams per kilometer for all new cars by 2012.^{xxvi}

Performance standards could restrict emissions rather than mileage.

- Performance standards could follow California's lead by restricting the greenhouse gas emissions from tailpipes. Together, the populations of "clean car states" now account for more than 30 percent of the nation's market for new vehicles. Maryland's legislature recently joined the list of states adopting California's standard.^{xxvii}
- Performance standards accomplish energy savings and pollution reduction benefits without heavy taxpayer support or the government telling consumers how to behave.

Clean energy performance standards save consumers money and create new jobs.

- Our federal appliance and equipment standards will save consumers about \$230 billion by 2030 -- \$2,300 per household.^{xxviii}
- Automakers have spent the past twenty years using similar technologies to nearly double power and increase weight by twenty-five percent instead of increasing fuel economy.^{xxix}
- James Hansen of NASA's Goddard Institute and at Columbia University, says that the biggest obstacles to avoiding greater climate disaster are utility plants and motor vehicles that use too much fuel. "Automakers oppose efficiency standards and prominently advertise their heaviest and most powerful vehicles, which yield the greatest short-term profits."^{xxx}
- Americans do not have to sacrifice safety, comfort or utility in their vehicles in order to achieve much greater fuel economy. The technology advances that have been used for

power and weight, which can now be directed to fuel economy. Data in the 2002 report by the National Academies of Sciences on CAFE indicate that the technology exists to reach 37 mpg in a fleet of the same make-up as the NAS analyzed, even ignoring hybrids and cleaner diesels.^{xxxii}

- Paul Portney, chair of the NAS committee, noted that, “It might be possible to meet more stringent fuel economy standards at lower costs than the committee foresaw.”^{xxxii}
- Dr. Walter McManus, a former GM market analyst now at the University of Michigan, reported recently that if U.S. automakers increased their energy efficiency to accommodate increasingly conservation-minded customers, they could collectively increase profitability by \$2 billion in model year 2010. Following their current plans, Dr. McManus concluded, they are projected to lose \$3.6 billion that year.^{xxxiii}

The dilemma the Detroit automakers face is that while they may believe that they cannot afford to make fuel economy a high priority, in actuality, it turns out that they cannot afford not to. In the meantime, they continue to churn out vehicles that increase our nation’s addiction to oil – an addiction even President Bush has said compromises national security in both economic and political terms.

Biofuels are not a silver bullet – they are part of the solution – but not THE solution.

Corn ethanol impacts are greater and benefits are fewer than other biofuels.

- The Proceedings of the National Academy of Sciences (PNAS) published the first comprehensive analysis of the full life cycles of soybean biodiesel and corn grain ethanol that shows biodiesel has much less of an impact on the environment and a much higher net energy benefit than corn ethanol, but that neither can do much to meet U.S. energy demand.^{xxxiv}
- Responding to the “ethanol boom”, corn prices, 75 percent of the cost of ethanol, have doubled in the past six months to more than \$4 a bushel and may head higher still.^{xxxv}
- Soaring prices for farm goods, driven in part by demand for crop-based fuels, are pushing up the price of food worldwide and creating a new source of inflationary pressure. If the trend gathers momentum, it could contribute to slower global economic growth.^{xxxvi}
- Vehicles powered by ethanol get 20-30 percent fewer miles per gallon than they do with gasoline, so in order to reduce spending at the pump any renewable fuels mandate must be coupled with significant improvements to auto fleet efficiency.^{xxxvii}
- At present, only a tiny fraction of U.S. service stations enable a driver to fill up with ethanol, in part due to resistance from oil companies. Although some oil executives voice enthusiasm for alternative fuels, oil-company policies make it harder for many service stations to stock a fuel called E85.^{xxxviii}
- Without tighter fuel economy standards, and before ethanol fuels become widely

available, the more flex-fuel cars and trucks that are produced, the more gasoline is consumed, thereby dramatically increasing greenhouse gas emissions and deepening the country's dependence on petroleum. Union of Concerned Scientists estimates that without the flex fuel loophole in place, the U.S. would have burned 4 billion fewer gallons of gasoline since 1998. " xxxix

- An unprecedented 1.5 million alternative fuel automobiles were sold in 2006, surpassing automaker sales' expectations by 50 percent, and bringing the total number of flex-fuel vehicles on U.S. roads to 10.5 million. ^{xi}
- The automobile industry's preferred options call for conversion to biofuels, requiring them to make relatively low-investment modifications to existing technology. This shortsighted approach will not create the macro solutions needed to address both oil dependency and climate change perils.

The bottom line is we need an approach to vehicle fuel economy that incorporates both upstream fuel choices AND downstream vehicle efficiency.

Coal to liquid is not a solution: this process increases global warming emissions and endangers public health.

- Coal-to-liquid fuels are embraced in the president's proposal. While they may reduce reliance on oil, making the liquid coal fuels and burning them exacerbate global warming. ^{xii}
- Coal-based transportation fuels would result in double the global warming pollution per gallon of fuel as compared with the petroleum-based fuels we use today. The EPA's own recent analysis confirming that liquid coal would result in *100 percent more emissions* than gasoline. ^{xiii}
- Even with carbon capture and disposal at the production end, liquid coal fuels would still result in nearly ten percent more global warming pollution overall.
- Building a liquid coal fuel industry is expensive and would come at the expense of taxpayer subsidies, while potentially leaving private investments stranded in a technology that has no competitive edge in a carbon-constrained market.
- An 80,000 barrel per day liquid coal plant could cost as much as \$7-8 billion. Federal subsidies that support liquid coal would unfairly tilt the playing field away from clean, renewable fuels and reward a mature industry, rather than supporting cutting edge clean fuel and energy efficiency technologies.
- Every public or private dollar invested in liquid coal is a dollar unavailable for investment in efficiency, renewable energy resources, public transportation and consumer incentives that will yield real reductions in global warming pollution.

- Liquid coal fuels would also exacerbate the public health, land and water impacts of coal mining and transport, potentially resulting in doubling of coal mining in the U.S.

We must reduce oil dependence *and* global warming pollution together. Since transportation accounts for a third of U.S. global warming pollution, solving the problem will require a transition toward *lower-carbon* fuel alternatives and more efficient use of whatever fuel goes in the tank. Therefore, any new fuel we make available at the pump should have a significantly better greenhouse gas emissions footprint than the fuels we use today.

The American people, and Michigan citizens, specifically, want the government to take action to reduce greenhouse gas emissions and increase fuel economy.

- A new Gallup poll shows overwhelming support to strengthen government restrictions on greenhouse gas emissions and to spend more taxpayer money to develop alternative energy sources, with 79 percent supporting higher auto emissions standards.^{xliii}
- The latest Detroit Free Press-Local 4 Michigan Poll shows a majority of Michigan citizens favor higher fuel economy standards for cars and trucks, with some supporting increases to 40 miles per gallon or more. Many would pay hundreds of dollars extra for more efficient vehicles. When asked how much they would be willing to pay for an 8-m.p.g improvement in fuel economy for vehicles similar to what they drive now, 47 percent said they would pay \$1,000 to \$2,000 more, and 20 percent said \$500 to \$700.^{xliv}
- At least 300 bills have been filed in 40 states that address heat-trapping gases and climate change in some form, according to the National Conference of State Legislatures.^{xlv} (NYT) *PP Bush Spits with Congress 4/4/07*

Policy Recommendations

We can no longer afford an energy policy that undermines our national security by funneling billions of dollars to our enemies around the world, and continues to increase emissions of heat trapping gases that cause global warming. Our oil dependence and global warming problem require immediate and comprehensive action from Congress in order to address both challenges together.

Scientists warn that we have only a short window for action to prevent catastrophic global warming. Delay -- as many recent economic studies reveal in sharp relief -- would make emissions reduction more difficult and more costly than action now.

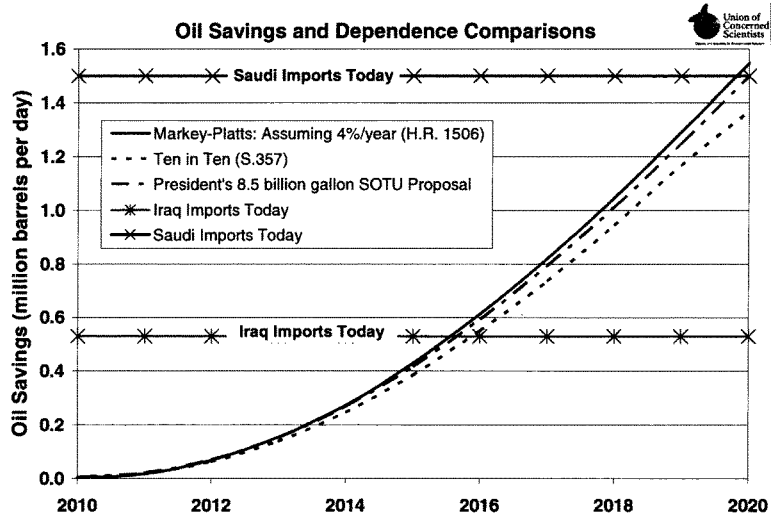
To address both challenges together we need both an economy-wide cap on global warming pollution that will provide long-term certainty and guarantee emissions reductions, as well as sector-specific strategies to jump-start emissions reductions. In the case of the transportation, sector performance standards for vehicles and fuels, in addition to a cap,

are essential to guarantee meaningful oil savings, and thereby benefits to our national and economic security.

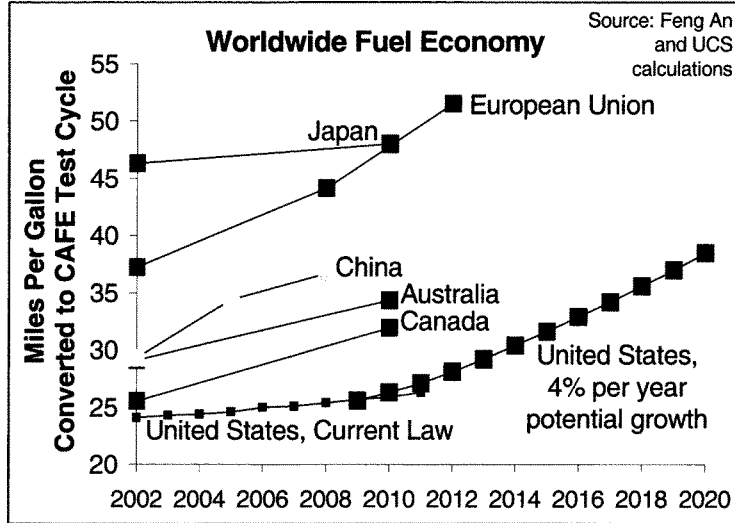
In the immediate term, I urge the Congress to:

- Enact an economy-wide, long-term declining cap on emissions from all sectors that would reduce global warming pollution by 2 percent per year from current levels, reaching an 80 percent reduction by 2050. This is the greenhouse gas emission reduction level that scientists advise is necessary to prevent catastrophic global warming.
 - ⇒ The Wall Street Journal editorialized, “By far the biggest question, however, is where the cap is set. The trading of emissions credits does nothing to lower the quantity of emissions – it merely shifts around the right to emit. It’s the cap that sets the amount of CO2 put into the air. ... When the EU started emissions trading in 2005, the price of a ton of CO2 quickly tripled before cratering when participants realized that the cap hadn’t been set low enough to create a genuine shortage.”^{xlvi}
- In conjunction with an economy-wide cap, raise vehicle fuel economy standards to at least 35 miles per gallon by 2018 – the level recommended by the National Academies of Sciences and consistent with the President’s proposal of 4 percent per year improvement. By making this level of improvement binding, rather than leaving it up to the administration, we could save as much oil as we currently import from the Persian Gulf, benefiting our economy and our long-term strategic interests.
 - ⇒ Congress should follow key steps to realize oil savings and emissions benefits from available vehicle technology:
 - Require at least 35 mile per gallon fuel economy for cars and light trucks by 2018, and regular rate of improvement thereafter
 - Give the administration flexibility to restructure the standard, but do not leave goal-setting up to the administration
 - Provide consumers and/or automakers with economic incentives to invest in technology for increasing fleet wide fuel economy
- Establish a low-carbon performance standard for transportation fuels that will reduce the carbon content of our fuel mix over time. This will ensure that fuel providers share the obligation with auto companies in reducing emissions, and that investment flows toward cleaner, sustainably made fuel, rather than dirtier fossil fuel alternatives.
 - ⇒ Governor Schwarzenegger recently proposed such a standard in CA, requiring fuel providers to reduce the carbon intensity of their fuel mix by 10 percent by 2020. This is a good model for the federal level, since it is technology neutral and lets the market decide which low-carbon fuels are most viable.

Current congressional proposal will have significant impact on our oil dependency.



As the chart below shows, while a 4 percent per year path would still leave us 7 years behind Australia, 9 years behind China, and more than 15 years behind the European Union, the 4 percent per year path would cut oil dependence, slow global warming, and save consumers billions at the pump.



Finally, I urge Congress to take these additional immediate actions to

reduce global warming pollution:

- Establish a Renewable Electricity Standard (RES) requiring 20 percent of electricity to be produced from renewable energy by 2025.
- Establish Energy Efficiency Resource Standard, so electric and natural gas utilities save a certain percentage of the energy they sell through energy efficiency.
- Extend tax incentives for energy efficiency and renewable energy, using performance-based incentives that reward actual environmental benefits. These incentives should be provided in a manner that will have a positive, predictable and long lasting effect on the implementation of policies and the deployment of technologies that will make a measurable difference.

Conclusion

Our actions as Americans cannot stop with these measures. As noted earlier – THE SIZE AND SPEED OF THE SOLUTION MUST MATCH THE SIZE AND SPEED OF THE PROBLEM.

Throughout our history, Americans have successfully met critical challenges in both war and peace. Building a new, clean energy economy has become one of the great challenges of our time. Together we can move our Nation toward clean and secure energy supplies with policies that promote energy efficiency and the greatly increased the use of renewable energy. As we have in our Nation's past struggles, dedicated and concerned Americans from every part of the

country will play a key role in decisively winning the energy victory, both as citizens and as consumers.

We have ten years to reverse course – our Nation’s security depends on the swift, serious and thoughtful response of our elected leaders in Congress.

Thank you.

Endnotes

- ⁱ KRAUSS, CLIFFORD and SIMON ROMERO. “In Venezuela, a Showdown Looms Over Oil.” *New York Times* (Apr. 10, 2007).
- ⁱⁱ FARIVAR, MASOOD and IAN TALLEY. “Crisis Sparks Oil-Supply Fear/U.K.-Iran Standoff /Has Traders Pricing /In Risks of a Disruption.” *Wall Street Journal* (Apr. 2, 2007).
- ⁱⁱⁱ KRAUSS, CLIFFORD and SIMON ROMERO. “In Venezuela, a Showdown Looms Over Oil.” *New York Times* (Apr. 10, 2007).
- ^{iv} FARIVAR, MASOOD. “Military Seeks Oil Savings/Rising Demand, Supply Risks/Spur Conservation Move.” *Wall Street Journal* (Jan. 9, 2007).
- ^v FARIVAR, MASOOD and IAN TALLEY. “Crisis Sparks Oil-Supply Fear/U.K.-Iran Standoff /Has Traders Pricing /In Risks of a Disruption.” *Wall Street Journal* (Apr. 2, 2007).
- ^{vi} IZZO, PHIL. “Is It Time for a New Tax on Energy?/Economists Say Government Should Foster/Alternatives – But Not How Bush Proposes.” *Wall Street Journal* (Feb. 9, 2007)
- ^{vii} May, Clifford D. “Diversity Can Pave the Road Toward Energy Security.” *Scripps Howard News Service* (Jan. 25, 2007).
- ^{viii} Gongloff, Mark. “Oil Demand Growth to Double; Can OPEC Meet It?” *Wall Street Journal* (Mar. 8, 2007).
- ^{ix} CHAMBERS, Matt. “Crude, Gasoline Prices Surge/Decline in Imports/Helps Cut Reserves; “Temporary Blip?”” *New York Times* (Mar. 8, 2007).
- ^x Bruner, Jon. “Stock Focus/Sliding Back Into Oil.” *Forbes* (Feb. 2, 2007).

^{xi} LUHNOW, David. "Mexico Tries to Save A Big, Fading Oil Field/Cantarell's Drop-Off/Faster Than Expected/Turning to Technology." *Wall Street Journal* (Apr. 5, 2007).

^{xii} Ibid.

^{xiii} MOUAWAD, Jad. "Oil Innovations Pump New Life Into Old Wells." *New York Times* (Mar. 5, 2007).

^{xiv} CNA Report on "National Security and the Threat of Climate Change" April 16, 2007

^{xv} Informed Reader column "How Global Warming Will Play With Investors" *Wall Street Journal* (March 9, 2007)

^{xvi} (<http://www.ipcc.ch/SPM6avr07.pdf>) KANTER, James and ANDREW C. REVKIN. "Scientists Detail Climate Changes, Poles to Tropics." *New York Times* (Apr. 7, 2007). Jolis, Anne and Alex MacDonald. "U.N. Panel Reaches Agreement On Climate-Change Report." *Wall Street Journal* (Apr. 6, 2007).

^{xvii} MAX, ARTHUR. "Climate report: Poor will suffer most." *Associated Press* (Apr. 6, 2007).

^{xviii} Brown, Peter and Harry Stoffer. "The heat is on/How global warming is closing in on the U.S. auto industry." *Automotive News* (Feb. 7, 2007).

^{xix} Revkin, Andrew, "U.S. Predicting Steady Increase for Emissions." *New York Times* (Mar. 3, 2007).

^{xx} Associated Press Editorial Reprint. "Top Scientists Warn of Water Shortages and Disease Linked to Global Warming." *New York Times* (Mar. 12, 2007).

^{xxi} CNA Report on "National Security and the Threat of Climate Change" April 16, 2007

^{xxii} Ball, Jeffrey. "Electricity Group Backs Emission Caps." *Wall Street Journal* (Feb. 7, 2007.)

^{xxiii} Ball, Jeff "Conoco Calls for Emissions Cap" *Wall Street Journal* (April 11, 2007); Murray, Alan. "Bush Health-Care Plan Finds Business Backers." *Wall Street Journal* (Jan. 24, 2007); BARRINGER, FELICITY. "A Coalition for Firm Limit on Emissions." *New York Times* (Jan. 19, 2007).

^{xxiv} Brown, Peter and Harry Stoffer. "The heat is on/How global warming is closing in on the U.S. auto industry." *Automotive News* (Feb. 7, 2007).

^{xxv} Freeman, Sholnn. "Democrats Plan to Press Automakers on Fuel Efficiency." *Washington Post* (Mar. 10, 2007).

^{xxvi} Hutton, Ray. "Emissions row divides carmakers/Europe's motor industry can't decide how to deal with tough new limits on carbon emissions." *Sunday Times* (Mar. 18, 2007).

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- ^{xxvii} *Washington Post*. "As California Goes." (Feb. 2007)
- ^{xxviii} ACEEE March 2006
- ^{xxix} EPA Fuel Economy Trends Report, 2006
- ^{xxx} Brown, Peter and Harry Stoffer. "The heat is on/How global warming is closing in on the U.S. auto industry." *Automotive News* (Feb. 7, 2007).
- ^{xxxi} NRC, 2002
- ^{xxxii} Portney, Paul. February 9, 2005
- ^{xxxiii} (<http://www.osat.umich.edu/research/economic/FuelEconStrat.pdf>)
- ^{xxxiv} . *PNAS Study Science Daily*. "Environmental Valuation & Cost-Benefit News/Empirical Cost-Benefit and Environmental Value Estimates/Researchers Identify Energy Gains/And Environmental Impacts Of Corn Ethanol And Soybean Biodiesel." (July 13, 2007).
- ^{xxxv} BALL, Jeffrey and LAUREN ETTER. "Volatile Markets May Crimp Energy Plan/Shifting Corn, Oil Prices/Hinder Ethanol's Role/As Gasoline Substitute." *Wall Street Journal* (Jan. 24, 2007).
- ^{xxxvi} MECKLER, LAURA. "PUMP GAMES/Fill Up With Ethanol? □ One Obstacle Is Big Oil/Rules Keep a Key Fuel/Out of Some Stations;/Car Makers Push Back." *Wall Street Journal* (Apr. 2, 2007).
- ^{xxxvii} Shepardson, David. "Bush: Motorists must use more alternative fuel." *Detroit News* (Apr. 10, 2007); Wingfield, Brian. "Impact of New EPA Renewable Fuel Rules Likely Small" *Forbes* (April 10, 2007)
- ^{xxxviii} MECKLER, LAURA. "PUMP GAMES/Fill Up With Ethanol? □ One Obstacle Is Big Oil/Rules Keep a Key Fuel/Out of Some Stations;/Car Makers Push Back." *Wall Street Journal* (Apr. 2, 2007).
- ^{xxxix} Herbst, Moira. "The Dirty Secret about Clean Cars/President Bush and the Big Three are pushing cars that run on ethanol. But the policy may be doing more harm than good." *Business Week* (Mar. 28, 2007).
- ^{xl} Austin, Mike. "Automakers See Unprecedented Alternative Fuel Auto Sales In '06." *CBS 5* (Mar. 29, 2007).
- ^{xli} FIALKA, JOHN. "Energy Mandates Fuel a Rift/ Bush's Proposal Pits Coal Interests/ Against Environmentalists." *Wall Street Journal* (Jan. 26 2007).

^{xlii} . <http://www.epa.gov/otaq/renewablefuels/420f07035.htm>

^{xliii} Saad, Lydia. "Most Americans Back Curbs on Auto Emissions, Other Environmental Proposals/Solid majority opposes drilling for oil in Alaskan wilderness." *Gallup News* (Apr. 5, 2007).

^{xliv} HYDE, JUSTIN. "MICHIGAN POLL/Most favor tougher auto mileage rules, but not at Detroit's expense." *Detroit Free Press* (Mar. 20, 2007).

^{xlv} BARRINGER, FELICITY and WILLIAM YARDLEY. "Bush Splits With Congress and States on Emissions." *New York Times* (Apr. 4, 2007).

^{xlvi} "Review and Outlook/ Cap and Charade." *Wall Street Journal*, Editorial (Mar. 3, 2007).

The CHAIRMAN. Now I turn to our final witness, James Woolsey, who was director of the Central Intelligence Agency from 1993 to 1995, a Rhodes Scholar. Mr. Woolsey is currently the co-chair of the Committee on Present Danger and serves on the National Commission on Energy Policy. He is one of America's most articulate voices regarding the toxic combination of oil and terrorism.

Thank you for being with us. Mr. Woolsey, please begin.

STATEMENT OF R. JAMES WOOLSEY

Mr. WOOLSEY. Thank you, Mr. Chairman. It is an honor to be asked to be here today. We depend on oil for 97 percent of our transportation needs, Mr. Chairman, and oil contributes over 40 percent of the global warming gas emissions that human beings put into the atmosphere from fossil fuels. These numbers are so large because the world uses approximately 1,000 barrels of oil a second and we use in this country approximately 250 barrels per second.

The key here, I believe, is that what we need in the long term is a transportation fuel that is as secure as possible, as clean as possible in global warming as well as in other terms, and as inexpensive as possible. Today oil meets none of these three criteria. It is not just foreign oil, it is oil that doesn't meet these criteria.

Oil is a strategic commodity because we depend upon it so much for transportation. In a sense, salt was a strategic commodity until a little over a century ago because there was no other real way to preserve meat, a major share of people's intake. Wars were fought, national strategies were developed until the late 19th century having to do with salt. Today salt is not a strategic commodity. No nation sways world events because it has salt mines.

I think we have to strive for a similar path of decline, indeed destruction of oil as a strategic commodity; not destruction of oil itself, of course. Like salt, we will find lots of uses for it and will be using it for a long time. But it is this dependence for transportation that is the heart of our problem.

Now national security requirements certainly, I think, dictate us moving away from oil for a number of the reasons that have been mentioned: two-thirds of the world's proven reserves being in the Persian Gulf area; al Qaeda attacks in Abcaiq can risk oil cutoffs; the royal succession in Saudi Arabia is going to be a problem in a few years; Iran's President is a part of a circle around Ayatollah Mesbah-Yazdi that is radical even by Iranian standards; and now six Sunni states have decided they need nuclear programs as well as Iran, since many of these states have huge reserves of oil and gas. One suspects that those nuclear programs, like Iran's, may not be limited to electricity generation.

We borrow over \$300 billion a year, nearly a billion dollars every calendar day to import oil, which weakens our economy and dollar. And if it does that to us, think what it must do for developing countries where debt is the central problem for economic development.

The oil revenues that go to Saudi Arabia and other parts of the gulf are used, directly and indirectly, to spread Wahhabi—the Wahhabi version of Islam around the world. It is essentially the

same ideology as that of al Qaeda. They and al Qaeda disagree only about who should be in charge.

The fatwas of the Wahhabis are murderous, literally, with respect to the Shi'a, to Jews, to homosexuals and apostates, and they are horribly repressive with regard to everyone else including, particularly, women.

So as we fund the dissemination of this ideology around the world, this is the only war the U.S. has ever fought in which we pay for both sides. And as Tom Friedman puts it, the price of oil and the path of freedom run in opposite directions. There is a good deal of academic learning on this, but one needs only to observe Mr. Ahmadinejad, Mr. Chavez, and Mr. Putin to see the consequences of that.

Now, oil in transportation is not going to be particularly affected by other steps to reduce carbon emissions by carbon cap-and-trade or carbon taxes. That has only a tiny effect on oil's use, pennies' worth of effect, say, on the price of gasoline. There has to be another approach.

People can have one set of views, I think quite logically, with respect to what you do about carbon going into the atmosphere from coal-fired power plants, but another is possible with respect to oil's use in transportation.

I think what is interesting is that the steps we would want to take for moving away from oil in transportation for global warming reasons are essentially the same ones we want to take for purposes of moving away from oil dependence for strategic reasons. Indeed, there are a number of steps that can be implemented, and let me just say that renewable fuels of a number of kinds deserve support.

Support is also deserved, I believe, for removing barriers to alternative fuels, and that has to do with making it possible for pumps to be put in at filling stations for flexible-fuel vehicles to be produced readily by Detroit and other automobile manufacturers, but especially now to move towards electricity. Plug-in hybrid gasoline electric vehicles are routinely now in their prototypes, dozens in California getting well over 100 miles of gallon of liquid fuel because one is running on off-peak overnight electricity for 20, 30, 40 miles before one becomes a regular hybrid vehicle.

What is often not understood is that because the automobile fleet in the United States has 20 times the energy that the electricity grid does and is utilized only 10 percent of the time, most all cars drive less than 4 hours a day, this creates a reserve of ability to fuel automobiles from off-peak overnight electricity at very low cost, approaching a penny a mile in many circumstances, and it also creates no need for new power plants.

Pacific Northwest Laboratory has said there could be 85 percent of the cars on the road that can be plug-in hybrids before you need any new power plants, so we are not talking about building new coal-fired power plants.

With that, Mr. Chairman, I will stop. I see I have run over. Thank you.

The CHAIRMAN. Thank you, Mr. Woolsey, very much.
[The statement of Mr. Woolsey follows:]

U.S. House of Representatives

Select Committee on Energy Independence and Global Warming

Hearings on

Geopolitical Implications of Rising Oil Dependence and Global Warming

April 18, 2007

Testimony of R. James Woolsey

Mr. Chairman and Members of the Committee it is an honor to be asked to testify before you today on this important subject. I represent only my own views and not those of any institution with which I am affiliated.

There are many aspects of our dependence on oil for 97 per cent of our transportation needs that affect both our national security in a traditional sense and, via oil's contribution to global warming, our security in a broad sense as well – oil contributes over 40 per cent of the global warming gas emissions caused by fossil fuels.

I do not believe that we will reach a sound energy policy if we ignore any of three key needs: to have a long-term supply of transportation fuel that is as secure as possible, as clean as possible (in terms of global warming gas emissions as well as other pollutants), and as inexpensive as possible. Today oil meets none of these three criteria. The reason this is important to us is that oil is a strategic commodity today insofar as we are in near-total dependence on it for transportation – not merely a commodity. Until a little over a century ago salt was such a strategic commodity as well (I am indebted to Anne Korin of IAGS for pointing out this analogy). Wars were fought and national strategies driven in part by salt, because it was the only generally-available means of preserving meat, a major portion of our food supply.

Today we haven't stopped using salt, but no part of our national behavior is driven by the need for it – it has a market and is shipped in commerce. But because it has affordable and effective competitors for meat preservation -- refrigeration, among other technologies – its dominant role is over. No nation sways world events because it has salt mines.

For a number of reasons we must strive for a similar path of decline in influence for oil – away from being a strategic commodity and toward being simply a commodity. Oil will still be useful and valued for its high energy content and its relative ease of shipment for a long time. It will be used in heating and in the production of some chemicals as well – in those uses it is already, in a sense, no longer a strategic commodity because it has competitors. Doubtless it will be used for many years to produce transportation fuel as well. But in the interests of our national security, our climate, and our pocketbooks we should now move together as a nation – indeed as a community of oil importer nations – to destroy, not oil of course, but oil’s strategic role in transportation as quickly and as thoroughly as possible.

National Security

The national security reasons to destroy oil’s strategic role are substantial.

Over two-thirds of the world’s proven reserves of conventional oil lie in the turbulent states of the Persian Gulf, as does much of oil’s international infrastructure. Increasing dependence on this part of the world for our transportation needs is subject to a wide range of perils.

Just over a year ago, in response to bin Laden’s many calls for attack on such infrastructure, al Qaeda attacked Abcaiq, the world’s largest oil production facility, in northeastern Saudi Arabia. Had it succeeded in destroying the sulfur-clearing towers there through which about two-thirds of Saudi crude passes -- say with a simple mortar attack -- it would have succeeded in driving the price of oil over a hundred dollars a barrel for many months, perhaps close to bin Laden’s goal of \$200 a barrel.

Royal succession in Saudi Arabia could also bring major problems. King Abdullah is a sponsor of some reforms in the Saudi system and sometimes works toward cordial relations with us and other oil importers, but he is in his eighties, as is Crown Prince Sultan. Prince Nayef, the Interior Minister, is one possible successor to the throne. His views are famously close to those of the extremely reactionary Wahhabi religious movement in the Kingdom. It was he, for example, who decided not to inform the US before the Khobar Towers bombing when "... a few months earlier Saudi authorities had intercepted a car from Lebanon that was stuffed with explosives and headed for Khobar." (Wright, *The Looming Tower*, 2006, pp. 238-39). Cordial relations with the US may not be at the top of his agenda.

Iran's President is part of a circle, the Hojateih, around Ayatollah Mesbah-Yazdi that is radical even by Iranian post-1979 standards. Indeed Mesbah-Yazdi was exiled to a school in the city of Qum by Ayatollah Khomeini because the latter thought Mesbah-Yazdi too radical. The Hojatiehs' views center on the importance of encouraging the return of the Twelfth Imam from the 10th century (the Mahdi) so that he may begin the battles between good and evil that they believe will end the world. The efficacy of deterrence and containment in dealing with Iran's nuclear weapons development program is not clear when Iran's leaders talk of the desirability of Iran's becoming "a martyr nation" and shrug at the possibility of millions of deaths by saying "Allah will know his own."

In response to Iran's nuclear program, this past winter six Sunni Arab states, including Egypt and Saudi Arabia, announced that they too would have "peaceful" nuclear programs. But since a number of these states have very plentiful supplies of oil and gas it seems unlikely that all these programs will be limited to electricity generation. We may be seeing the beginning stages of a nuclear arms race in the Gulf region between Sunni and Shia.

The US now borrows from its creditors such as China and Saudi Arabia over \$300 billion per year, approaching a billion dollars a day of national IOU-writing, to import oil. This contributes heavily to a weakening dollar and upward pressure on interest rates (our annual oil debt is well above our trade deficit with China). For each of these daily billions of dollars that we can avoid borrowing and can figure out how to spend productively producing domestically for our transportation needs we create 10,000 or more jobs in the US. Another interesting perspective is that net farm income in the US is in the range of \$80 billion annually. So by replacing about a fourth of our imports with domestically-produced alternatives, we create value in this country about equal to a doubling of net farm income.

If these IOUs we send abroad put a strain on the world's wealthiest economy, think what they do to the economies of developing countries in, say, Africa that have no oil themselves. Debt is the central inhibitor of economic development – importing expensive oil is helping bind hundreds of millions of the world's poor more firmly into poverty.

A share of our payments for oil, along with others', find their way to Saudi Arabia. The Saudis provide billions of dollars annually to their Wahhabi sect, which establishes religious schools and institutions throughout the world. Lawrence Wright in his fine work, The Looming Tower, states that with about one per cent of the world's Muslim population the Saudis support via the

Wahhabis "... 90 per cent of the expenses of the entire faith, overriding other traditions of Islam." (p.149)

These Wahhabi teachings, if one reads the fatwas of their imams (see Shmuel Bar, Warrant for Terror: Fatwas of Radical Islam and the Duty of Jihad, 2006), are murderous with respect to the Shia, Jews, homosexuals, and apostates and horribly repressive with respect to everyone else, especially women. They are essentially the same basic beliefs as those expressed by al Qaeda. The Wahhabis and al Qaeda do not disagree about underlying beliefs but rather, a bit like the Stalinists and Trotskyites of the 20's and 30's, about which of them should be in charge. The hate-filled underlying views of both, however, point in the same overall direction. Many Wahhabi-funded madrassahs, world-wide, echo and perpetrate this hatred and thus promote its consequences. Thus, as has often been said, when we pay for Middle Eastern oil today, this Long War in which we are engaged becomes the only war the US has ever fought in which we pay for both sides.

Finally, as Tom Friedman of the New York Times puts it, "the price of oil and the path of freedom run in opposite directions". Work by Collier at Oxford and other scholars has pointed out the link between commodities commanding huge amounts of economic rent, such as oil (or the gold and silver brought from the New World by Spain in the sixteenth century) and political autocracy. Such a commodity, unless it is acquired by a mature democracy such as Norway or Canada, tends to concentrate and enhance the power in the hands of a ruler. "There should be no taxation without representation" says Bernard Lewis, "but it should also be noted that there is no representation without taxation." If a country is so oil-rich that it doesn't need taxes it does not need, and often does not have, any real legislative body to levy them – and thus no alternate source of power in the State. And as for enhanced power from oil wealth, note the behavior recently of Messrs. Ahmadinejad, Chavez and Putin.

So the national security reasons to move against oil's role as a strategic commodity are substantial.

Carbon Emissions

Most of the attention regarding climate change has centered on reducing CO2 emissions from coal because of its central role in many parts of the world, including the US, in electricity generation. This testimony will not deal with these particular emissions except to note that oil use in transportation is only lightly affected by the steps that may be taken, such as carbon taxes or carbon cap-and-trade systems, to limit CO2 emissions from coal. An increase in price of

many dollars per ton of CO₂ will have only pennies' worth of effect in the price of gasoline. So while such methods of limiting emissions from coal combustion have much to commend them, they have little to do with reducing the over-40 per cent of CO₂ emissions that come from oil, especially in its transportation uses. Other tools must be found.

Replacing gasoline with corn-derived ethanol provides a start, but only a start. As a general proposition, fuels made from renewable resources merely recycle differently the CO₂ that is already in the atmosphere and that will stay there in any case, e.g. by unharvested grasses (which have fixed CO₂ in the photosynthesis process) dying and decaying in the field. Thus compared to fossil fuels, which introduce into the atmosphere CO₂ that could otherwise remain sequestered below-ground, renewable fuels typically exhibit much lower net CO₂ emissions on a well-to-wheels basis. When ethanol is made from corn, however, the process may use enough natural gas in producing fertilizer and, (depending on the fuel used to fire the ethanol plant), on ethanol production that its use reduces global warming gas emissions perceptibly but only modestly compared to those from gasoline (although even corn ethanol of course reduces oil use). Also, beyond the range of replacing approximately 10 per cent of gasoline, use of corn-derived ethanol for transportation fuel begins to create problems with land use. Other fuels (see below) need to be utilized

In my judgment it is important to limit the CO₂ emissions from oil used for transportation (somewhere around a quarter of our fossil-fuel CO₂ emissions), but I find much of the current debate, couched in terms of belief, to be less than enlightening. Belief in a scientific theory, even one that has been accepted by many reputable scientists for many years, should always be held tentatively and, Karl Popper taught us well I believe, a theory should always be regarded as a candidate for refutation. Such refutation may be total – the late senior Saudi imam Ben Baz to the contrary notwithstanding, the sun doesn't rotate around the earth. Or it may be partial: Newton wasn't so much proven wrong by Einstein but rather his theories were shown to have limitations.

Today the clear weight of scientific opinion – e.g. the views of the US National Academy of Sciences -- is on the side of the proposition that global climate change is in part anthropogenic and that it is related to the release of CO₂ and other gases such as methane. And although critics are right to point out that earlier predictions by others have not occurred – global cooling, massive famine from population increase – this should not affect our judgment about CO₂ and global climate change (except to give all of us a reasonable reminder about the importance of scientific theories always needing to be held tentatively).

I find most congenial the approach to these issues adopted by Nobel-Prize-winning economist Thomas Schelling, who points out that we insure

against many phenomena which we are not certain will occur, but which we nonetheless take seriously. It is a question of the insurance premium's appropriate size. With respect to coal-fired electricity there is a major debate because most steps to abate CO₂ emissions have cost – e.g. moving toward carbon capture and sequestration – but no major benefits other than limiting CO₂ emissions, at least none (e.g. pollution abatement) that can't be dealt with more cheaply.

But breaking oil's strategic role in transportation, I would maintain, is different. As discussed below, such an objective has modest costs (some of them indeed are negative) and substantial other benefits. Oil should thus be an early candidate for public policy decisions to speed its strategic demise.

Affordability

We have made some substantial mistakes with regard to affordability in the past. Ignoring cost in attempting to destroy oil's strategic role in transportation is not only expensive, it is self-defeating. For example, in the aftermath of war, revolution, and oil crises in the Middle East in the 1970's the US initiated the very expensive Synfuels Corporation. It promptly went bankrupt in 1986 after the Saudis increased production from their reserves and drove the price of oil down to near \$5/barrel. Something similar happened to various expensive petroleum alternatives in the late 90's when, for a number of reasons, oil prices sank to around \$10/barrel.

Our most recent mistake has been investing so heavily in hydrogen fuel cell technology for passenger vehicles. Hydrogen fuel cells have real utility in many fixed applications, in the space program, and perhaps, once their cost has been adequately reduced, for some types of fleet vehicles. Hydrogen production for chemical use may also be one reasonable way to utilize stranded electricity (electricity produced at a site for which no, or inadequate, transmission is available). But to install an adequate number of hydrogen fueling stations in our neighborhoods to support family cars driving on hydrogen would require a huge investment in infrastructure, by some estimates nearly a trillion dollars.

And then one needs to answer a few questions about creating hydrogen from either natural gas or electricity. Why reform natural gas into hydrogen for fuel cells and not just put the natural gas into internal combustion engines in the first place, especially since the conversion wastes about a third of the original energy? Many cities have natural-gas-powered buses and Iran is even modifying its existing automobile fleet to be dual-fuel vehicles of a sort that can use either gasoline or natural gas. Or why convert electricity (via electrolysis of water) into hydrogen and then via a fuel cell into electricity again, losing about three-

quarters of the energy in the process? Why not put the electricity into the vehicle's battery, as with a plug-in hybrid, in the first place?

If we insist on expensive single solutions such as hydrogen – a platinum (not just silver) bullet – and ignore cost and the utility of building on existing infrastructure, we will fail. This is in part because in addition to oil's being a strategic commodity for transportation from the point of view of us, the importers, it is also a strategically manipulable commodity from the point of view of those who control it. Chinese and Indian demand, and the possibility that the peak oil theory will prove out and the major Middle Eastern fields will see declining production capability, may keep oil prices high. But many investors will still be worried about a repeat of the sharp oil price drops of the mid-eighties and the late nineties. The world changed in important ways in the early 1970's when the Railroad Commission of Texas was in effect replaced by OPEC as the arbiter of the world's oil prices.

We need to convince our investors and ourselves that our economy is not subject to being manipulated by others based on their perception of whether we are being too aggressive in developing alternatives to oil, or supporting Israel's existence too determinedly. Instead we should develop a portfolio of approaches to breaking oil's strategic hold on us, building on existing transportation capabilities wherever possible and keeping in mind cost, carbon emissions, and national security.

Toward a Portfolio

Electricity

As modern battery technology has developed in response to the markets for electronics, communications, power tools, and a host of other uses, it has brought with it opportunities to substitute electricity for oil products in transportation. Hybrid gasoline-electric cars have now been provided with these advanced batteries -- such as lithium-ion – with improved energy and power densities. Dozens of vehicle prototypes are now demonstrating that these "plug-in hybrids" can more than double hybrids' overall (gasoline) mileage. With a plug-in, charging your car overnight from an ordinary 110-volt socket in your garage can let you drive 20 miles or more on the electricity stored in the topped-up battery before the car lapses into its normal hybrid mode. If you forget to charge or exceed 20 miles, no problem, you then just have a regular hybrid with the insurance of liquid fuel in the tank. And during those 20 all-electric miles you will be driving at a cost of between a penny and three cents a mile instead of the current 10-cent-a-mile-plus cost of gasoline.

Utilities are rapidly becoming quite interested in plug-ins because of the substantial benefit to them of being able to sell off-peak power at night. Because off-peak nighttime charging uses unutilized capacity, DOE's Pacific Northwest National Laboratory estimates that adopting plug-ins will not create a need for new base load electricity generation plants until plug-ins constitute more than 84% of the country's 220 million passenger vehicles. Further, those plug-ins that are left connected to an electrical socket after being fully charged (most U.S. cars are parked more than 20 hours a day) can substitute for expensive natural gas by providing electricity from their batteries back to the grid to aid in stabilization of the grid's frequency and voltage, and "spinning" reserves to help deal with power outages.

The economic savings that can result from these vehicle-to-grid (V2G) connections are very substantial.

First of all, V2G takes advantage of the fact, surprising to most people, that today's light vehicle fleet has twenty times the power capacity of our electric power system and less than one-tenth its utilization. A relatively few vehicle batteries can thus store much larger amounts of energy relative to the grid's needs than most people realize. Vehicles that are fully charged can be left plugged into electric outlets and serve useful, and profitable, purposes. I would refer the Committee to experts on this matter – particularly Professor Willett Kempton of the College of Marine and Earth Studies at the University of Delaware who, together with his colleagues there, has published widely on this subject. But one example is that if only 3 per cent of the nation's light vehicle fleet were plug-in hybrids, plugged into the grid, they would alone be able to handle the grid stabilization market, on which utilities today spend about \$10 billion.

Second, major infrastructure changes are not needed in order to use V2G. Forty out of fifty states today have net metering laws which let homeowners sell power they generate, such as from rooftop photovoltaics, back to the grid – those who have solar systems on their roofs can literally watch their electricity meters run backwards. V2G's flexibility will improve as the grid gets "smarter" but it can be done today. Professor Kempton's work thus suggests that utilities can save a great deal of what is now spent on fossil fuels by substituting V2G connections and that this in turn can benefit consumers quite substantially. In his models the credits a consumer obtains from connecting his plug-in hybrid to the grid, after it has been fully charged, for several hours a day cover a substantial share of the consumer's monthly car payments. It seems too good to be true that both consumers and utilities could make money while together they reduce fossil fuel emissions, but such seems to be the clear logic of the economics of plug-in hybrids and V2G.

Once plug-ins start appearing in showrooms, (company announcements now make it seem likely that we will see the first production models within 2-3 years), it is not only consumers and utility shareholders who will be smiling. If cheap off-peak electricity supplies a portion of our transportation needs, this will help insulate alternative liquid fuels from OPEC market manipulation designed to cripple oil's competitors. Indian and Chinese demand and peaking oil production may make it much harder for OPEC today to use any excess production capacity to drive prices down and destroy competitive technology. But as plug-ins come into the fleet low electricity costs will stand as a substantial further barrier to such market manipulation. Since OPEC cannot drive oil prices low enough to undermine our use of off-peak electricity, it is unlikely to embark on a course of radical price cuts at all because such cuts are painful for its oil-exporter members. Plug-ins thus may well give investors enough confidence to back alternative liquid fuels without any need for new taxes on oil or subsidies to protect them.

Environmentalists are joining this march, and over time with increasing enthusiasm. The Environmental and Energy Study Institute has reported that, with today's electricity grid, there would be a national average reduction in carbon emissions by about 60% per vehicle when a plug-in hybrid with 20-mile all-electric range replaces a conventional car. Further studies are underway on this important subject, but it seems clear that replacing a conventional vehicle with a plug-in hybrid will show substantial reductions in carbon emissions today in clean-grid areas such as the West Coast and some reductions on an average basis nation-wide (coal fuels about 51 per cent of our overall electricity generation). In states where coal-fired generation dominates the electricity market there may still be some reductions in carbon emissions on a net basis by moving toward plug-in hybrids. In any case, if other public policies such as cap-and-trade lead to electricity's increasingly being generated from less carbon-emitting sources -- such as renewables, nuclear power, or coal with carbon capture and sequestration -- this process will further reduce net vehicle emissions as well.

And as far as infrastructure investment is concerned, some is indeed needed for plug-in hybrids: each family with such a vehicle would need an extension cord. Period.

Renewable Liquid Fuels

Because, as discussed above, renewable liquid fuels hold the promise of very substantial CO₂ reductions on a well-to-wheels basis I will limit this discussion to them. It is of course possible that technological innovation will make possible a sufficient degree of carbon sequestration from other alternative fuels – from oil sands, oil shale, coal-to-liquid – that they will meet relevant CO₂ emissions requirements.

In my view, even if the nation moves toward plug-in hybrid gasoline electric vehicles, and even with expected battery improvements, there will be a substantial market for liquid fuels. This is because in order for a driver not to be concerned at running out of electricity I believe there will be substantial motive to have liquid fuel in the tank. Liquid fuel will be necessary for road trips in a plug-in hybrid beyond the battery-charge range. And although over time we can probably expect battery performance to improve and the need for liquid fuel to decline, battery cost today (perhaps \$500-600/kilowatt hour) substantially limits battery size for moderate-cost vehicles to the plug-in hybrid ranges rather than all-electric. In addition to battery cost reductions, wide availability of quick-charging could reduce the demand for liquid fuels over time, but those renewable fuels with a substantial cost advantage may prove particularly durable in the public market.

Cost advantages can accrue from a number of sources.

For example, the ability to grow feedstocks such as switch grass on many types of land effectively removes the land limitations frequently associated with corn-derived ethanol. We found on the National Energy Policy Commission in our 2004 report that, with reasonable assumptions about improvements in vehicle mileage and yield per acre of feedstocks, enough switch grass could be grown on the amount of farm land equivalent to the soil bank (about 30 million acres, or around 7 per cent of US farm land) to replace over the next twenty years about half of US gasoline.

Further, over time cellulosic ethanol and cellulosic methanol may exhibit cost advantages over corn-derived ethanol; for example, cellulosic ethanol's production is likely to be simplified by the perfection of consolidated bioprocessing (so that hemi-cellulose and cellulose may be processed together). Its production costs may be lowered by rapid yield improvements using new genetic techniques, possibly but not necessarily including the genetic engineering of the feedstocks themselves – e.g. to simplify the breaking down of the grasses' or other feedstocks' lignin. And its shipping costs may be lowered by locating

small facilities near markets – switchgrass will grow in more parts of the country than corn.

Bio-butanol may exhibit the above advantages and also profit from the fact that it is both more energy-intensive and more pipeline-friendly than ethanol.

Renewable diesel, made by thermal processes from many types of carbon-based waste -- from turkey offal to hog manure to used tires – and P-Series fuels, made from waste and biomass, may both exhibit cost advantages from environmental cleanup. Conversion of only a portion of industrial, municipal and animal wastes—using thermal processes now coming into commercial operation—appears to be able to yield several million barrels a day of diesel, or with modest further processing, methanol.

In Europe the negative costs (“tipping fees”) that a fuel producer can obtain while making fuel from such clean-up processes are substantial – approximately \$100/ton in some cases. We may be about to see some of these processes that simultaneously clean up the environment and produce fuel leave the United States and migrate to Europe, particularly since the executive branch has recently decided to extend to oil refineries the \$1/gallon “renewable diesel” credit previously focused on cleanup renewable fuel-producing technologies. (See IRS Notice 2007-37)

And one or more of the above processes may also find cost advantages in the production of high-margin niche products in biorefineries that do not produce only fuel. For example, today polylactic acid, a major ingredient in many plastics that is ordinarily made from hydrocarbons, is being produced from carbohydrates (corn) in Nebraska. In relative short order we may see other such products moving us in a transition from hydrocarbon to carbohydrate feedstocks for a range of chemicals.

In short there is a good deal of promise that we may be able to shift our liquid fuel consumption toward renewable fuels that radically reduce our reliance on oil products. A key policy step to enabling liquid fuel choice is to ensure that most new cars are flexible fuel vehicles, cars that can run on any combination of gasoline and alcohols such as ethanol and methanol. Every car sold in the U.S. is required to have seatbelts and airbags; similarly, every car should enable fuel flexibility, a feature which adds less than \$100 to the manufacturing cost of a vehicle and provides a platform on which fuels can compete.

Materials and Other Fuel Efficiency Steps

There are a range of fuel efficiency steps that can be undertaken. I will mention here only one: constructing vehicles with inexpensive versions of the carbon fiber composites that have been used for years for aircraft construction. This can substantially reduce vehicle weight and increase fuel efficiency while at the same time making the vehicle considerably safer than with current construction materials. This is set forth thoroughly in the 2004 report of the Rocky Mountain Institute's *Winning the Oil Endgame* ("WTOE"). Aerodynamic design can have major importance as well. Using such composites in construction breaks the traditional tie between size and safety. Much lighter vehicles, large or small, can be substantially more fuel-efficient and also safer. Such composites have already been used for automotive construction in Formula 1 race cars and BMWs, Corvettes, and other high-end automobiles. Adoption by automobile manufacturers for wider use is underway. The goal is mass-produced vehicles with 80% of the performance of hand-layup aerospace composites at 20% of the cost. RMI's investigations suggest that such construction is expected approximately to increase the efficiency of a normal hybrid vehicle by something in the range of 70 per cent without increasing manufacturing cost. (WTOE 64-66).

A Portfolio of Programs and Criticisms Thereof

None of us is wise enough to be able to tell today how quickly and affordably, say, battery improvements will occur compared with progress in the production of bio-butanol, or when it will be more economic to produce family cars from carbon composites than to spend the marginal dollar on improving consolidated bioprocessing for cellulosic ethanol. This sort of decision is best made by the market, once access to it has been made possible. Indeed, as with the family's investments, the nation is better off putting stock in a portfolio of approaches rather than looking for any single solution. The search should not be for a platinum bullet such as hydrogen fuel cells but rather for a number of pieces of silver-plated buckshot.

Indeed I believe that the principal effort of the federal government on these issues should be to remove market barriers to entry for transportation programs such that oil, as a strategic commodity, sees vigorous competition. These steps will, if undertaken wisely, help introduce Americans and others sooner rather than later to practical alternatives in their daily lives – the ability to choose rather than the requirement to take what OPEC decides to give us.

Critics of Moving Away From Dependence

Broadly speaking there seem to be four main types of critics of developing a portfolio to move away from oil dependence.

The first, more or less characterized by a recent report by the Council on Foreign Relations, seems to be driven by a concern that in seeking to move away from oil dependence we will do foolish nationalistic things. For example, the report states that “[t]he voices that espouse ‘energy independence’ are doing the nation a disservice by focusing on a goal that is unachievable over the foreseeable future....” But virtually no one who is working to reduce dependence on oil has as his objective a simple switching of buying patterns (e.g., we buy more from Canada and Mexico, Europe buys more from the Middle East); this, of course, would have no major effect on the essentially world-wide oil market. Nor are those who wish to reduce dependence fixated on achieving at any cost total energy autarchy – the straw man the report creates, then argues against. The American people have met difficult challenges before – there is no reason not to use our capacity for technological innovation to reduce our oil dependence decisively while at the same time avoiding fantasies of finding single perfect solutions. The Council Report amounts to telling someone afflicted with alcoholism that he needs to remember that a glass or two of red wine a day would be good for his health. There is truth in the point, but it’s not the main thing he needs to fix right now.

The second type is a few car buffs who have not kept up with battery technology and are somehow infuriated at the suggestion that electricity could be a useful and effective method of fueling transportation in place of gasoline. It is indeed difficult to rev loudly a car using electric drive – it just persistently stays quiet. If performance is the objective, however, the acceleration of which an electric motor is capable can be quite remarkable. The new Tesla all-electric roadster advertises zero to sixty in 3.95 seconds. I’ve driven it. It’s true.

The third type of critic apparently prefers paying oil producing states in the hope that they will not generate terrorists rather than giving tax credits for producing alternative fuels in the US. For example, recently in the Milken Institute Review Messrs. Jerry Taylor and Peter Van Doren wrote that they didn’t want to see greater use of alternative fuels lead to “smaller producer-state subsidies” to the “young” and “underemployed” of oil-exporting states since “reduc[ing] revenues flowing to Islamic terrorists might perversely increase the recruitment pool for Islamic terrorists....” This might be called the “Billions for tribute, not one cent for oil alternatives” approach.

Finally, there is the new Satanism school. Writing in the Wall Street Journal columnist Holman Jenkins recently accused me personally of

“surrendering [my] soul upfront” and “rushing into a devil’s bargain” by praising the use of ethanol rather than oil products, and then again that “Satan will insist on his due” even though I urge moving from corn to cellulosic biomass as a feedstock. I was really shocked at this allegation – not about me, since I would honestly have to plead guilty to at least second-degree ethanol support, but I was surprised to see Mr. Jenkins link the Devil to ethanol, even outside the context of excessive recreational ethanol consumption. So I communicated to Mr. Jenkins that I had given him a call and the Devil had assured me that it wasn’t true: “I’m totally,” he said, “invested in geothermal.”

Legislative Programs

There are two that I wish to mention.

The first is that of the National Commission on Energy Policy.

The Commission, of which I am a member, is a bipartisan group of energy experts that first came together in 2002 and issued a comprehensive set of consensus recommendations for U.S. energy policy in December 2004. (full report at www.energycommission.org) The Commission is supported primarily by the Hewlett Foundation with support from several other private, philanthropic foundations. The Commission’s ideologically and professionally diverse 21-member board includes recognized energy experts from business, government, academia, and the non-profit sector.

Our final recommendations, which are described in our 2004 report, *Ending the Energy Stalemate*, were informed by intense discussions over several years, by dozens of analyses, and by extensive outreach to over 200 other groups. Those recommendations, I should stress, deal with a comprehensive set of energy policy issues including climate change, our nation’s dependence on oil and the need for increased investment in new energy technologies and critical energy infrastructure. Two years later, although Congress passed major energy legislation in the summer of 2005, concerns about oil security and climate change continue to grow more urgent. The Commission has continued to explore options for meeting these central energy challenges. Just yesterday, the Commission issued an updated suite of recommendations focused on addressing the demand as well as supply side of the oil security equation as well as advancing a timely response to the problem of global climate change.

Focusing on the Commission’s views of the achievements necessary in the transportation sector to enhance oil security, the Commission originally called on Congress to “significantly strengthen” and “simultaneously reform” the existing

Corporate Average Fuel Economy (CAFE) program. It also proposed providing targeted manufacturer and consumer incentives to accelerate the deployment of advanced vehicle technologies and to address the competitiveness concerns of the U.S. auto industry. I am glad that we made these recommendations, but I was always disappointed that we couldn't pick a number in 2004.

A little over two years later, I am very pleased to announce that Commission is now calling for establishing a 4% per year fuel-economy improvement target. Despite promising advances on the technology front—including substantial progress in developing vehicles, such as hybrid electric and plug-in hybrids, that could radically reduce gasoline consumption per mile traveled—I believe that improving the efficiency of the nation's light-duty vehicle fleet remains an important and as-yet-untapped area of policy opportunity for reducing oil dependence and making the nation more energy secure. Further, it is an enabler for other positive steps such as a rapid transition to plug-in hybrids and flexible fuel vehicles (FFV's).

In addition to strengthening CAFE, I would urge on the Commission's behalf that Congress establish a five to ten year tax incentive program for manufacturers and consumers to encourage the domestic production and purchase of plug-in hybrid, hybrid-electric, and advanced diesel vehicles that achieve superior fuel economy. Cost is always an issue, of course, in the Committee's deliberations. I would only note that, in view the over-300-billion-dollar debt that we are incurring annually for oil imports, each billion dollars marks about a day of borrowing. Each day that we replace oil imports with domestic production of an alternative thus roughly equates to 10,000 or more potential new American jobs. Thus a \$ 3 billion tax incentive program would be a major step, and the funds would of course have to be found for it. But in the overall context, it is only the equivalent of three days of oil imports as we attempt to satisfy our nation's 250-barrel-per-second appetite for oil.

The effect of encouraging a portfolio of approaches to destroying oil's role as a strategic commodity is that the programs can work together, and together they can give us a much better chance of succeeding than banking on one. For example, a 50 mpg hybrid, once it becomes a plug-in, will likely get solidly over 100 mpg of gasoline (call it "mpgg"); if it is also a flexible fuel vehicle using 85% ethanol, E-85, its mpgg rises to around 500; if it is made from light, crash-resistant carbon composites its mileage may approach doubling again – edging toward 1000 mpgg. Any one, or all, of these technologies may not work out as well as we hope, but a portfolio approach gives us a chance for substantial progress even if this is not the case. Suppose we achieve only 200 mpgg? Still not bad.

With a portfolio approach the market will likely operate to expand sharply the use of these technologies that heavily reduce oil use in the foreseeable future and are already in pilot operation. However, in order to speed their introduction into the marketplace, the government would need to provide targeted consumer and manufacturer incentives to promote their domestic development, production, and deployment. In conclusion, I believe that we need a combination of improved fuel economy standards coupled with the greatly accelerated adoption of transformative vehicle technologies. Incentives alone will not do the job: absent a change in standards, average fuel economy will continue to stagnate so long as gains from more efficient vehicles can be offset by a larger market share for less efficient models. As the Commission and I have argued in the climate and national security contexts, a combination of regulation and incentives is likely to be more effective than either approach in isolation because it generates a simultaneous market pull and market push for new technologies.

I have also appended to this testimony a point sheet setting out the provisions of the DRIVE Act, titled the Vehicle and Fuel Choices for American Security Act in the 109th Congress and re-introduced in the 110th Congress by Congressmen Engel, Kingston, and 77 other Representatives, including four Members of this Committee: Representatives Inslee, Cleaver, Hall, and McNerney. Among the important steps this legislation, based on the Set America Free Coalition's Energy Security Blueprint, advances are: a national oil savings target of 2.5 million barrels per day by 2015, increasing over time; programs that increase fuel choice in transportation; and federal manufacturing retooling incentives for producing efficient vehicles and the authority to set efficiency standards for tires and heavy duty trucks.

A key policy step to enabling liquid fuel choice is to ensure that most new cars are flexible fuel vehicles, cars that can run on any combination of gasoline and alcohols such as ethanol and methanol. Every car sold in the U.S. is required to have seatbelts and airbags; similarly, every car should enable fuel flexibility, a feature which adds less than \$100 to the manufacturing cost of a vehicle and provides a platform on which fuels can compete.

A Surprising Coalition

You have not asked me to assess the domestic political dimensions of this issue, and such is far from my expertise. I would only conclude by noting that I continually find it interesting that there seems to be much more consensus on what needs to be done in moving decisively to reduce oil dependence than on

the reasons for doing so. In broad terms the approach suggested above – using a combination of regulatory and market mechanisms to remove barriers to the use of oil alternatives, including electricity, and to promote the development and commercialization of a portfolio of such renewable technologies – can obtain, I believe, substantial support from a potentially rather wide coalition.

There are a number of reasons individuals come to be interested in moving the US (indeed the world) away from oil dependence. Some are interested in protecting the environment, including of course from climate change. Some are struck by the impoverishment of developing countries, a condition substantially exacerbated by oil debt. Some are particularly interested in improved prosperity for rural America, and indeed moving increasingly toward a carbohydrate-based, rather than hydrocarbon-based, economy for transportation and chemicals. Some are focused on the order-of-magnitude reduction in driving costs that can come from electricity. Some are especially worried about our increasing dependence on the Middle East for oil and resentful at the use to which an important share of the Middle East's oil earnings are put. Some are excited at the prospect of innovation in this field creating economic opportunities. Some in the business of providing electricity see the opportunity for reduced costs and increased earnings. Some believe that the Bible's injunction that we should both care for the planet and see that it is used for human benefit points us generally in this direction. And some are simply struck by a sense of commitment.

With no disrespect intended, especially since I personally see merit in all of the above arguments, I have called this in the past a coalition of the tree huggers, the do-gooders, the sod-busters, the Mom and Pop car owners, the cheap hawks, the venture capitalists, the utility shareholders, the evangelicals, and Willie Nelson.

But what is interesting is that, as long as the basic criteria that our transportation be secure, have low emissions, and be affordable are kept in mind any one of these arguments suffices. So it is not necessary that people agree about the reasons for moving sensibly but decisively to reduce oil dependence, merely that each, for his or her own reason, is willing to work toward the same end.

Post-Script: A Further Evolution in Security and Low Emissions

Today electricity production and transportation fuel demands have little to do with one another. Unlike the 1970's, when around 20 per cent of our electricity was produced by oil, today only 2 per cent is so produced. So

substantial changes in the way we produce electricity – with renewables or nuclear energy, for example – don't really affect our oil use.

We have seen above how the coming of plug-in hybrids can to a substantial extent replace gasoline with electricity as a fuel and that, for some time, this will put little added demand on electricity production because of the use of off-peak power for these purposes and the use of V2G.

There is a further development on the horizon, however, of which we should be aware. The security of the electricity grid requires attention. In addition to its heavy use of coal (without carbon capture and sequestration), a condition that contributes heavily to global climate change emissions, the grid has substantial security problems.

Three and a half years ago, for example, a tree branch fell in a storm in Ohio and the cascading grid failures quickly took about 80 gigawatts, the equivalent of eighty nuclear power plants, off line. New York, New England, and Eastern Canada were without power for over a day. As we require more and more from the grid, and refuse to build enough transmission lines, we contribute substantially to the grid's vulnerability. Whether it is resistance to electricity generation (such as wind farms), or resistance to power line construction we have almost gone past "Not In My Back Yard" (NIMBY) to "Build Absolutely Nothing Anywhere Near Anything" (BANANA). Also, our fragmented regulatory system hinders security measures. A National Research Council study in 2002 on which I served, and a number of other reviews as well, have pointed out grid vulnerabilities, including unprotected transformers and the easily hackable SCADA (Supervisory Control and Data Acquisition) control systems.

The point is that with the current grid tree branches are bad enough, but terrorists are much smarter than tree branches. They would know what parts of the grid to attack (much of this is, sadly, on the internet – this is a subject about which the US is, perhaps to our peril, quite open), and could produce outages lasting months not just days.

So, in addition to taking steps to improve grid security such as requiring the stockpiling of transformers and other key components and better protecting the SCADA systems, we need to build resilience into the grid by generating our own electricity when we can.

Fortunately the technology of both distributed solar generation (thin film, then nano-solar at the site where the electricity is used) and distributed roof-top wind generation that can operate in a light breeze are coming along, and costs

are going down. Wind tends to blow at a different time of day than the sun shines, so distributed wind and solar operating together, with new technologies that can lower costs, show real promise. For example just last week I saw a solar electricity-generating blanket being assessed by the US Army. It is about the size of a pool table top and, once spread on the ground in the sun, generates about a kilowatt of electricity within five minutes. Several of these would power the needs for light, refrigeration, and communications within a home that was using electricity frugally (e.g. the right kind of light bulbs, and not too many turned on).

Especially when distributed wind and solar are combined with battery storage, say in the basement of a home, we are not that far from many residences and other buildings being able to generate a portion of their electricity needs themselves. Today if a tree branch or a terrorist takes out a major segment of the grid, once we have used up any available diesel fuel for diesel generators we are back in the 19th century. But before too many years we may be in a position to have such an outage, for many of us, affect only, say, our homes' air conditioning. Losing air conditioning can be bad, but being shoved unceremoniously back into the nineteenth century would be considerably more bracing.

Finally, the advent of plug-in hybrids will affect these distributed-generation possibilities as well. If part of what I am replacing with the electricity generated on my roof is gasoline (by charging my plug-in hybrid), the overall security, efficiency, and lowered emissions of my evolving home electricity system could be quite promising.

There are some interesting opportunities coming if we will but grasp them.

Landmark Vehicle and Fuel Choices Legislation:

The DRIVE Act

The bipartisan **DRIVE Act**, titled the **Vehicle and Fuel Choices for American Security Act** in the 109th Congress, was re-introduced in the 110th Congress by Senators Bayh (D-IN), Brownback (R-KS), Coleman (R-MN) and Lieberman (I-CT) and 21 other Senators, and companion legislation in the House re-introduced by Engel (D-NY), Kingston (R-GA) and 77 other Representatives with the aim of putting the nation on the path to independence from foreign oil. The bills blaze this trail by requiring a real plan to boost efficient use of oil in our transportation sector, offer consumers non-petroleum fuel choices, and encourage the use of fuels produced from domestic resources. The bills are based on the Set America Free Coalition's Blueprint for Energy security. Both bills include four components:

- An national oil savings target starting at 2.5 million barrels of oil per day in 2015 and increasing over time, achieved through a menu of existing and new authorities and incentives;
- Programs that increase fuel choice in the transportation sector;
- Federal manufacturer retooling incentives for production of efficient vehicles and authority to set efficiency standards for tires and heavy duty trucks; and
- A national energy security media campaign to educate the public about oil dependence.

An Oil Savings Plan

The centerpiece of the bills are a national oil savings strategy that would direct the federal government to develop and implement a plan to reduce U.S. oil dependence, starting with oil savings of 2.5 million barrels of oil per day within ten years and increasing significantly by 2025 (ramping up from a 10% to more than 20% reduction from projected oil demand). The elements of the plan are the following:

- Office of Management and Budget (OMB) designs a plan for federal agencies to use existing and new authorities granted in the bill to achieve the specific oil savings from all sectors of the economy, not just vehicles;
- Savings are measured in comparison to the government's 2005 forecast of oil use for each year;
- Federal agencies must then promulgate requirements necessary to achieve plan goals; and
- The President must conduct regular reviews and update the action plan as necessary to keep the country on course as the plan is implemented.

Focus on 21st Century Vehicles – Renew Detroit

While the plan addresses all sectors of the economy, transportation is responsible for two thirds of our oil consumption and it is currently 97% reliant on oil. The legislation creates some new authorities and research programs to help achieve the oil savings from our cars, trucks and buses, including:

- Providing a tax credit, loan guarantees, and grants to auto manufacturers and suppliers who decide to retool factories to build more efficient vehicles, including especially hybrids, plug in hybrids and advanced diesels, and associated components;
- Removing the cap on the number of consumer tax credits for advanced vehicles;
- Closing the gas guzzler tax loophole that encourages businesses to purchase very large SUVs but maintains an exemption for farm vehicles;
- Establishing a program to move fuel-efficient tires into the marketplace;
- Creating a program to test the efficiency of heavy-duty trucks and set minimum efficiency standards for new heavy duty trucks;
- Funding to help local educational agencies reduce school bus idling;
- Establishing new requirements for oil savings and advanced vehicle usage for federal fleets and new incentives for private fleets that purchase more efficient vehicles; and
- Funding for research, development and deployment to speed commercialization of both near-term vehicle technologies, such as plug-in hybrids, and advanced vehicles technologies, such as light-weight materials.

Increase Fuel Choice

In addition to using oil more efficiently, we must also give consumers more choices so that they can use alternatives to oil. The bill also provides a suite of policies which ramp up commercialization of alternative fuels and provide infrastructure for delivering such alternatives to gasoline to consumers, including:

- Increasing the number of fuel choice enabling vehicles on the road by requiring a growing number of new vehicles to be capable of operating on alcohol fuels, such as ethanol and methanol, and a range of other efficient vehicle technologies;
- Increasing the tax credit for alternative fuel pumps and infrastructure to 50 percent of qualifying costs, and increasing the number of alternative fuel pumps.
- Creating a near term targets for production of cellulosic biofuels, building on the renewable fuel standard enacted in EPAct 2005;
- Increasing the authorized spending for cellulosic biofuels production incentives to \$200 million annually over five years;
- Doubling R&D authorization level for bioenergy program in EPAct 2005; and
- Providing grants to encourage transit-oriented development to help build communities that help drivers reduce vehicle-miles traveled.

Encourage Electricity for Transportation

- Provides vehicle consumer tax credits for purchases of plug-in hybrid and flexible fuel hybrid vehicles.
- Incentives for installation of heavy duty vehicle idling reduction equipment.
- Plug-In Hybrid Electric Vehicle Prize.
- An Education Program that would authorize a nationwide education strategy for electric drive transportation, and specific authorizations for a university level PHEV competition and for assistance to institutions offering electrical and mechanical engineer training.
- An Electric Drive Transportation Program containing the following elements:
 - 1) a DOE-administered research, development, demonstration and commercial application program for electric drive technologies, including batteries, on-board and off-board charging components, drive train systems, control systems and power train development, nanomaterial technology, and smart vehicle and grid interconnection devices and software; 2) a DOE program, in consultation with EPA and industry, to inventory existing electric drive technologies and markets and barriers to technology deployment; 3) a DOE grant program to provide partial support to utilities for programs to encourage use of off-peak electricity; and 4) a testing and certification program to provide information on the emissions, energy and petroleum usage of hybrid electricvehicles, to be administered cooperatively by DOE and EPA.

Public education

Media Campaign: Both bills would create a nationwide oil security media campaign to be administered by the Secretary of Energy, educating consumers about ways to reduce wasteful oil use.

Provisions Specific to the House or Senate bills

The companion bills are similar in most respects, and there are a few provisions unique to each:

- *Oil savings trajectories:* Both bills commit to savings of 2.5 million barrels a day, the House bill by 2015 and the Senate bill by 2017. Beyond the initial target, the House requires 5 mbd savings by 2025, while the Senate bill requires 7 mbd savings by 2026 and 10 mbd savings by 2031.
- *Ethanol:* The Senate bill contains an additional target for ethanol derived from sugar, and creates program of loan guarantees and grants for farmer-owned ethanol producers to develop and build E85 distribution infrastructure including pumps;
- *Oil savings "scoring" and audit:* The House bill directs federal agencies to evaluate the oil savings impacts of federal regulatory actions. It also directs federal agencies to audit their overall oil usage, building on EPA's 1992 guidelines for reducing the federal government's petroleum fuel use.

- *Prize*: The House bill contains a detailed provision for a plug-in hybrid prize whereas the Senate bill contains a less detailed amendment to include prizes for plug-in hybrid and hydrogen as a subset of an EPACT 2005 program.
- *Fuel choice provisions unique to the House bill*: The House bill includes additional incentives and safeguards that ensure effective oil savings from the transportation sector, including:
 - Phases out a loophole in the fuel economy standards for flexible fuel vehicles as their production increases by tying the credits to actual alternative fuel use in these vehicles.
 - A Transition to Fuel and Technology Neutral Regulations, which would require EPA to: 1) report to Congress on fuel or technology-specific requirements under Federal environmental law and on how a fuel and technology neutral emissions reduction program might be established; and 2) to establish such a program, which would become effective within 10 years of the date of enactment.
 - A Plug-In Hybrid Electric Vehicle Demonstration Program, which would be administered by DOE, and would provide cost-shared grants for projects to demonstrate PHEV.
 - Establishes an "ethanol action plan" requiring a ramp-up of petroleum displacement with biofuels for ground transportation.
 - A Near-Term Electric Transportation Deployment Program, to be administered by EPA. The program would provide grants and loans for qualified electric transportation projects, which could include port electrification, truck stop electrification, airport electrification, industrial electric fork lift energy efficiency demonstrations, and similar projects.

The CHAIRMAN. That completes the time for statements by our panel.

Now we will turn to the question and answer period. The Chair recognizes himself for 5 minutes.

Yesterday at the United Nations Security Council, the British Foreign Secretary, Margaret Beckett, said, I quote her, "Climate change is an issue which threatens the peace and the security of the whole planet."

Would one of you take that and comment upon it? General Sullivan.

General SULLIVAN. Mr. Chairman, I think what she is suggesting is essentially what our conclusions were; that is, that in regions of the world like Africa, many parts in Africa, climate change, drought; drought causes famine, causes governments to fail because they can't provide services for their populace, which creates the environment for nonstate actors to appear. It is a petri dish for terror and instability and obviously creates migration irrespective of borders. Nomadic people move to get water and food and so forth and so on, and they also move from south to north, from North Africa to Europe.

And I think what she is getting at is what we talk about in our report. By the way, in this report we are not just talking about oil, petroleum, hydrocarbons, we are talking about drought, natural resources, all natural resources. So I see a direct link, as do my colleagues. Certainly her comment is well taken with regard to our report.

The CHAIRMAN. Do any other of the panelists want to comment on that? Mr. Woolsey.

Mr. WOOLSEY. Mr. Chairman, I would only add that much of the disagreement about the extent of climate change has to do with what scientists call positive feedback effects. It is sort of an unfortunate term because there is nothing positive about these effects.

They are not modelable so they don't show up in most of the model calculations. If the models show the possibility over the next several decades of inches of sea level rise and a degree or so of centigrade of global warming, a lot of people look at what the models say and say well, that looks like it might be something we can manage. Even that will have some important effects.

But these feedback effects that are not in the models such as, let's say, after 2 degrees increase the tundras start melting, the tundra has huge amounts of methane. It is 20 times worse as a global warming gas than carbon dioxide.

So the release of methane in turn creates the release of more methane. Those effects are what lead to some of these predictions of meters of sea level rise and a number of degrees of increase. It is a matter of some uncertainty but there are data that suggest some of these things are at risk.

The CHAIRMAN. Let me ask one final question before my time expires. In 1977 the United States imported 47 percent of its oil, but we passed a law here and President Ford signed it in 1975, that actually reduced our dependence back down to 27 percent fuel economy standards for vehicles by 1986. We have had no new laws since then. We have the SUV exception. We are now up to 60 per-

cent dependence upon imported oil. It goes up year after year, adding 65, 70, 75 percent.

Could one of you speak to the national security implications of that ever-increasing percentage of oil which is imported?

Mr. POPE. Let me respond by saying that actually you speak to the national security opportunity of getting back on the pathway we undertook in the 1970s. If we can improve the efficiency of the average vehicle by 4 percent a year, which in engineering terms is well within everybody's capacity, and if we simultaneously work seriously at enabling a substantial part of the petroleum fraction to be replaced by cellulosic ethanol, we will be in a situation in which, as Mr. Woolsey said, oil may still be an interesting commodity but it will not drive the world and we will have the freedom and flexibility to decide in our own national interest how deeply engaged we wish to be in places like the Persian Gulf, Venezuela and Nigeria. Right now we have no freedom of action.

The CHAIRMAN. Thank you. My time has expired. The Chair recognizes the gentleman from Wisconsin, Mr. Sensenbrenner.

Mr. SENSENBRENNER. Thank you, Mr. Chairman. I think all of us in this room agree that oil dependency is bad and it has a lot of negative impact on our economy, on our national security and the like. So I guess the question is how to reduce the dependency on oil.

I also think it is almost a given that the sign of a healthy economy is electricity consumption, which is one of the reasons why the Chinese are opening up a new coal-fired power plant about once a week, because their economy is expanding so rapidly.

Now, to get us away from oil and to provide the electricity that we need both to run our economy as well as to transfer our transportation fuel mix, as Mr. Woolsey has eloquently explained—I guess I would like to ask all five panelists to give just a yes or no answer, since my time is limited—what about the rapid expansion of nuclear power plants in this country, because nuclear power plants do generate electricity and they emit no greenhouse gases. Good idea or bad one? I would like each of the five panelists to say yes or no.

General SULLIVAN. As long as everybody understands that that is not in the report and you have asked me a personal question, I will give you a personal answer, Congressman. Yes.

Mr. SENSENBRENNER. Mr. Haass.

Mr. HAASS. You are not going to like my answer, Congressman. It is not whether it is a good idea or bad idea, it is whether it is a feasible idea. And I think there are fundamental questions about the feasibility. Give me 30 seconds here.

We have 103 nuclear plants in the United States that are operational. Even with service—

Mr. SENSENBRENNER. My time is running out, sir.

Mr. HAASS. I will do it quickly.

Mr. SENSENBRENNER. It is my time, not yours. Yes or no?

Mr. HAASS. Not every question has a yes or no answer, sir.

Mr. SENSENBRENNER. You pass.

Mr. POPE. With today's technology, no. We ought to see if we can find the technology that enables nuclear power to be both safe and competitive. Today it is neither.

Mr. SENSENBRENNER. Admiral McGinn.

Admiral MCGINN. Yes, provided we can do it with adequate levels of security and in an economic way. Every dollar that we spend—

Mr. SENSENBRENNER. Thank you.

Mr. Woolsey.

Mr. WOOLSEY. Nuclear power doesn't replace oil because only 2 percent of our electricity comes from oil. Nuclear power is clean, which is good, but I would prefer an emphasis on renewables, frankly.

Mr. SENSENBRENNER. Second question is since the U.S. has got about a 200-year reserve of coal, how about clean coal as an electrical generating source? Yes or no, good idea?

General Sullivan.

General SULLIVAN. I pass.

Mr. SENSENBRENNER. Mr. Haass.

Mr. HAASS. Not until we can make it clean and not until we can capture it.

Mr. SENSENBRENNER. Thank you.

Mr. Pope.

Mr. POPE. Coal should be mined responsibly, burned cleanly, and its carbon stored safely.

Mr. SENSENBRENNER. Do I take that as a qualified yes?

Mr. POPE. Qualified yes.

Mr. SENSENBRENNER.

Mr. McGinn.

Admiral MCGINN. Clean coal for electrical production, yes. Coal for liquid, no.

Mr. SENSENBRENNER. Mr. Woolsey.

Mr. WOOLSEY. I agree with my friend, Denny McGinn, and coal—the question is can you sequester the carbon affordably. You can capture it now with IGCC. If you can sequester it affordably, it is a reasonable path and the experiments are still being worked on.

Mr. SENSENBRENNER. Now I will make an observation in the time that I have left. This shows how difficult it is for policymakers to figure out a way to wean us from our dependency on oil in a way that does not wreck our economy. I think that this is really at the heart of the debate, because if we reduce the total supply of energy, the same thing is going to happen in the United States that has happened in Europe; jobs get outsourced to Third World countries where electric generating is cheaper. And if electricity is not affordable, then factories end up being closed for certain parts of the day, as was reported in one of the major newspapers that happened as a result of the cap-and-trade policy as it applied to The Netherlands.

Thank you very much. I think you have kind of helped us to show at least how difficult this issue is. Nobody wants to wreck the economy. I yield back the balance of my time.

Admiral MCGINN. I would like to make the observation that the debate has to take place in increments greater than 5 minutes, because we were all constrained in our answers by the rules of the committee.

Mr. SENSENBRENNER. Yes. I think that we are going to be doing a lot of debating on that, and I had 5 minutes. But both of those issues had to be on the table. I thank the Chair.

The CHAIRMAN. The gentleman's time has expired. The gentleman from Oregon, Mr. Blumenauer, is recognized.

Mr. BLUMENAUER. Which is why I saved my 3 minutes in terms of having the context.

I would make an observation, with all due respect to our Ranking Member, that we are not going to advance the debate with yes or no answers. I think you have identified that in the course of your testimony here today. It is not yes or no. That is the mindset that has backed us into the situation that we are in today.

I would further comment that the notion that electric consumption is a sign of a healthy economy, I think, is highly questionable. As we look at some of the other countries around the world that by any measure are strong economically and rival the United States, they do so with a fraction of our energy consumption on a per-capita basis or industrially.

So the notion that we have to burn a lot of electricity to show that we are prosperous is, I think, sadly misguided and not supported by the facts.

I had an opportunity Friday to spend a few minutes with Douglas Durst who prides himself, I think, as being the largest developer of green buildings in the country. I had made a reference that Portland had the largest green certified platinum lead building; and I said, not for long because he is opening the Bank of America Building on 42nd Avenue.

Those green buildings are not being constructed by Mr. Durst, or in my community where Congresswoman Solis was kind enough to spend a day for me, a week ago today, where we have more green certified lead buildings than anyplace in the country. They are not being built because they are losers economically. They repay the 2 or 3 percent premium in a short period of time and the developers who are now going up and down the west coast and other places will tell you that they command a premium in rent because smart business people don't waste energy, and we are starting to do the same thing with water.

So I am hopeful in the course of this discussion we can adjust our thinking. I thought, Mr. Woolsey, your point about this being the only war where we are financing both sides, and the testimony here gave, I think, great weight to the notion that this is an economic—this is a national security issue. It is also an opportunity for economic security.

Even if the science was not compelling, which the consensus, I think, is these are risks that we should not be taking and, again, Congresswoman Solis and I had a conversation, maybe not as exciting as you had in Seattle, but business is rushing forward to take advantage of this.

I am concerned about two things that weren't mentioned in the course of your testimony. One, we are talking about higher fuel efficiency. But there was—the same way that we need to talk about conservation of energy for electricity or for oil, we have not had a word about the trip that is not taken, about shorter trips, less frequent trips, being able to locate Federal facilities in places where

it is a more efficient use, where people don't have to burn a gallon of gas to buy a gallon of milk.

I am wondering if any of our witnesses would talk for a moment about more efficient transportation systems that aren't single-occupant vehicles spread all over the countryside. Does that enter into the thinking?

Admiral MCGINN. Yes, sir, it does. It goes beyond mass transportation systems. They are certainly a part of getting a more efficient economy and a more efficient quality of life. I think it goes even more, fundamentally, than that to community and regional: by using rail-enhanced development, for example, as I know Portland is a great example for the Nation in that regard, by reducing the distances between where people live and where people work by creating wonderful downtown neighborhoods, or by moving appropriate businesses to where people live.

But the development path and development plans that the country embarks on in the future can have a tremendously beneficial effect on our energy consumption and our energy efficiency.

Mr. BLUMENAUER. Mr. Chairman, I am going to lobby you to perhaps, as we do some field hearings around the country, to be able to look at what we have been doing in Portland to give people choices, not force them on bicycles or on streetcars or trolleys or buses or car pools, but give people choices, and not make illegal by antiquated zoning—which makes it illegal in too much of America for somebody who works in a drugstore to live in an apartment above it. I think it is worth consideration.

The second question that I would put to the panel speaks to government leading by example. We are spending huge sums of money as the largest consumer of energy in the world. The United States Government is contributing to this, and not so much about rules and regulations and what-not for the rest of America, but the ability of the United States Government to say we are not going to lease or build anything that isn't lead certified by 2012; that we are not going to purchase any vehicles that do not meet our standards, and particularly for the Department of Defense, which is the—I know there is some great research that has been done.

At our first organizational meeting I think I mentioned the fact, if I understand it correctly, an aircraft carrier gets 17 feet to the gallon.

Admiral MCGINN. Those were the old fossil fuels.

Mr. BLUMENAUER. Okay. Maybe Mr. Woolsey, Mr. Pope, if you have some thoughts about how the Federal Government might be able to jump-start this and be able to get some advantage out of the process.

Mr. WOOLSEY. Congressman, I just chaired the Policy Panel for a Defense Science Board look at energy and defense, and there are a number of things that have come out of that and that can be done. One of the most important is to make it possible for military facilities in the U.S.—and also I think other places like hospitals and police stations—to be able to use locally generated electricity to replace what would come from the grid in case there is an attack on the grid or the grid just goes down by a tree branch falling, the way it did 3 years ago for New York, New England, and eastern Canada.

Most military facilities would be capable, not all, of slimming down their requirements by exactly the type of building efficiency steps you are talking about, fixing on which of those requirements are absolutely essential to carrying on the base's activities and then by using locally generated wind, solar, geothermal, others, to be able to operate for months rather than just days to hours, which is what one has with diesel generators.

This is something that is of real interest in the Defense Department right now.

Mr. BLUMENAUER. Mr. Pope, any comment on either of those?

Mr. POPE. The key function the Federal Government plays in setting an example is to create a market. If people know, if entrepreneurs know there is a Federal market for a certain kind of high-efficiency glass, they can build those factories earlier than they can—they can demonstrate that they are cost competitive and then private builders can take advantage of them.

The Federal Government should be the market creator for innovative new technologies of all kinds, inside and outside the Defense Department.

Mr. BLUMENAUER. Thank you.

The CHAIRMAN. The gentleman's time has expired. The gentleman from Arizona, Mr. Shadegg.

Mr. SHADEGG. Thank you, Mr. Chairman. I want to thank all of you for your testimony. It has been very enlightening.

Mr. Haass, let me begin with you. You made the point about our definition of energy security. I completely agree with that and the point about comprehensive approach. Obviously we have lots of alternatives, and looking at any one is ill advised.

In your testimony you talked about diversification of oil supplies, increasing domestic production, clean-burning coal, expansion of the role of nuclear. You did mention that in your testimony, though I am a little bit in doubt now where you are on that issue.

I guess I would like you to talk to me about what you believe are the right ways to look for diversified supplies here in the United States, and tell me what ones you are referring to and would support.

Mr. HAASS. Domestically in terms of, I think, coastal areas off limits, should not be off limits. I think there is some potential there, given new modern drilling technology. I think we should explore that.

I think there are two areas that should come through loud and clear. One has been alluded to several times, which is doing something about replacing oil in the transportation sector. There are things that can and should be done in the near term.

But the big long-term question on climate change is coal. A lot of this debate comes down to coal. That is where we have got to think about not—in terms of Congress and the Federal Government only licensing clean coal facilities now, and we have got to think about putting out enough money so we can figure out how to capture—more important, store, sequester the carbon.

Right now this is a big idea. It has not been proven on anything like a commercial scale. That to me has got to be one of the priorities for the U.S. Government, is to seed an awful lot of experimen-

tation and exploration so we find out the best way to do it as fast as we can learn it.

Mr. SHADEGG. One of the concerns I have, I heard a general opposition to coal gassification in this panel—that may not be a fair characterization—and yet I met over the break with a number of such people who believe, in the process of coal gassification, we can remove a lot of the carbon dioxide better than alternative uses of that coal.

Admiral MCGINN. I am very familiar with a project that is sponsored by the Department of Energy called Future Gen. Future Gen will produce a coal-fired near zero emission power plant in 2012. The four sites that are potentially going to be the site for the first plants are two in Texas and two in Illinois, are chosen for two factors: their ability to access coal for fuel as well as the geological formations that lend themselves to carbon sequestration.

There are seven regional projects sponsored by the Department of Energy in which carbon dioxide is actually being sequestered in deep wells, one of which is called Mountaineer, and it is being sponsored by American Electric Power as one of the utility companies.

Mr. SHADEGG. Time restrains you and me. One of my concerns about CO₂ sequestration is it seems to me to be a difficult, inefficient process to lock it up permanently as opposed to using it in some other way. Would all of you agree that other alternative uses we ought to pursue include expanded use of hydroelectric power?

Mr. Sullivan. If we can.

General SULLIVAN. Sure. If hydroelectric power is available, I suppose it would be great. I am not sure the water is going to be available.

Mr. SHADEGG. We have higher technology to use the in-stream flow.

Mr. Haass.

Mr. HAASS. Congressman, I support all of the renewables.

Mr. SHADEGG. Mr. Pope.

Mr. POPE. In-stream flow and other low technologies, I mean low-impact technologies, are very desirable. How scalable they are, I don't know.

Mr. SHADEGG. Mr. McGinn.

Admiral MCGINN. Yes. In an environmentally responsible way, yes.

Mr. SHADEGG. Mr. Woolsey.

Mr. WOOLSEY. Most of the big rivers that can be dammed have been dammed and one doesn't want to have any further impact on the environment by going that route. But a lot of the existing generators from dams are very inefficient, and one can get quite a few gigawatts of power out of modernizing the generation from existing hydroelectric plants.

Mr. SHADEGG. That takes me directly to an issue. In the Commerce Committee we have heard testimony on both the limitations on new energy imposed by our current new source review policies and by our transmission line setting policies. One of the witnesses testified that there is lots of wind power potentially in west Texas, but nobody there to consume it, and they can't the lines to get it out of that region.

A number of executives of electric companies came in and testified that they could put in much more efficient turbines in dams or other plants, including coal and other fossil-fueled power plants, but new source review is causing them to find that economically unviable at this point in time.

Would you all agree we ought to examine those policies? Mr. Woolsey.

Mr. WOOLSEY. I would say absolutely. We have gone beyond NIMBY for many transmission lines, to BANANA, Build Absolutely Nothing Anywhere Near Anything. We have a lot of stranded energy out there, particularly on the Great Plains, huge amounts of wind. There may be other innovative ways to get the electricity out from that sort of power generation.

But today it takes about 2 years to permit and construct a wind farm and it takes 7 to 12 years to permit and construct transmission lines, if you can make it happen.

Mr. SHADEGG. My time has expired. Is there anybody that would disagree we should not, in looking at global warming, look at those policies?

Mr. POPE. You should look at modernizing the grid. You have a grid that is outdated and cannot handle and distribute efficiently the electricity available to it because of the, frankly, poorly designed incentive structures the way the industry is deregulated. You need a modern grid as well as more grid.

General SULLIVAN. Thirty percent of the power at Schofield Barracks for Army housing will come from photovoltaic cells, and the Army community will receive money back from the power department for that. It will go into the grid.

The CHAIRMAN. The gentleman's time has expired. The gentleman from Washington State, Mr. Inslee.

Mr. INSLEE. Thank you. Mr. McGinn, I was heartened by your comment about the need of something like a new Apollo Project. I just want to let you know that I am introducing a bill called the New Apollo Energy Project that I think will fit the bill of really inspiring the country as Kennedy did.

I think we really are in a situation like we were in 1961, where we had this enormous technology potential ready to get tapped as long as we spark it and I hope we are going to spark it in the next couple years in Congress. My bill will do a whole host of things, a cap-and-trade system to drive investment into these new clean energy systems and so when you have photovoltaics on your roof, you get paid for it, your utility; green buildings standard so that we build buildings that are like the ones that Mr. Blumenauer talked about; a clean fuel standard so that when we adopt alternative fuels they really are from a global standpoint, that we are not going to another dirty fuel.

Last but not least, significant increase in R&D. I was stunned; we have cut our R&D budget in energy by 60 percent since 1979. At a time where R&D in defense has gone up 10 or 15 times, we have actually cut it by two-thirds. That is pathetic. We have got to increase it. So I was encouraged by your comment.

I want to ask you about the electrification, Mr. McGinn, and coals to liquid. I am really encouraged by the electrification of our vehicles. I drove a plug-in hybrid, I think it was the first one up

on the Hill, with 150 miles a gallon. It will be available commercially, goes 40 miles on plug-in, then runs on gasoline or flex fuel after that.

You made a comment about coal to liquid, Mr. McGinn. I want to ask you about it. I am very high on alternative fuels. Electrification, cellulosic, ethanol, biodiesel, all seem to have significant savings in global warming gases of one dimension or another. Even using the grid today has about a 30 percent increase if you do a plug-in hybrid because of the efficiency.

Coal to liquid, I just saw an EPA report, coal to liquid would have 118 percent increase, increase in carbon dioxide per gallon compared to gasoline today; and if you do sequestration, if you do sequestration during the process you still have a 3 percent increase in CO₂ according to the EPA.

Now that is a great concern to me to think we are going to start a whole new industry and end up going backwards on a global warming perspective. I noticed you mentioned when you were asked about this you said no. Is that the reason for your thoughts or are there others?

Admiral MCGINN. I think you have got it right, Congressman. It is a big assumption that we can produce liquid fuel from coal in a zero-emission environment. There is a lot of work that is ongoing to produce electricity from coal in a clean, near zero-emission type of plant. Even assuming we can do it, it is the actual chemistry of the liquid produced that has a high carbon content and therefore will negate a lot of the advantages that you would have. In fact, if you compare it to such alternative fuels as cellulosic ethanol, it isn't even in the same ball game.

The other point you make is a very, very good one. As we make decisions about going in one technological direction or policy direction or another, there are opportunity costs. If we spend billions to produce coal-to-liquid plants, that is billions that could be used to increase our efficiency of our transportation sector, our electrical utility industry, that would extract much more gross domestic product for every unit of electricity than whatever you were going to get out of that coal-to-liquid investment.

Mr. INSLEE. To my friends from coal regions I am going to suggest we need to make our investment the smart place, which is in clean coal technology to generate electricity. If we do that, we have the capacity of reducing CO₂ and, importantly, selling this technology to China. This Ramgen that has developed compression, they want to sell this to China. We all know we have to get China on board. This is an economic opportunity if we play our cards right. But if we do it wrong, we are going to end up going backwards both economically on CO₂.

So for those who have resisted dealing with global warming because they are afraid of China or because they are afraid of our ability to use coal, I would suggest we need to find a bipartisan way to move forward on clean coal research to electricity rather than coal to liquids. Anybody else want to comment?

Admiral MCGINN. I agree with that. Just one caveat is we need to make sure we understand what the full environmental impacts of coal extraction or coal mining are.

Mr. INSLEE. As Mr. Pope said, mined responsibly, burned cleanly, and forgot the third one.

Mr. POPE. Carbon sequestered safely.

The CHAIRMAN. The gentleman's time has expired.

The gentleman from Oregon, Mr. Walden.

Mr. WALDEN. Thank you very much, Mr. Chairman. I want to thank the witnesses for your testimony today. It has been both enlightening and helpful in our efforts.

I want to touch on a couple of things. One of the things I learned during the break regarding ethanol and biodiesel is the other side of the story, which is what to do with the wet distiller's grain or dry distiller's grain after you produce the ethanol. At a PowerPoint presentation at Pendleton Grain Growers a scientist there was talking to me about biodiesel. And pointed out that for a 100-million-gallon-a-year biodiesel plant you would need 900,000 tons of feedstock, using canola grown on a million acres, that would produce 540,000 tons of meal, for which it would take 570,000 cows to consume, and you would have 10, I believe million, 10 million gallons of glycerine as a byprod. That is just for a 100 million plant for biodiesel.

This was one of the issues I know we looked at ethanol, was the wet distiller's grain, 4 to 7 days before it starts fermenting again. And there is this whole downside. I was down in Klamath Falls and a rancher said, let me tell you what ethanol has meant to me: \$100,000 higher cost to finish my beef because of the price of corn.

So I am intrigued by especially the military folks and all talking about the displacement that may occur in some of these nations as drought sets in. We see the same sort of potential, I think, as the price of food goes up. Wheat is now chasing corn up over \$4 a bushel and even higher in some areas. I am just concerned about both what it takes to get the feedstock to grow our way into alternatives, as much as I support them, and then what you do with the byproduct.

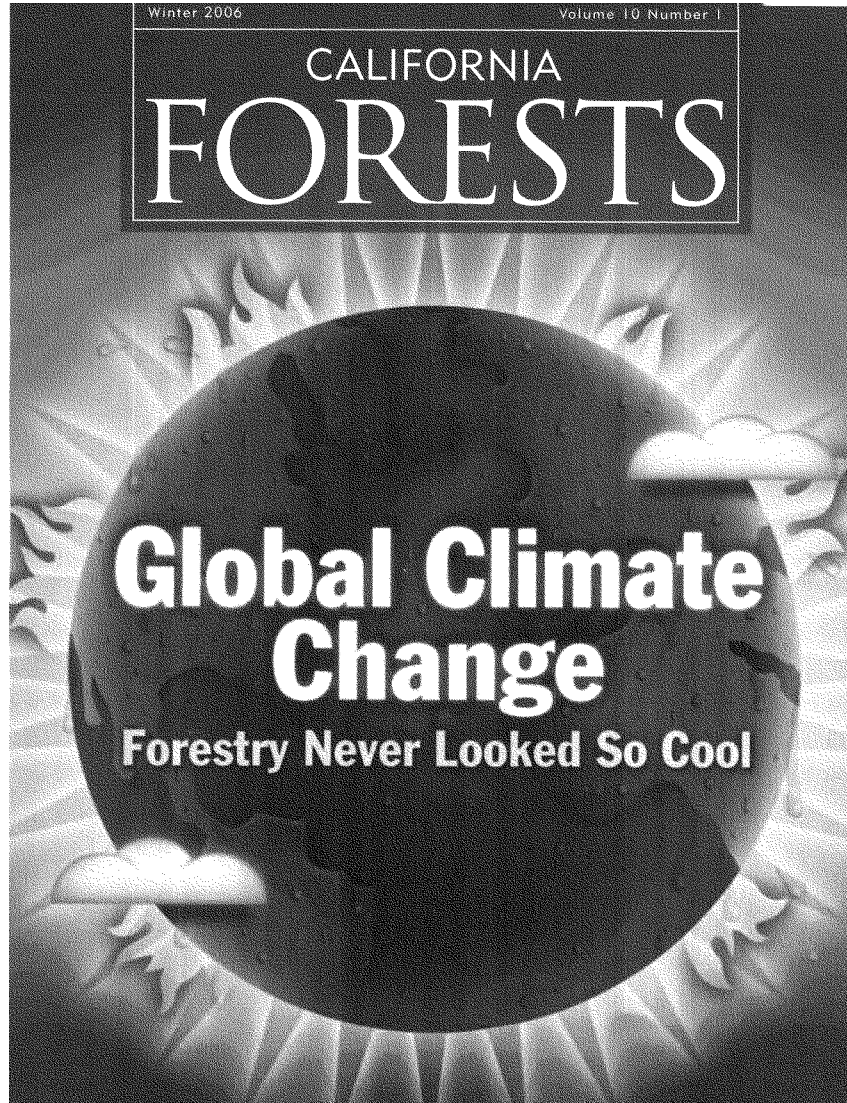
Mr. WOOLSEY. This is why it is important to move away from food-based feedstocks and toward cellulosic biomass. I serve on the National Energy Policy Commission and we did some pretty careful studies and calculations on this. If you move to something like switchgrass, the prairie grass that was out there when the buffalo were there, you can grow enough of that over the course of evolution—we looked at the next 20 years, and reasonable increases in yield, reasonable improvements in automobile mileage—you can grow enough switchgrass on 7 percent of U.S. farmland, which is what is called the conversation reserve program, the soil bank. It is over half now planted in switchgrass. If you grew that just in switchgrass, that 30 million acres, turned that into cellulosic ethanol, you would be able to replace about half of the country's gasoline. Now, that assumes some modest growth in mileage along the lines of what the Chairman and others of you have suggested for automobile vehicles and assumes a modest increase in yield.

Mr. WALDEN. Let me talk too about—I obviously represent 10 national forests. Enormous amount of woody biomass. People are going to get sick of me talking about forests. You can use woody biomass as an ingredient. We have catastrophic fires.

Mr. Chairman, I would like to put in this record—and I will get you a copy of this for that purpose—a publication from California Forests. I hope our committee members—I will make it available to them individually. A lot of activity going on in the State of California on forest management practices as a way to use forests as a carbon sink. I don't know, Mr. Haass, Mr. Woolsey.

The CHAIRMAN. Without objection we will include that in the record. If you have copies we will distribute it.

[The information follows:]



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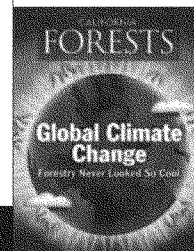
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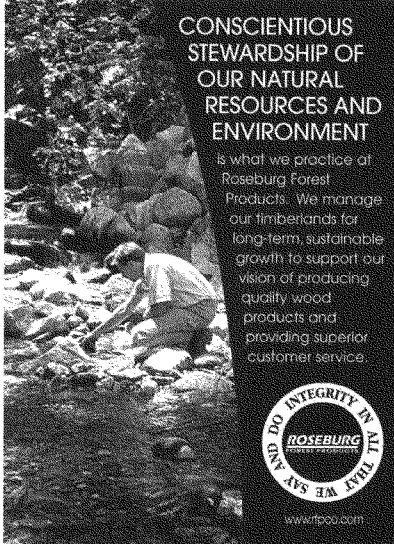
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PRESIDENT'S MESSAGE

Forestry's Carbon Balancing Act



David A. Bischof
President, CFA

Nature is full of cycles. There are life cycles, energy cycles, and now taking center stage, a carbon cycle.

Carbon naturally cycles through earth's atmosphere, oceans, soils and vegetation. We are currently experiencing relatively high concentrations of atmospheric carbon. Though neither the causes nor effects on our climate are fully understood, many people draw correlations between carbon emissions and global warming.

Climate change is a hot topic in social circles, the media and at universities. Carbon policies are being debated at global, national and state levels.

Governor Schwarzenegger has assembled a climate action team to implement global warming emission reduction programs. He has also taken a leadership position on environmental issues. Supporting sustainable forestry in California is a logical way to help obtain his climate change objectives and uphold California's environmental values.

Nobody knows exactly what affect human activities have on climate cycles. But what is certain is that sustainable forestry removes carbon from the air efficiently and effectively. Carbon storage, or sequestration, is a natural by-product of sustainable forestry cycles. Sustainable forestry also ensures that forestland stays forested.

Trees in well-managed forests excel at removing carbon from the atmosphere. They store it in leaves, roots and wood fiber. Trees sequester carbon most efficiently during their peak growing years. Once they mature, their sequestration rate slows, though carbon stays trapped in their wood. Harvesting trees once their optimum growth rates are achieved maximizes their carbon sequestration potential, and turning those trees into products (like lumber for homes) sequesters that carbon for decades if not centuries. Replanting the forest completes the forestry cycle and continues the carbon sequestration cycle.

Unfortunately, sustainable forestry in California faces significant challenges. While California foresters perform to the highest environmental standards in the world, duplicative regulatory processes have inflated the cost of doing business to the point where private landowners are pressured to sell out and see their land converted to non-forest uses. A recent study from Cal Poly University, San Luis Obispo found that forestry-planning costs have increased 1,200 percent in the last 30 years. Another Cal Poly study found that over-regulation has the unintended consequence of encouraging forestland conversion.

Last May, forestry company representatives, environmental groups, academics and government officials met at a conference sponsored by UC Berkeley and the Pacific Forest Trust to address the threat of forest loss and fragmentation. Forest loss in California has implications far beyond our borders -- we already import nearly 80 percent of our wood, and losing forests means losing an important tool for addressing atmospheric carbon...and that those forests won't be here for future generations. Retaining our working forests is an environmental objective we should all rally behind.

We should not shy away from using wood -- it is a remarkable renewable resource with environmental advantages over nearly all other building materials. We should embrace the value of sustainable forestry as it pertains to global carbon cycles.

Governor Schwarzenegger has positioned California to be a leader in addressing climate change. Policymakers throughout the state should recognize forestry and working forests as critical to our state's economic and environmental wellbeing, and take steps to ensure a future for sustainable forestry in California. ■

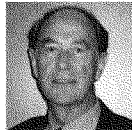
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Kenneth Green, Ph.D. is the executive director of the Environmental Literacy Council. He received his doctorate in environmental science and engineering from UCLA.
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John A. Helms, Ph.D. is professor emeritus of forestry at the University of California, Berkeley, and current president of the Society of American Foresters.
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John Kadyszewski is the coordinator for Winrock International's Ecosystem Services Group. He launched Winrock's work on biomass energy in 1989 and is now responsible for implementing pilot projects for the West Coast Carbon Sequestration Partnership (WESTCARB) funded by the U.S. Department of Energy.
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Bruce Lippke, Ph.D. is a professor at the University of Washington's College of Forest Resources and president of the Consortium for Research on Renewable Industrial Materials (CORRIM), a non-profit collaborative of 15 research institutions. CORRIM research has been funded by the USDA Forest Service R&D and Forest Products Lab, U.S. Dept. of Energy, consortium members and private companies.
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Patrick Moore, Ph.D. is a co-founder of Greenpeace, holds a doctorate degree in ecology, founded and chaired the BC Carbon Project in 1990, and is now chairman and chief scientist of Greenspirit Strategies Ltd. in Vancouver, Canada.
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(Interview on Page 16)



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(Story on Page 21)

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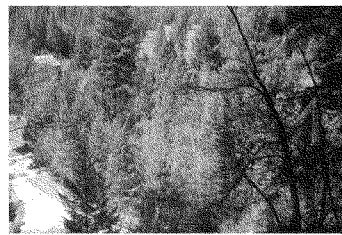


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Fruit Growers Original Mill Site Circa 1900



Same Location in 2005 After Three Harvests



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Forest Management: Part of the Climate Change Solution

TREES ARE THE MOST POWERFUL CONCENTRATORS OF CARBON ON EARTH

This is a win-win situation for both the economy and the environment. One of the best ways to address climate change is to use more wood, not less.

Wooden furniture made in the Elizabethan era still holds the carbon fixed hundreds of years ago.

By Patrick Moore, Ph.D.

As the world looks for ways to keep carbon dioxide (CO₂) – the greenhouse gas produced by burning fossil fuels – out of our atmosphere, science tells us managed forests will play a key role.

Trees are the most powerful concentrators of carbon on Earth. Through photosynthesis, they absorb CO₂ from the atmosphere and store it in their wood, which is nearly 50 percent carbon by weight.

You might be surprised to learn young forests outperform old growth in carbon absorption. Although old trees contain large amounts of carbon, their rate of absorption has slowed to a near halt. A young tree, although it contains little fixed carbon, pulls CO₂ from the atmosphere at a much faster rate.

While it is true that cutting down an old tree results in a net release of carbon, new trees growing in their place can more than make up the difference. And wooden furniture made in the Elizabethan era still holds the carbon fixed hundreds of years ago.

Taking carbon out of the air

The relationship between trees and greenhouse gases is simple enough on the surface. Trees grow by taking carbon dioxide from the atmosphere and, through photosynthesis, converting it into sugars. The sugars are then used as energy and material to build the cellulose and lignin that are the main constituents of wood.

When a tree rots or burns the carbon contained in the wood is released back to the atmosphere.

Active forest management, such as thinning, removing dead trees, and clearing debris from the forest floor is very effective in reducing the number and intensity of forest fires. And the wood that is removed can be put to good use for lumber, paper and energy.

Accounting provides a useful metaphor to discuss forests and carbon sequestration. Old-growth forests often have a large "balance" of carbon that has built up over time in wood and soil. They are not adding much new carbon because they are decaying at about the same rate as they are growing. In financial terms, this is like a company that has a lot of assets but is operating on a break-even basis. Young forests have a smaller balance of carbon compared to old forests but they are accumulating carbon at a rapid rate. In that sense they are like an emerging company that has few assets but is very profitable and growing rapidly.

The impact of forests on the global carbon cycle can be boiled down to these key points:

- On the negative side, the most important factor influencing the carbon cycle is deforestation, which results in a permanent loss of forest cover and a large release of CO₂ into the atmosphere. Deforestation – which occurs primarily in tropical countries where forests are permanently cleared and converted to



Young forests have a smaller balance of carbon compared to old forests but they accumulate carbon at a rapid rate. In that sense they are like an emerging company that has few assets but is very profitable and growing rapidly.

agriculture and urban settlement – is responsible for about 20 percent of global CO2 emissions.¹

On the positive side, planting fast-growing trees is the best way to absorb CO2 from the atmosphere. Many countries with temperate forests have seen an increase in carbon stored in trees in recent years. This includes New Zealand, the United States, Sweden and Canada. Plus, using wood sustainably reduces the need for non-renewable fossil fuels and materials such as steel and concrete – the very causes of CO2 emissions in the first place.

The good news is that forests in the United States are net carbon sinks, since annual growth exceeds annual harvest. We are currently experiencing an increase in forested land as forests are being re-established on land previously used for agriculture. Catastrophic wildfires are uncommon in managed forests, whereas millions of acres of unmanaged forests burn every year due to excessive build-up of dead trees and woody debris.

How wood stacks up

Every wood substitute, including steel, plastic and cement, requires far more energy to produce

than lumber. More energy usually translates into more greenhouse gases in the form of fossil fuel consumption or cement production.

Some activists would have us believe using wood is bad for forests. Yet we are the largest per-capita consumers of wood in the world, and North American forests cover approximately the same area of land as they did 100 years ago. According to the United Nations, our forests have expanded nearly 10 million acres over the past decade.

This is precisely because we use a lot of wood, which sends a signal to the marketplace to grow more trees to meet demand. This is a win-win situation for both the economy and the environment. One of the best ways to address climate change is to use more wood, not less. Wood is simply the most abundant, biodegradable and renewable material on the planet.

It is hard to imagine a more all-purpose, environmentally friendly act than that of contributing to the number and variety of trees growing throughout the world. In the age of climate change, Johnny Appleseed takes on a new meaning.

¹ Intergovernmental Panel on Climate Change, IPCC First Assessment Report Overview, August 1990.



How Forests Can Combat Climate Change

VITALITY IS THE KEY TO REMOVING CARBON FROM THE AIR



When the capacity of old forests to remove carbon is measured against young forests, old forests come up short. In young forests, the uptake of carbon dioxide greatly exceeds the loss. The reverse can be true for very old forests.

By John A. Helms, Ph.D.

It is well known that human activities like burning fossil fuels that pump carbon into the atmosphere are likely contributing to global warming. While we must seek ways to reduce carbon pollution there is another approach that, in effect, enables us to buy time – that is to capitalize on the remarkably efficient capacity of trees to remove carbon from the atmosphere.

In particular, it's the young trees and forests that are most efficient in taking up carbon. Not that old forests don't contribute – they do. But when their capacity to remove carbon is measured against young forests, old forests come up short.

First, though, a little Biology 101: Trees take up carbon dioxide from the air and return oxygen in the process of photosynthesis. The carbon is stored in leaves, branches, stems and roots. However, trees also respire some carbon dioxide back to the atmosphere. In young forests, the uptake of carbon dioxide greatly exceeds the loss due to respiration. The reverse can be true for very old forests. This prompts two questions: Can we enhance a forest's capacity to store, or sequester, carbon? And if so, what's the best way to do it?

The answer to the first question is fairly straightforward. Increasing carbon storage in forests goes hand-in-hand with other forest management goals, such as providing essential wood products, enhancing watershed health and maintaining biodiversity across the landscape. What's good for forest health is good for carbon sequestration. Active forest management can certainly increase carbon sequestration,

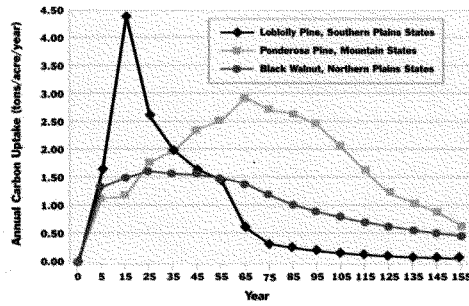
especially when the carbon forests capture is put into long-term storage such as in wood products like lumber for building construction.

So how do we enhance carbon sequestration by forests? By improving growing conditions, controlling stand density, increasing tree vigor, examining the implication of rotation lengths and encouraging the development of urban forests. The more rapidly leaves are produced, the quicker leaf area reaches maximum for that given site, and the more carbon is taken out of the atmosphere and stored. The faster a tree grows, the more effective it is at removing carbon from the air. Creating ideal conditions for growing trees also creates ideal opportunities for carbon sequestration.

As forests become older, the rate at which they take up carbon dioxide slows and the rate at which they lose carbon to the atmosphere through respiration and decomposition accelerates. However, older forests with many large trees store more carbon than young forests. In short, there is a trade off in that young forests are better at sequestering carbon, but older forests have higher storage capacity.

Younger Forests, Greater Carbon Sequestration

Carbon sequestration rates for three region/species combination



Source: Stavits and Richards, 2005

Younger trees sequester carbon at a faster rate than older trees. In California's mixed conifer forests, the annual rate of net carbon uptake would likely increase rapidly in early years, much like the loblolly pine trend line shown, and sustain higher rates longer like the ponderosa pine. Site quality and stand density affect sequestration rates and the total carbon sequestered.

Forest management, focused on the goal

The climate-helping character of young forests should be a boon to society because whether you're interested in wood production or carbon sequestration, the forest-management approaches are similar: you want to increase leaf area, maintain forest health and accelerate growth. That means thinning forests to remove the less vigorous trees, leaving the rapidly growing trees. Replanting the land with fast-growing, young trees quickly restores the forest canopy which continues the process of sequestering carbon.

The same forest-management techniques that maintain healthy forests and sequester carbon offer another climate-change benefit: they reduce the threat of high-intensity wildfires that release tremendous amounts of carbon into the air in a single, catastrophic event.

Active management, active sequestration

To increase the capacity of forests to sequester and store carbon we need to maintain and enhance California's forestland base. We must

recognize the negative effects of loss of forests to urban sprawl and development. We should also give careful consideration to encouraging the conversion of marginal agricultural and range lands to forests.

Just how forest management can best be deployed in the effort to increase carbon sequestration is debatable. Although there's currently no market incentive in place to manage forestland to store carbon, California established the Climate Action Registry in 2001 and is refining protocols that may eventually reward forest management activities that increase carbon sequestration. Without financial incentives it is unlikely that forests will reach their full carbon sequestration potential.

But this much is certain: rapidly growing trees sequester carbon more quickly and efficiently than old ones. That fact should stay front and center in policy discussions. If we want to maximize carbon sequestration and storage, we need forest management that results in healthy forests of all ages on the landscape. That means sustainable forestry and plenty of young forests. ■

What's good for forest health is good for carbon sequestration. Active forest management can certainly increase carbon sequestration.

This much is certain: rapidly growing trees sequester carbon more quickly and efficiently than old ones.

The Unseen Connection:
**Building Materials
 and Climate Change**

INCOMPLETE DATA SKEWS THE IMPACT OF ENVIRONMENTALLY
 FOCUSED BUILDING STANDARDS

You might expect "green" building standards to reduce greenhouse gas emissions or favor removing carbon from the air. But don't count on it.

No green building standard today adequately addresses the carbon stored in wood products or the value in substituting wood for fossil-fuel intensive materials.

By Bruce Lippke, Ph.D.

Before you buy breakfast cereal, you have a pretty good idea of what you're getting. The label on the Wheaties box gives you information about carbohydrates, saturated fats, calories, sodium and so on. You may not always choose the healthiest cereal, but that's up to you.

"Green" building standards should come with the kind of label breakfast foods do.

Environmentalists exploiting fears over global warming have thrust building standards aimed at "environmentally friendly" design and construction into the limelight. So, you might expect those standards to reduce greenhouse gas emissions. You might expect them to favor removing carbon — an element frequently linked to global warming — from the air.

But don't count on it. Instead, the few green building standards that exist today provide incomplete data and often reflect more about a sponsor organization's agenda than a true scientifically based environmental footprint. As a result, states and municipalities that adopt these standards get a skewed perspective of construction's impact and may inadvertently contribute to global warming.

That's where life-cycle inventories and assessment (LCI/LCA) comes in, or should.

Seeing the bigger picture

LCI essentially measures all inputs and outputs for every stage of processing a building material from origin through construction, producing a comprehensive set of data. LCA aggregates the data into key environmental risk indices like global warming potential and water pollution.

By comparing building assemblies using different products and manufacturing processes, LCA makes clear the trade-offs between one building material and another. It measures the environmental effects of each material from forest management or extraction to product manufacturing, transportation, building use and final disposal or recycling.

Lacking sufficient information, some green building standards promote the use of non-renewable resources over renewable resources even when they consume much more fossil-fuel energy. An LCA shows that using steel and concrete results in more greenhouse gas emissions, more energy consumption, and greater water quality degradation than using wood.

Measuring wood's performance

Recent work by the Consortium for Research on Renewable Industrial Materials (CORRIM) compared steel, concrete and wood in residential home construction. In Minneapolis, a wood frame house was compared to a steel frame house. In Atlanta, wood was compared to concrete. The study found that using steel in the above-grade wall generates 33 percent more greenhouse gas emissions than wood, and concrete 80 percent more.

In fact, wood outperformed steel in terms of greenhouse gases, energy use, air and water

emissions. The wood wall outperformed concrete in all measures except water pollution, which showed no difference.

A closer look at greenhouse gases reveals wood's unique advantages in addressing global climate change. Trees remove carbon from the air (first positive impact) and store it in long-lived wood products (second positive impact). Furthermore, wood is used to generate clean energy in biomass or cogeneration facilities (third positive impact). Already, the majority of energy used in wood processing is generated from wood residuals like bark.

Using wood products reduces the need to burn fossil fuels for concrete and steel products, which reduces the amount of carbon released into the atmosphere (fourth positive impact). Forests can also be regenerated, so while much of the carbon from a harvested forest remains sequestered in wood products, growing new trees takes more carbon out of the air (fifth positive impact).

In contrast, using steel or concrete depletes a non-replaceable resource and emits greenhouse gases. Yet, there is an apparent anti-wood bias in some green building standards.

Shortsighted analysis, long-term detriment

No green building standard today employs LCA, nor do they adequately address the carbon stored in wood products or the value in substituting wood for fossil-fuel intensive materials. Adopting LCA, now up for consideration, would require a dramatic overhaul of current rating systems.

Sustainable forest management leverages a renewable resource and reduces greenhouse gas emissions. CORRIM's research further shows that forest management can be adapted to maximize carbon sequestration. For example, intensive forest management that can grow more wood on shorter rotations rather than longer intervals between harvesting can sequester more total carbon over time. Frequently trapping carbon in wood products can capitalize on young trees' rapid growth to sequester carbon and more quickly create opportunities to replace the use of fossil fuel-intensive building materials like concrete or steel.

Ignoring the carbon stored in wood products and the impact of non-wood substitution can result in misleading building guidelines, flawed policies and unintended environmental consequences.

The core problem with green building standards today is insufficient or skewed data. They miss the

Understanding the Value of Wood

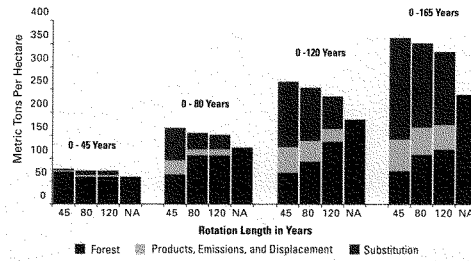
Environmental performance indices for above-grade wall designs.

Minneapolis house	Wood frame	Steel frame	Difference	Steel vs. wood (% change)
Embodied energy (GJ)	250	296	46	18%
Global warming potential (CO ₂ kg)	13,009	17,252	4,253	33%
Air emission index (index scale)	3,820	4,222	402	11%
Water emission index (index scale)	3	29	26	867%
Solid waste (total kg)	3,496	3,181	-315	-9%

Atlanta house	Wood frame	Concrete frame	Difference	Concrete vs. wood (% change)
Embodied energy (GJ)	168	231	63	38%
Global warming potential (CO ₂ kg)	8,345	14,982	6,637	80%
Air emission index (index scale)	2,313	3,373	1,060	46%
Water emission index (index scale)	2	2	0	0%
Solid waste (total kg)	2,325	6,152	3,827	164%

Shorter Rotations, More Carbon Sequestered

Average annual carbon in forest, product, and concrete substitution pools for different rotations and specified intervals.



mark on greenhouse gas emissions. LCA can address this problem.

It's like the cereal box label: you need to know what you're getting before you choose. When energy consumption labels were put on refrigerators, units with low efficiency were driven out of the market quickly. LCA offers the chance to make an informed decision when designing building components and selecting building designs.

The complete CORRIM study is available online at: www.CORRIM.com

Shorter harvest intervals can increase the total amount of carbon sequestered by increasing the carbon stored in wood product pools and displacing carbon emissions by substituting wood products for other building materials sooner.

Source: CORRIM, 2004

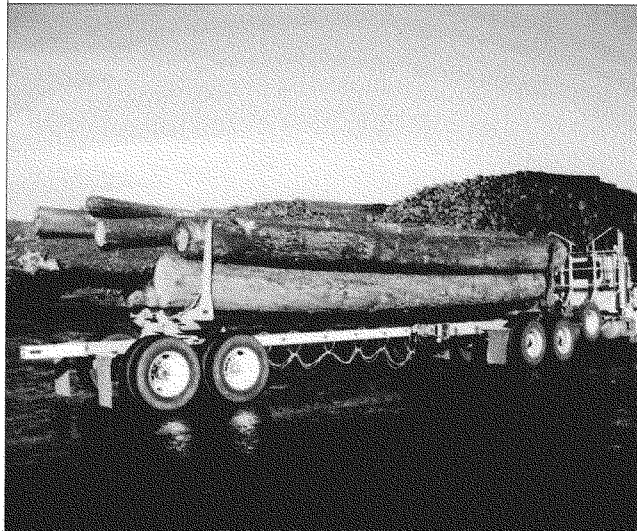
Beyond Reducing Emissions

FORESTS CAN PLAY A LARGER ROLE IN ADDRESSING CLIMATE CHANGE

The immediate storing of carbon in wood products and young forests, the reduced risk of wildfire on managed land, and clean energy production potential all highlight the value of forest management in addressing global climate change.

By Kenneth Green, Ph.D.

When it comes to global climate change, we know the basic dynamic – the climate is an ever-changing system that has recently entered a warming period, and human activities such as greenhouse gas emissions and land use changes are likely contributors to that warming. But beyond that, we know very little about the probable extent of change, or which human activities have the strongest impact on the climate.



>> About 70 percent of the carbon in every log brought to a sawmill is sequestered in wood products.

That ignorance should spur a broad range of explorations to determine the full spectrum of our policy options.

Unfortunately, rather than asking hard questions and looking even-handedly at a range of both interceptive and adaptive options, the overwhelming focus of climate change discussion has focused on the idea of reducing greenhouse gas emissions. Far less attention is paid to options that pull greenhouse gases out of the air (called sequestration), or finding ways to adapt to climate changes at the local level. We need to go beyond the current tunnel-vision approach that examines one element of the climate change equation (greenhouse gas emissions) without considering the factors that affect it. To that end, let's look outside of the "reduce emissions" box and talk about the "pull the carbon out of the air" approach. Numerous research studies have shown that forestry holds excellent potential for removing carbon from the air. When trees grow, they absorb carbon dioxide (CO₂) from the atmosphere and separate the carbon atom from the oxygen atoms through photosynthesis. The tree returns the oxygen to the atmosphere but uses the carbon to build its own structure in the form of wood fiber, roots and leaves. Healthy, rapidly growing forests function as efficient air cleaners and carbon holders, constantly adding wood fiber and releasing oxygen.

Wood also continues to store, or sequester, carbon long after trees have been harvested. The carbon stays trapped in the wood, locked in the lumber, furniture or paper product the tree becomes. In California, about 70 percent of the carbon in every log brought to a sawmill is sequestered in wood products.

This simple fact has been too frequently overlooked in climate change discussions. According to researchers, failure to account for the long-term storage of carbon in wood-based products has caused overestimates of worldwide CO₂ emissions by 10 percent.

Action beats preservation

To fully understand the forest's role in carbon sequestration, we must consider the potential energy-saving and product-storing impact of actively managing forests rather than simply "preserving" them as they are. All forests sequester carbon, but not equally.

Compared to simply preserving a mature forest as it is, the use of advanced forest management techniques – including forest thinning, "stand"

improvement, fire protection, competition control and pest management – can enhance the removal of carbon dioxide by improving forest growth. Over the long haul, such practices can sequester more carbon in forests, displace more non-renewable fossil fuel energy, and store greater amounts of carbon in products than simple forest preservation alone can.

According to the USDA Forest Service, managed forests in the United States remove approximately 310 million metric tons of carbon, or 17 percent of U.S. greenhouse gas emissions, per year. This is equivalent to removing the carbon dioxide emissions from 235 million automobiles on the road per year.

More aggressive forest management could subtract even greater amounts of carbon. Managed forests provide beneficial growing conditions and efficient carbon sequestration. Furthermore, tree harvesting essentially transfers the carbon from one "pool" – the forest pool – to another – the product pool – where it can stay for hundreds of years. Post-harvest replanting starts the cycle over again. Through sustainable forestry, a single land mass can provide a continual, effective source of carbon sequestration.

The immediate storing of carbon in wood products and young forests, the reduced risk of wildfire on managed land, and clean energy production potential, all highlight the potential value of forest management in addressing global climate change.

Multiple options, maximum value

There are many different approaches that we might take to the question of manmade climate change – it's not a one-dimensional issue. We could choose to reduce greenhouse gas emissions, or pull carbon dioxide out of the air through sequestration processes, or focus on adapting to the change that we already think is waiting in the climate pipeline, or we could look at "all of the above."

Policies aimed at affecting global climate change will inevitably involve trade-offs – ecosystems and economic systems are inexorably linked. Looking at only one part of the picture (greenhouse gas emissions) while giving short shrift to options like forestry-based sequestration is likely to lead society to make policy decisions that are ultimately less effective, and wasteful of the resources that we need to continue building prosperity around the world.

The opinions expressed here are solely those of the author.



Wood products provide long-term carbon sequestration.

Carbon stays trapped in the wood, locked in the lumber, furniture or paper product the tree becomes.

All forests sequester carbon, but not equally. Compared to simply preserving a mature forest, forest management can enhance the removal of carbon dioxide.

Address Air Pollution at its Roots

MANAGED FORESTLAND CAN HELP CLEAR THE AIR

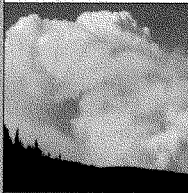


Photo courtesy of Alaska Division of Forestry

When a forest
isn't burning,
it's helping to clean
the air.

Not managing
forests, leaving
them to grow
overcrowded, invites
short and long-term air
quality degradation.

California Forests interviewed Gabriele Pfister, Ph.D. Following is a text of her remarks.

Scientists know that when forests burn, air quality suffers. The summer of 2004 provided a unique opportunity to see just how badly.

That year, particularly intense wildfires blazed through Alaska and Canada, driven by unusually warm and dry weather. For more than two months, wildfires burned more than 11 million acres and spewed as much carbon monoxide into the air as all the cars and factories in the continental United States combined in those same months.

The same wildfires increased ground-level ozone by up to an estimated 25 percent in parts of the northern United States and 10 percent as far away as Europe during intense burning.

Poor air quality aggravates asthma and leads to other ailments. Carbon monoxide can cause nervous system and brain damage. Ozone irritates the eyes, nose and respiratory systems and may increase the risk of heart attack.

If we really want cleaner air, we must understand where pollutants come from and how they interact with our atmosphere, then address air quality threats at the source.

Capitalizing on a scientific opportunity

The International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) study conducted during the time of the Alaskan and Canadian wildfires captured uniquely comprehensive measurements of the effect of catastrophic wildfires on air quality.

Using satellite, air- and land-based monitoring technology, this campaign traced wildfire plumes throughout North America and all the

way to Western Europe. Those efforts are helping researchers to distinguish wildfire pollutants from other pollutants and study the impact these fires had on atmospheric composition.

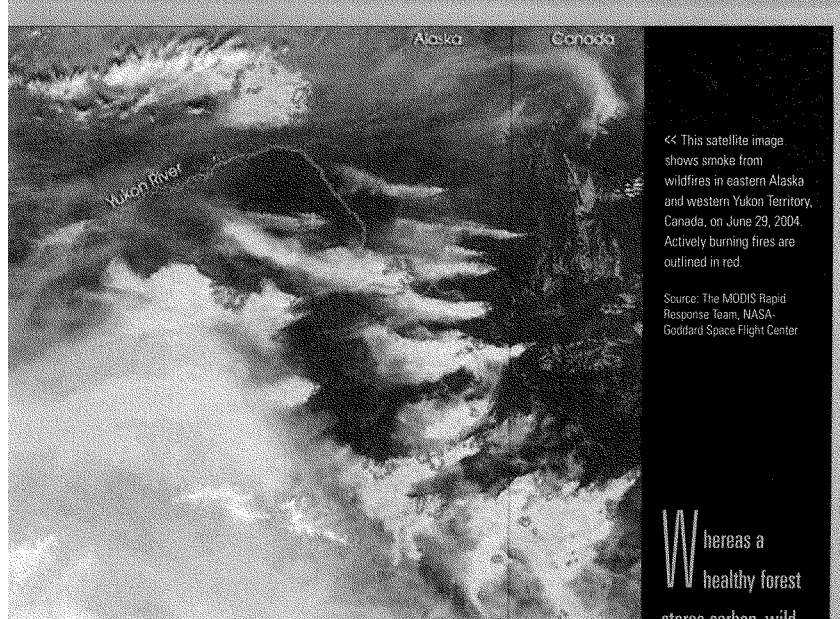
Human activities like burning fossil fuels account for major contributions to the elevated pollutant levels in the atmosphere, and reducing fossil-fuel emissions is a necessary step toward better air.

Wildfire smoke releases similar pollutants as automobile tailpipes, and millions of acres of forestland burn every year in North America. With wildfires, reducing pollution at the source is feasible and can have doubly positive effects on atmospheric carbon concentrations. When a forest isn't burning, it's helping to clean the air.

Forest vegetation removes carbon dioxide from the air through photosynthesis. Trees store the carbon as wood fiber and release oxygen to the air. Trees also capture trace elements of other gases that if left in the atmosphere can contribute to poor air quality.

Whereas a healthy forest stores carbon, wildfires release carbon. When the forest burns, all of the carbon that was trapped in the wood is released in one massive outburst. Chemical reactions in the smoke trigger ozone production, and ash can fill the sky for hundreds, even thousands of miles.

Eventually, the carbon released in wildfires will be offset by the up-take during forest re-growth. But in the near term, the massive release of



<< This satellite image shows smoke from wildfires in eastern Alaska and western Yukon Territory, Canada, on June 29, 2004. Actively burning fires are outlined in red.

Source: The MODIS Rapid Response Team, NASA-Goddard Space Flight Center

carbon in a fire can throw natural systems out of balance – an effect made worse because many unmanaged forests in the West have become overcrowded. Human fire suppression efforts have put out natural fires that would have thinned the forest for a century. That extra forest fuel contains extra carbon.

Hands-on approach can help air quality

Managing a forest can reduce fuel loads and the frequency of catastrophic fires. It simultaneously prevents the mass-release of carbon and accelerates the absorption of carbon from the air by growing trees and producing wood products that store carbon long-term.

Not managing forests, leaving them to grow overcrowded, invites short and long-term air quality degradation. Here's why: Catastrophic wildfires can pour thousands of tons of trace gases and particulate matter into the air. Carbon dioxide and other gases emitted by fires (e.g. methane) or produced from fire emissions (e.g. ozone) are greenhouse gases and contribute to an increase

in global temperatures, which, in turn, could lead to more droughts, thus increasing the incident of wildfires in boreal forests.

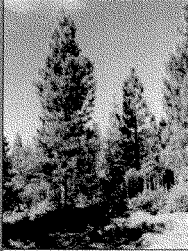
Actions after a fire can have an impact on air quality. Private forestland managers replant after fires to accelerate the return of a healthy forest. Much charred public forestland goes without reforestation. According to a 2005 survey by The Forest Foundation, only 28 percent of California's severely burned national forestland in 2001 has been replanted, and only 43 percent will ever be replanted. Replanting a burned forest prevents the landscape from turning to brush fields or rangeland, both of which store far less carbon than a thriving forest.

While we look for ways to reduce emissions from our freeways and factories, as we must to conserve a healthy environment, we might also want to consider ways to neutralize the impact of similar emissions from wildfires. Managing forestland so it stores carbon rather than mass-releases it, so trees grow rather than burn, could help us all breathe a little easier. ■

Whereas a healthy forest stores carbon, wildfires release carbon. When the forest burns, all of the carbon that was trapped in the wood is released in one massive outburst.

Global Warming, Ice Ages and Forests

FORESTS CHANGE WITH THE TIMES, AND ENDURE



By Thomas M. Bonnicksen, Ph.D.

We live in an Ice Age. You may find this surprising because most people think our climate is stable and warm, and the Ice Age is just something that happened long ago. Think again.

We must keep our forests more open to mimic the way they looked when the climate was hotter and low-level fires more frequent.

Mile high sheets of ice slid southward 17 times during the last 1.65 million years. Each time they melted as the climate warmed, then they returned. Together these warm and cold periods form Ice Ages.

Cold periods lasted about 100,000 years and warm periods lasted up to 20,000 years. The last cold period was the Pleistocene. We live at the end of the most recent warm period, the Holocene, which counterintuitive as it may seem, is still part of an Ice Age.

We know that Earth's surface temperature increased 0.5 – 1 degree F in the last century. We also know that atmospheric carbon dioxide (CO₂) has increased 31 percent since 1750, although how much comes from human activity is uncertain. Finally, we know CO₂ is a greenhouse gas that can trap heat in the atmosphere. Many people then jump to the conclusion that CO₂ emissions from burning fossil fuels are the primary cause of global warming. They may be right, but they also may be wrong. Just because two things happen at the same time doesn't mean one causes the other.

No single influence

We cannot isolate one cause of global warming since many natural forces and human activities, including today's unnaturally large forest fires, influence earth's climate in unpredictable ways. As the Environmental Protection Agency (EPA) points out, "scientists think rising levels of green-

house gases in the atmosphere are contributing to global warming; but to what extent is difficult to determine."

So many things influence earth's climate that temperatures rise and fall in short irregular cycles even within long cold and warm periods. Earth has experienced cold snaps as it has warmed, spikes in temperature as it has cooled, and extended periods of extreme temperatures. Earth's climate is never stable and neither are forests. The forests we see today seem permanent, but science shows that they have assembled from tree species that moved from place to place in response to climatic changes.

Roughly 12,900 years ago, for instance, earth had been warming for thousands of years when temperatures dropped back to full glacial conditions. This event, known as the Younger Dryas cold period, lasted 1,300 years. Then the warming trend abruptly resumed.

Some 9,000 years ago, during the Holocene Maximum, temperatures rose to 4 degrees F warmer than today. Many meadows went dry in California's Sierra Nevada and lake levels dropped throughout the West. The drought also robbed the Great Basin of much of its moisture and previous Ice Age lakes disappeared.

This Great Drought, which lasted 4,000 years, profoundly influenced people and forests throughout the world. For example, Paleoindian tribes in eastern North America thrived because nut-bearing trees such as oak, hickory, beech,

and chestnut expanded their range while people who lived on the Great Plains suffered. This also was the time when thick forests of Douglas fir, western hemlock, and alder spread over vast areas in the Pacific Northwest.

Middle-age warmth

Global temperatures have dropped and risen many times since the Great Drought. The climate grew significantly warmer during the Medieval Warm Period that extended from AD 900 to 1300. As a result, foxtail pine moved higher into alpine areas of the Sierra Nevada and fires doubled in frequency in Giant Sequoia forests. Forests were open then and frequent, low-intensity fires kept fuel to a minimum.

Temperatures plummeted again in AD 1450, taking the world into the Little Ice Age, which ended about 1850. This cold period forced foxtail pine to lower elevations in the Sierra Nevada while eastern hemlock and white pine did the same in the White Mountains of New England.

What history teaches

The climate may again be shifting to a temporary warm period. If so, we must learn from history and expect warm climate species, such as ponderosa pine, to expand their range. Likewise, we must keep our forests more open to mimic the way they looked when the climate was hotter and low-level fires more frequent.

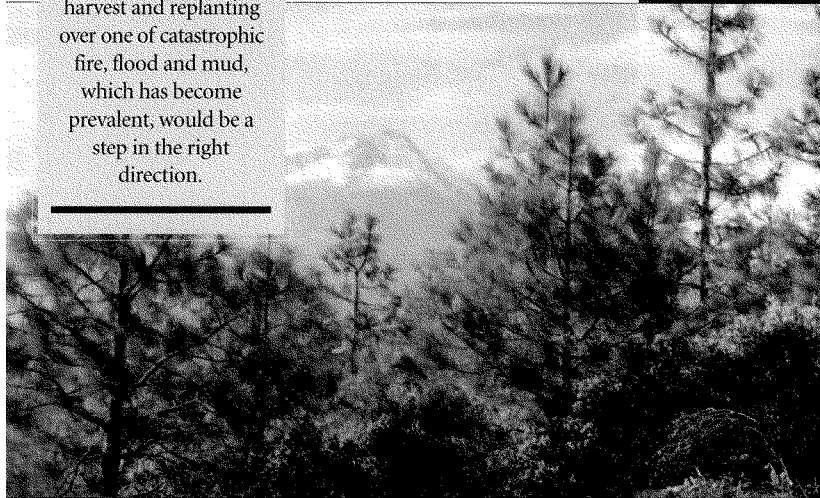
A historical perspective can help guide management that makes productive use of forest resources and reduces the incidence of high-intensity wildfire. Rather than ignore climate change and corresponding changes in forests, we ought to use our technology and insight to adjust to a warmer climate. Embracing a cycle of harvest and replanting over one of catastrophic fire, flood and mud, which has become prevalent, would be a step in the right direction.

Earth is warming, but continental glaciers will return. Unfortunately, science can't tell us how warm it will get or when it will grow cold again. But one thing is certain; we must live with the climate we have. Managing forests to conserve resources and prepare for anticipated climate change seems more than prudent – it seems the obvious choice. ■

A historical perspective can help guide management that makes productive use of forest resources.

✍ If our climate shifts to a warm period, we should expect warm climate species, such as ponderosa pine, to expand their range.

Embracing a cycle of harvest and replanting over one of catastrophic fire, flood and mud, which has become prevalent, would be a step in the right direction.



Clean Energy Offers too Much Potential to Ignore

CAN WE MAKE BIOMASS CREDITS WORK?

For mechanical thinning to become a source of biomass energy fuel, alternate revenue streams must be established to offset the costs.

✓ Burning biomass material can produce clean energy and help reduce carbon emissions.



By John Kadyszewski

America will continue to burn fossil fuels for the foreseeable future even though their emissions increase carbon dioxide concentrations in the air and may contribute to global climate change. But if we focus efforts elsewhere, burning biomass may be able to remove carbon dioxide from the air and prevent carbon dioxide from being released into the atmosphere.

Biomass energy is widely used by forest products companies to meet internal energy needs, and a few independent plants supply power to the electric grid. Cost considerations, however, have prevented biomass energy production from becoming widespread. But what if crediting biomass energy for its value in reducing carbon emissions and its value in reducing wildfire risk could turn that around?

Limited use, vast potential

Biomass energy is produced through the controlled burning of organic material. It has a "net zero" carbon impact because it releases the same amount of carbon as the plant removed from the atmosphere when it was growing. The carbon released can be replaced by re-growing organic material. Wood residues from timber harvesting, or waste from wood products manufacturing, can be turned into biomass energy.

So, too, can the excess trees that now crowd many unmanaged lands. Natural fire has been suppressed for so long that many unmanaged forests have grown dense with material that would have been burned off with more frequent, lower intensity fires. In California, according to the USDA Forest Service, some 8 million acres and more than a thousand communities face a serious threat of catastrophic wildfire.

Can forest management provide the biomass necessary to reduce carbon emissions and reduce wildfire risk at the same time?

It won't be easy. Most thinning efforts face significant regulatory and economic challenges. The fuels that must be treated – small trees and brush that can quickly carry a fire into tree crowns – have little or no economic value. Prescribed burns – intentionally set fires aimed at reducing fuel loads – represent the least expensive fuel treatment option, though in many cases, forestlands are too crowded to allow controlled burns. Mechanical thinning can be effective, but is expensive.

Harvesting some larger trees can help offset some costs, but for mechanical thinning to become a source of biomass energy fuel, alternate revenue streams must be established to offset the costs of collection and transportation. More than half of California's biomass energy facilities have closed since 1990, increasing the cost of getting fuels to the plants that remain.

The carbon dioxide reducing benefit of biomass energy may provide the answer. Not only can removing accumulated fuels from the forest floor reduce catastrophic fires and the emissions they produce, but using that fuel to increase the production of biomass energy can reduce the need to burn fossil fuels for energy.

Addressing an immediate need

California faces the challenge of meeting the energy needs of a rapidly growing population.

Continued on Page 22

Bringing Carbon Buyers and Sellers to Market

OBSTACLES ABOUND, BUT MARKETS HOLD POTENTIAL

By David Sunding, Ph.D.

Ask any inventor: Thinking up a workable idea is one thing. Marketing it in a meaningful way is another. It's the difference between, say, having the blueprints for the internal combustion engine and an assembly line ready to roll out a fleet of Model Ts.

The carbon market is in a similar situation. We know that sustainable forestry can help lower atmospheric carbon levels, a stated goal for those concerned with global climate change. Well-managed forests flush with rapidly growing trees remove (or "sequester") carbon quite efficiently. But we don't know yet whether markets can be established in this country to provide any economic incentive to do so.

Trading carbon credits might work, the idea is straightforward. If a company wants to build a new power plant that would result in X amount of carbon emissions, for example, it could offset those emissions by buying credits from another company with the means of sequestering the same amount of carbon in trees or other sources.

In Europe, carbon trading is already being practiced. Components of the Kyoto Agreement, the first multi-national attempt to limit carbon emissions, established protocols for companies in ratifying nations to openly trade carbon credits. And while the Agreement has proved controversial in the United States and elsewhere, interest in developing domestic carbon markets is gaining momentum.

In fact, some carbon trading efforts are underway, but prices and limitations make it hardly worth the effort.

Getting out of the gate

Why the challenge? Complexity is the main culprit. Markets require established definitions, baselines and enforcement mechanisms – features

missing from the relatively new practice of commercial carbon sequestration. Much of the accepted science in the field comes with margins for error as high as 40 percent.

Truth is, carbon sequestration is difficult to measure. The amount of carbon being sequestered is not obvious, nor is the length of time the carbon is being sequestered.

Exactly what level of credit to grant for various activities isn't obvious, either. One school of thought says that credit should be given for actions that decrease net carbon emissions. But what about companies that already sequester carbon efficiently? They would receive no reward for their actions under such guidelines. The same is true for energy producers using comparatively "clean" technologies.

No company that helps reduce net carbon emissions should be ignored. California companies that practice sustainable forestry, for example, sequester tremendous amounts of carbon – and do so very efficiently – by optimizing tree-growing conditions on their lands. Unless these companies are "grandfathered" into any market agreements, they would forgo any benefit for what are extremely positive actions. If you are already sequestering carbon efficiently, your potential to provide a significant difference over "business as usual" is very slim.

These challenges, however, shouldn't prove insurmountable. Markets, once established,

Continued on Page 22

Unless California companies that practice sustainable forestry are "grandfathered" into any market agreements, they would forgo any benefit for what are extremely positive actions.

Markets are certainly preferable to more government regulation and mandates. Command-and-control approaches tend to be comparatively inefficient.

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CALIFORNIA FORESTS

Clean Energy Offers too Much Potential to Ignore

Continued from Page 20

Importing energy from fossil fuel sources only increases carbon emissions. Under such circumstances, meeting more of that need in-state with biomass energy not only reduces emissions but can produce economic benefits.

The challenge lies in establishing meaningful value for sequestering carbon and lowering carbon dioxide emissions. Some programs aimed at doing that are in place in the United States, but it is a small market, with few transactions and at prices too low to provide any real economic motivation to reduce carbon emissions.

But the concept – deriving value for having a positive impact on airborne carbon – holds promise.

Developing a system where credit is given for implementing a forest management regime that reduces the incidence of catastrophic fire should be encouraged as policies to address global climate change are created. Combined with a credit for displacing the use of fossil fuel-based energy, such a system might allow our forest resources to be more widely deployed in efforts to combat global warming.

We have the ability to manage forests to further reduce the amount of carbon in our air. We must find economic incentives to make it happen. ☐

Bringing Carbon Buyers and Sellers to Market

Continued from Page 21

ultimately bring efficient solutions. They are certainly preferable to more government regulation and mandates. Command-and-control approaches tend to be comparatively inefficient, and they likely would make it more costly to reduce net carbon emissions.

California may have sufficient economic clout to be a leader in establishing domestic carbon markets. While high real-estate values and costs of doing business may put California companies at a disadvantage, there are advantages to taking a leadership role and encouraging markets to develop sooner rather than later. Once markets are established, the expertise companies develop becomes marketable, transferable knowledge.

If the cost of sequestering carbon in forests or through other means provides a financial incentive to other methods of reducing net emissions, carbon markets could flourish. It's too soon to tell for sure, but forestry and other land-based sequestration possibilities look promising. ☐

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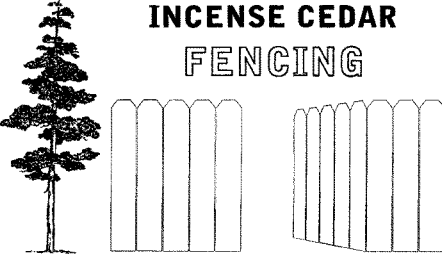
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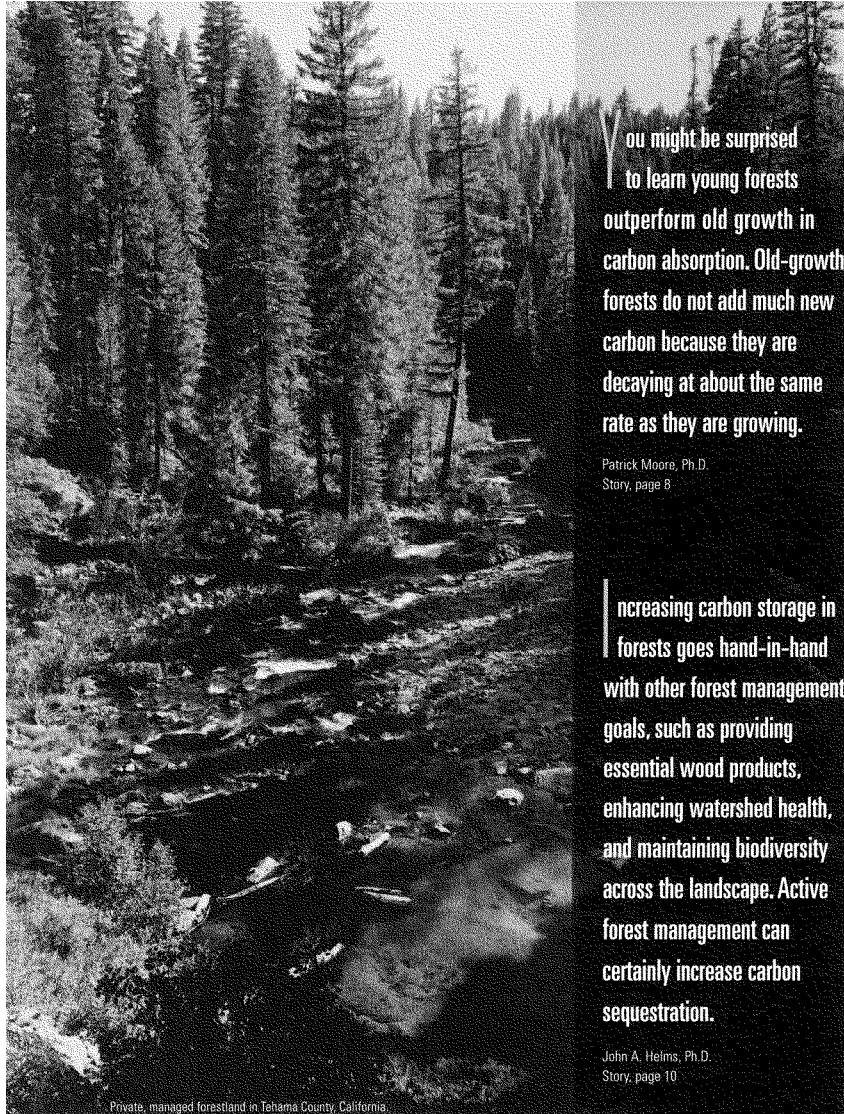
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Patrick Moore, Ph.D.
Story, page 8

I ncreasing carbon storage in forests goes hand-in-hand with other forest management goals, such as providing essential wood products, enhancing watershed health, and maintaining biodiversity across the landscape. Active forest management can certainly increase carbon sequestration.

John A. Helms, Ph.D.
Story, page 10

Mr. HAASS. Congressman, I think you are onto a big topic. One of the cheapest, potentially, and certainly most available aspects or dimensions of a climate control policy has got to be to encourage forestation I—

Mr. WALDEN. And proper management.

Mr. HAASS. Discourage deforestation. We should be looking at our aid policy, what sort of practices in places like Brazil, Indonesia, and the rest that we encourage. It is also going to have a big impact on whatever takes the place of Kyoto. One of the failings of the existing global approach is it couldn't figure out how to factor in essentially benefits or premiums for sinks. We need to think when we come up with a post-2012 global framework how is it we essentially incentivize and reward those.

Mr. WALDEN. Let me interrupt because I will run out of time here. I wish we had hours to do this. I would be happy to meet with any of you individually. I also think we ought to go to a labeling system so consumers know when they buy a product what kind of carbon tradeoffs. Because I think American consumers, like most of us if not all of us on this panel, want to do the right thing.

Mr. HAASS. Home Depot would agree.

Mr. WOOLSEY. Congressman, the point you made about the right kind of management of the forest being compatible with the production of fuel is exactly right. It is in the forest so you don't get bonfires and forest fires. Then that cellulosic biomass can either be used to produce ethanol, produce methanol if you gasify it, and used to produce renewable diesel in thermal processes. There are lots of ways to get at it. I think it is a very positive direction.

The CHAIRMAN. The gentleman's time has expired. The Chair recognizes the gentleman from Connecticut, Mr. Larson.

Mr. LARSON. Thank you, Mr. Chairman. Mr. Chairman, before you start the clock on me, just a procedural question.

The CHAIRMAN. Hold on that clock.

Mr. LARSON. Given the time limitations that we have, would it be possible, especially for a number of the panelists who would like to respond further to an issue, that once posed a question that would require, as I am sure some of my questions will, further expansion, that they be able to submit to the committee further explanation on what their answer might be.

I am not specifically referring to Mr. Haass, but I know he wanted an opportunity to be able to elaborate on what oftentimes in terms of yes and no questions become very problematic. You ought to have that opportunity for the committee, and I would like to be the beneficiary of that.

The CHAIRMAN. I think, without objection, we will allow each of the witnesses to elaborate on any one of these points that they would like to, and put it in the record without objection.

I now will recognize the gentleman from Connecticut for 5 minutes.

Mr. LARSON. With that I have four specific questions that I would like to ask. One of them deals with the Kyoto Accords. The other deals with the establishment of financial platforms. The third deals with hydrogen fuel technology and its relationship to nuclear. And the last deals with a carbon tax.

Let me start with, first and foremost, with Kyoto. In the opinion of the panelists, if you were advising the Bush administration, should we have pulled out of the Kyoto Accords? I realize it is longer than a yes or no answer. If you could give me a yes or no answer.

General SULLIVAN. It was not a part of our group, although what I certainly feel and I think what we feel as a group is we need to be participating in follow-on to Kyoto, any international organization that is addressing these issues.

Mr. LARSON. Mr. Haass.

Mr. HAASS. Kyoto itself, I would argue, is deeply flawed, but the United States ought to be a full participant in its follow-on.

Mr. LARSON. So you would have advised to follow up and stay with it.

Mr. HAASS. Pardon me?

Mr. LARSON. You would have advised the administration to stay with it.

Mr. HAASS. To continue talking about the issues but not to accept the specifics of the Kyoto framework.

Mr. POPE. We went it alone on Kyoto, we were left alone in Iraq.

Admiral MCGINN. I think beyond Kyoto is where we need to go. There are some downsides to Kyoto that would limit its positive effect, but I think we definitely need to be leading in these issues and international forums and treaties.

Mr. WOOLSEY. The cap-and-trade system has worked well for sulfur dioxide in the United States. The international market makes it a lot more complex, but either a carbon tax or carbon cap on trade along the lines of Kyoto, modernized and updated, is going to be essential to getting at coal's contribution to global balance warming initiatives.

Mr. LARSON. Are the Kyoto Accords and pulling away from the nuclear testimony ban treaties and the whole notion of a policy of unilateralism a wise position for the country to continue to follow, especially as relates to national security? Start with you Mr. Woolsey.

Mr. WOOLSEY. Well, it is an intricate question, Congressman. Let me say that moving to nuclear power as an alternative to coal internationally creates huge problems, because the international arms control regime for all of this doesn't work. It doesn't bar countries from getting into the fuel cycle. And as a result, we could handle substituting for coal with nuclear power in the United States if we could ever figure out where to store waste, politically. But from the point of the view of the world moving toward nuclear power, we would have to have a completely different kind of international treaty regime than we have now in order to keep that from adding to proliferation.

Mr. LARSON. Admiral.

Admiral MCGINN. I agree with Mr. Woolsey.

Mr. POPE. So do I.

Mr. LARSON. Mr. Haass.

Mr. HAASS. Global problems require global solutions. Climate change is one of the quintessential global problems. We are going to have to be involved in it, in part if we want others like China and India to be full participants as well.

Mr. LARSON. General.

General SULLIVAN. Mr. Congressman, I served during the Cold War. The bulk of my time in the Army was during the Cold War. This Congress spent billions, trillions, on the Cold War. We were able to succeed, however you define success. That was a conflict which we managed.

In my view we are involved in an issue here, you are discussing here where we could have a climate change or any number of things happen, and I think we need to have an effort which is equally as global and serious here in the United States. I believe that the security of the United States is at risk on some of these issues.

Mr. LARSON. Because my time is about to run out, two-part question with regard to both financial platforms—several of which have been discussed—in terms of the standards that are going to be needed, and where is the funding going to come from, and what kind of incentives either through the tax base that would inspire entrepreneurialism, as Mr. Inslee talked about, or in the article that the Chairman started at the very start of this, referring to Thomas Friedman, after he went through a very lengthy article concludes by saying this, essentially; that if we are not willing to focus on some kind of carbon-related tax that directly provides the fencing-off of dollars that will go to directly assist the goals that many of you have outlined from a national security perspective, et cetera, we will not be able to move forward. It is just all folly and discussion.

Your comments.

Mr. HAASS. There is going to have to be—if there is going to be a global approach here—either a carbon tax or a cap-and-trade system or some hybrid involving the two, and the good news is there is 4 years or so to work that out on a multilateral basis. But first we, ourselves, the United States, I think also have to figure out what we are prepared to support.

Mr. POPE. You can do this either by taxing carbon or by selling the permits in a cap-and-auction system. Either one generates enormous revenues by getting people to stop doing bad things, and enables you to lift taxes which are discouraging people from doing good things like employing people.

Mr. WOOLSEY. A carbon cap-and-trade is essential, or a carbon tax or some combination, but it will not solve the oil problem. Oil is over 40 percent of the world's emissions of carbon, and you do not affect oil substantially at all, and especially because we only make 2 percent of our electricity from oil today. So oil is a separate issue. One has to deal with it separately. Carbon cap-and-trade won't solve it.

Admiral MCGINN. Carbon tax or cap-and-trade is very much needed. Take a look at the Chicago carbon exchange for the marketplace dynamics. The marketplace and industry are looking to the United States Government for some leadership in this regard. They want to get out of the uncertainty and get on with deploying the right kind of technology and process.

The CHAIRMAN. General Sullivan, do you want to have the last word on that?

The gentleman's time has expired. The gentlelady from Michigan, Mrs. Miller.

Mrs. MILLER. Thank you very much, Mr. Chairman. I just think this has been a fascinating discussion and a very, very interesting and challenging issue. And I am really very hopeful of the work that can come out of this committee with the kinds of questions that have been asked. And, again, in full disclosure here, I do live in southeast Michigan, and I represent the domestic auto industry in a very big way. It is literally our lifeblood there in Michigan, and we do feel sometimes as though we are under attack. And I guess what I want to say here is that we want to be partners, not adversaries, in getting to where we all want to be.

And I would mention here, as has been mentioned by many of the witnesses, about 90 percent of all of the transportation modes are because of our reliance on oil, whether that is cars or vehicles or rail or aviation. And if you look around the globe and think about how some of the other nations are dealing with the challenge of climate change or their energy needs—I mean you have in Brazil, which is always highly touted about them using such a high percentage of ethanol—and then you can go over to Europe and it is interesting to note at this time, they still have voluntary mandates—they have no mandates, it is voluntary on their vehicles there. And even though they have small vehicles, in a lot of ways there are incentives, of course, because of their very high tax on gasoline, et cetera. Drive by any of those beautiful buildings and they are all various shades of gray because of all the emissions that have happened in Europe. And, in fact, what they are doing in Europe is really focusing on aviation as a huge part of climate change, although that is only about 3 percent, they will tell you, of what is happening in regards to pollution.

They are now talking about emissions trading and everything else for aviation for all of the links, and I am not quite sure how all of that is going to work. But I would say this: There has been a lot of talk about utilizing new technologies, et cetera, how the government could help with hydroelectric, how the government could help with coal, better clean-burning coal, et cetera. And I am just wondering whether or not, when you look at an industry like the domestic auto industry that spends probably more on R&D than any other industry in the nation, and yet we are under the microscope again to continue to do a number of things, do any of you have any comment, or do you think that the Federal Government has any role to play in assisting the domestic auto industry with R&D for various types of very creative kinds of things that they are coming out with now? You can think about the Chevy Volt, the plug-in Chevy Volt that was just showcased at the North American International Auto Show, or the Ford edge, or some of these different kinds of—

In other words I would say this: When you look at, for instance, lithium ion batteries, and we see that the Japanese are about to have a corner on that market, and why is that? They are being assisted by their government. Is there any role for the Federal Government to assist the domestic auto industry, which by any definition is absolutely struggling now?

Again, we want to be proactive about it. I think we are. And I guess I would also like to comment, again, Mr. Chairman, as we are thinking about field hearings, that I would like us to consider coming to Detroit.

Mr. POPE. Let me respond to that by saying that I believe that if we want to enable the American auto industry to be a viable vibrant partner in the future, we need Federal assistance, and we need a national compact between the Federal Government and the auto industry. We don't just need help with R&D. The auto industry actually needs help to accelerate the turnover of old infrastructure.

The American auto industry faces much higher interest rates than its foreign competitors. The American auto industry has very serious legacy costs, which Germany and Japan do not have. And we need to cut a bargain in which the auto industry commits to help the Nation solve its global warming and oil dependence problems and the Nation commits to help the auto industry modernize and become competitive if we are serious about having an American auto industry, and I think we have an obligation to do so.

Mr. WOOLSEY. Congresswoman, I think this is a very important subject, and I believe that there is definitely a Federal role, but the Federal Government has not done this well in the past. One thing it has done, for example, for the last number of years, is encourage, with a great deal of resources, hydrogen fuel cells for family automobiles. This is, as far as I am concerned, one of the most expensive, most wasteful, and least desirable innovations in transportation in a long time. Not only to make this work does one have to bring the cost of fuel cells down by a factor of 40 to 50, and one would have to figure out a way to have a nationwide distribution system that one former Republican Secretary of Energy told me would be at least a trillion dollars' worth of family fueling stations, but one has to get away from the problem that by changing from natural gas to hydrogen, one loses about a third of the value of the energy, and by changing from electricity to hydrogen back to electricity again, one loses about three-fourths of the energy. One can put the electricity in the car in the first place as a plug-in hybrid, as you said, or one can put the natural gas in the bus in the first place.

So for the Federal Government to get into something and say this is the solution, this is the single solution, its history has not been good. I think it would have to be something like Sima Tech, which changed very much for the better our ability to produce and manufacture computer chips in this country for things like battery technology.

The CHAIRMAN. The gentlelady's time has expired. The gentlelady from South Dakota, Ms. Herseth.

Ms. HERSETH. Thank you, Mr. Chairman.

And I appreciate the written testimony you have submitted. As I have reviewed that, some of you have talked a bit about corn-derived ethanol. Mr. Woolsey, you mentioned some of the limitations of corn-derived ethanol.

I represent the State of South Dakota, a leader in that area. We wouldn't be where we are today with the advantage of a potential for cellulosic ethanol without the advancements, before a market

was truly created in the Energy Policy Act of 2005 for renewable fuel standards, and what we are able to accomplish and the types of companies that have evolved as entrepreneurs and innovators to advance cellulosic ethanol production.

I think when we talk about the geopolitical implications of warming and climate change in each of the areas where all of you have worked and the life experiences you bring to the table today, I would imagine that there probably wouldn't be a lot of disagreement about the relative stability and economic prosperity of a country based on the state of its agriculture sector.

We see how Saddam Hussein has devastated over time Iraq's irrigation system, other areas of its agriculture. We know what President Karzai is dealing with in trying to move farmers in southern Afghanistan to plant something other than poppy.

So when we look at our objectives of energy independence and addressing carbon emissions, I think agriculture, not just American agriculture but agriculture across the board globally, really presents us with part of a significant solution. And I am just wondering if any of you could comment on whether it is renewable fuels, whether it is wind energy.

South Dakota has a wealth of wind energy but the problem is transmission. Where you see our policy—our domestic policy and facilitating the growth of renewables for our domestic energy needs, but also the sharing agreements, perhaps with India and China and with others, so that we don't stifle the economic growth that some of those countries have faced at the same time they are grappling with significant problems in rural parts of their countries because of the migration to cities.

Mr. WOOLSEY. I think the renewable technologies you are talking about, particularly wind and, increasingly, solar, with Thin Film Solar and Nanosolar the costs are going to come down, and that is a way for China and everybody to grow without negatively impacting the environment.

And from the point of view of rural prosperity in the United States, if we replaced only one-quarter of our oil imports with domestically generated energy—so that is, let's say, about 80 million barrels—if we replaced that, we would create something like 800,000 jobs, most of them in rural America, and the \$80 billion that was net farm income last year would effectively be doubled. And that is just replacing a quarter of our oil imports with domestically generated energy. This could mean very substantial prosperity for rural America.

Mr. POPE. Let me speak to India, because India is still a nation, the majority of whose population is still rural. It makes absolutely no economic sense to electrify India by stringing wires between villages from central station power plants. It is nuts. India could electrify much more efficiently and much more cleanly if it had available to it the whole array of biomass, solar, and wind technologies suitable for small-scale village deployment. If the United States would lead the way in developing those technologies, we could have a phenomenal new industry, and we could be the world leader in that industry.

Admiral MCGINN. I would like to add, the American farmer has a key role to play in meeting this energy challenge. We need to be

careful, though, in trying to solve one problem—energy dependence, for example, oil dependence—that we are not creating another by introducing inefficiencies of using food crops to produce fuel. We need to keep our American agricultural economy very much informed by the technology that is coming out in terms of crop yield as well as the kinds of crops that lend themselves more easily to the process of creating a bio-based fuel.

Ms. HERSETH. General Sullivan.

General SULLIVAN. I concur. This is all interrelated. And indeed some of our exports are feeding people who are living in countries without a robust agricultural society, and they need foodstuffs, and many of those foodstuffs come from the United States. So, you know, it is all interrelated. It is a very complex equation, and before we rush off, I think, on some of these issues, we need to be careful.

Ms. HERSETH. And I don't disagree with the caution there. Although the alternative argument that I will put out is, one of the concerns that some developing countries have had with the state of their agriculture is that the United States and other countries, because of our technology and our high yields and our production, have actually been dumping commodities on the export market at a loss. It is not good for our farmers. It is not good for farmers in developing countries.

So it is actually the more we use some of those crops for value-added fuel production, as well as environmentally friendly livestock production with anaerobic digesters that are a fully integrated system, that this actually could help as it relates to the global agricultural environment and give some producers in developing countries an opportunity to get a fair price for their commodity, if we are not dumping some of our surplus out onto the export market.

Another question if I might, and I thank you for those responses. But I do want to move just quickly, before my time is up, to the issue of capturing—carbon capturing sequestration.

Earlier today I was meeting with the CEO of the Southern Company and talking about nuclear energy and what happened in France and Japan of using the reprocess of spent fuel and reprocessing that spent fuel, whereas we made a decision back in the 1970s to store it rather than to reprocess it. So when carbon—when CO₂ is captured in electricity generation, for example, what can be done with it besides just pumping it back into the ground, sequestering it? Are there other potential industrial uses of CO₂? And is there any way to further process CO₂ so that it is no longer posing an environmental threat?

In other words, is there potential in technology beyond sequestration that we should be more fully evaluating based on what may be happening elsewhere?

Mr. WOOLSEY. There are, Congresswoman. One of the more interesting sets of developments has to do with algae that eat CO₂ and can be used to produce lipids to be turned into something very much like biodiesel. There is some work on that going on up at MIT, I think, now. Most people believe the volumes of CO₂ that would be produced if you continue to use carbon—use coal for electricity production, though, is going to require a relatively cheaper way than we have now of sequestering the carbon in the deep sa-

line aquifers a mile or two down in the earth. At those depths, the CO₂ becomes liquid and can dissolve into saltwater. It is not entirely clear that that is foolproof from the point of view of ever getting out. But to a number of scientists I have talked to, it looks good. The question really is the expense.

The CHAIRMAN. The gentlelady's time has expired. The Chair recognizes the gentleman from Oklahoma, Mr. Sullivan.

Mr. SULLIVAN of Oklahoma. Thank you, Mr. Chairman. I again appreciate the panelists coming today, and I just have a different question for each of you. And I will start with General Sullivan. I like your name too.

General Sullivan, in order to make the U.S. less vulnerable to climate change, should Federal and State governments encourage building new refineries in different geographical locations? You know, I think Katrina kind of underscored the fact that we may need to do this with a lot of the refining capacity down there.

General SULLIVAN. Well that is not an area that our study group looked at. I would, just for what it is worth, it seems to me that our refinery base is way outdated and we are in danger of real problems. But that is a subject that I am not prepared to address. Based on our report—that is just an observation on my part—technology is way outdated, and, frankly, we are very vulnerable.

Mr. SULLIVAN of Oklahoma. I agree. We haven't built one or expanded one in many, many decades.

Mr. Haass, I have a question for you. In your testimony you say that another way to increase diversification of supply is to increase domestic production. Do you support opening the Arctic National Wildlife Reserve, ANWR, for domestic production of oil? And also what about the Outer Continental Shelf?

Mr. HAASS. Congressman, I would support opening up coastal areas. I would be comfortable in opening up ANWR. I think new drilling technology is far more efficient. It is also far more reliable. The only caveat I would say is many of the proponents—I am not suggesting this in your case—but many of the proponents who are doing just this exaggerate the consequences for U.S. energy security. It will not have a transformational or fundamental effect on our overall energy security picture. I think it is important that we do it both substantively and symbolically but we shouldn't exaggerate the likely results.

Mr. SULLIVAN of Oklahoma. Okay. And Mr. Pope, the U.S. will be using coal for its electric generation for the foreseeable future. Thus, to decrease CO₂ emissions, the U.S. must develop carbon sequester technology. However, this technology is not available today on the commercial side. Therefore, what technology, if any, would we replace the coal-generated electricity currently produced?

Mr. POPE. Well, I don't think we are in a situation at the moment where we can or should shut down our existing coal-fired capacity. We need to replace it over time, and gradually. It would be economically quite silly to try to shut it all down. We don't favor that. In the short term we believe there are enormous opportunities to make our own electricity use more efficient, to develop renewables, and to do the research in carbon sequestration to determine whether or not it pencils out.

I think it will work out. I don't know whether it will pencil out. But our studies show that we could meet all of our projected electricity needs between now and 2030—without using any new coal-fired capacity, without in fact using any new gas-fired or nuclear capacity, although we are likely to have more of those—just by deploying existing efficiency and renewables within today's price range. So we believe the numbers are there to solve the problem between now and 2030, which we also believe will give us time to develop the new technology we will then need.

Mr. SULLIVAN of Oklahoma. Thank you.

And Vice Admiral, you know the Navy has had great success with nuclear power as a fuel source. You did comment on it a little while ago, about you thought it was good, safe, and some other issues that you discussed. How do you see that playing out? What is it going to take for us to embrace that more? And do you think we can do it, have the facilities that—and environmentally safe and also safe for citizens in this country?

Admiral MCGINN. I think the challenge of increasing or revitalizing our nuclear power industry lies along the security concern, the waste concern, what do we do with the waste? We have wet waste building up with our existing legacy plants now, yet we can't seem to come to a national consensus on how to treat that for the long term. There is the money part of it. How much does it cost, real costs to design, build, deploy and produce nuclear-powered energy versus other sources that may be more economically viable? And I think that that is a key question that has to be answered before we go full bore ahead.

Mr. SULLIVAN of Oklahoma. Thank you.

And Mr. Woolsey, global warming is a global problem that requires global solutions. How do you suggest that we go about getting China and India to actively participate in reducing carbon emissions?

Mr. WOOLSEY. This is the—

The CHAIRMAN. Please answer the question.

Mr. WOOLSEY. This is an issue in which we have everything to gain, I think, by close cooperation with both India and China. We still are the seat of much of the innovation in these areas such as solar and wind and geothermal. And I think that—and biomass transportation fuels.

We have to understand that China and India want to economically, and they need to. From the point of view of their own internal stability, it is in our interest for China to be economically prosperous and stable. But we really need to work with them and develop the technology and share it with them and market it, that will help them do that without putting a lot of carbon into the atmosphere.

And there is a certain urgency here because they are putting out now, I think the last time I saw, a couple coal-fired plants a week. So we really need to put on the fast track our work on these renewables and renewable fuels, and help them move away from oil and help them move away from the dirtier forms of coal.

Mr. SULLIVAN of Oklahoma. Thank you, sir. I thank the gentleman.

The CHAIRMAN. The gentleman's time has expired. The gentleman from Missouri, Mr. Cleaver.

Mr. CLEAVER. Thank you, Mr. Chairman.

Let me first of all speak with you, General Sullivan. You mentioned at the beginning of your comments that you went into this process as somewhat of a skeptic. And my interest was piqued because I am wondering if there was some kind of defining moment, some defining piece of information you received that caused you to want to pursue the report that is now being discussed, hopefully all over the country. And I have a follow-up from that.

General SULLIVAN. That is a terrific question because I don't think I am unique in this group, in that none of us—there are a couple who are probably more technically qualified than the rest of us, but most of us are essentially soldiers, sailors, airmen and marines, without any particular technical skills in many of the areas you are talking about here.

I happen to have grown up in the Northeast, and I was in Vermont where in January it normally requires about four layers of clothes and a stocking cap. And believe it or not, the sap had not stopped running, which was not good for the maple syrup industry. And then I discovered as a result of this study that in addition to that, many kinds of fish that I had fished for off of Cape Cod in Massachusetts I no longer could buy in restaurants around the United States, and one reason admittedly was overfishing.

Another reason is plankton reduction, which may sound like a silly thing for an Army guy to be talking about, but it is a fact. And the maple tree is in fact dying out in New England. And a lot of those things came right home to me. And I think once I started getting interested in this, why is all of this happening, it became apparent that, number one—first of all I am not a scientist, as I said, and I didn't become one—but I looked at what I saw, and I saw the trends. And I said, you know, in my former life, I never had 100 percent certainty, and if I stuck around waiting for people to give me 100 percent certainty, I would get killed waiting for it. So if you want to know what my epiphany was, there it was. And it became very local, and I didn't like what I saw. And I don't like what I am seeing and I think it has huge implications for us, all of us.

Mr. CLEAVER. You ought to write an op-ed piece just describing what you just said. I think it would be very helpful because I have heard all kinds of reasons of why this issue has surfaced. I heard someone on a TV talk show say that this was a conspiracy of liberals to get money to college professors. And I mean—and that is, I thought, one of the more intelligent analyses.

But as a military—some of you, those of you who are military, let's assume that for the most part this is just hype and that there is only a 6 percent chance that the scientists are correct. How many people in the military do you think would give their soldiers a gun and tell them that there is one bullet, so you only have a 6 percent chance of blowing your brains out if you pull the trigger? How many volunteers do you think you would get for that? Thank you.

The point I am trying to make is that even if there is a low percentage that this is some hype, isn't it worth the effort not to take

that 6 percent chance on doing enormous damage to this world that we have inherited?

General SULLIVAN. Mr. Congressman, you know, what we were really looking at, and it has been stated here, is threat multipliers. It is a threat multiplier. And Somalia is probably the case in point. I was the Chief of Staff of the Army during the Somalia episode where we lost 19 men, they all happened to be men. But that is hard. The Somalia issue is related to the issue that we are talking about here. It was drought. It was drought that caused the original problem. Drought and a lack of food. The instability that was created by drought caused the warlords to try to control the food that was coming in from nongovernmental agencies, to include the United States and the U.N., and conflict erupted and people started dying because the warlords were controlling the food and they were giving it to their tribes. Migration, where we see Somalis moving into Kenya and Ethiopia, they couldn't control that migration. One thing led to another. The same thing is what is driving Darfur, and there has to be some recognition that these issues are, at the heart, environmentally related.

Mr. WOOLSEY. Congressman, your percentage mention of 6 percent makes a very solid point, which is that we insure against a lot of things in this life that we don't think there is an extremely high probability that are going to occur, like lightning striking our homes. And the scientific consensus on global warming seems to me to be quite substantial now with some effect. There is some question to the degree, but the consequences are so awful if we don't—if we don't do something, that I very much agree with your analogy. And as a matter of fact, Thomas Shelling, Nobel Prize winner in economics, a few months ago had an op-ed in *The Wall Street Journal* making exactly that point. This is like insurance.

So I think that is really a very key insight into all this. And the key thing for the insurance is that although we have to pay a premium with respect to coal and carbon, that might, you know, reduce our own consumption or reduce GDP, that happens all the time when we buy insurance for the family. But with respect to oil, essentially there is no premium because the steps we want to make by moving toward renewables and moving toward electricity use are the same steps you would want to take if you were taking this from the point of view of purely national security or any of a number of other—rural prosperity, any of a number of other desirable objectives.

So with respect to oil, people don't even have to believe in global warming if they don't want to. I think they are going to be driven to doing the same things for a whole host of other reasons.

With respect to coal, they really do need to face that they are going to have to pay some kind of a premium, but I think it is certainly a justifiable premium, given how disastrous the situation could be.

Mr. POPE. I think, Congressman, we have moved past the insurance era. A decade ago we were buying insurance. We are now in a situation where the wastebasket is on fire and we are sitting around the dining room saying, well, should we do anything about it? Well, maybe it will put itself out. Well, maybe it will, but maybe it won't. Maybe we ought to get a fire extinguisher.

Mr. HAASS. If I could take 30 seconds. It is not something that—in many cases we don't have to worry about cost, because we can do a lot of what needs doing without incurring an economic cost. Indeed, one of the few areas we made progress in over the last 10 years has been measures of energy intensity.

Essentially in the American economy what sort of GDP output are we getting for a unit of energy input? We are making progress. So actually, it was an area where I take exception to what Mr. Sensenbrenner said before. It is no longer a measure of a successful economy where electricity consumption or production is going up. What we have now shown, increasingly, is that we can detach economic performance and economic success from greater energy use. That is the great success here, which is why over time I don't think you need to sell this again as a cost worth paying. If we get it right, we can actually do this in ways that make financial sense.

The CHAIRMAN. The gentleman's time has expired.

Mr. CLEAVER. Thank you.

The CHAIRMAN. The gentlelady from Tennessee, Mrs. Blackburn.

Mrs. BLACKBURN. Thank you, Mr. Chairman.

And, Mr. Haass, I am going to come to you. I could tell you were wanting to add a little bit more as my good colleague was asking about floods and droughts and crop failures. And the IPCC report that is out reported that many of these disasters already occur from time to time, whether or not global warming plays a role.

So let's talk about this. And shouldn't the disasters, such as floods and droughts and crop failures and diseases be faced directly, regardless of global warming?

And then the other part of this question in this report, many of our leading economists and scientists have stated that these countries need to prioritize funding to deal with some of these disasters in health, water, education, hunger, and prioritize that first before dealing with climate change or global warming. Do you want to go ahead and respond?

Mr. HAASS. I am a great believer that developing countries, like anyone else, need to prioritize. But some of those choices, it would seem to me, would be false. If we want countries—say in Africa—would face a large part of the developmental challenge. Intelligent land use, intelligent water use are part and parcel of a fundamentally successful development strategy. They don't have the luxury of wasting units of energy. They need high energy efficiency, particularly countries which aren't blessed, like to some extent may be cursed, but don't have large amounts of domestic energy. If they have to import it, it will simply exacerbate the problems they face.

So rather than seeing these necessarily as tradeoffs, Congresswoman, I would suggest in many situations what you are essentially arguing for is a comprehensive developmental strategy that then involves energy efficiency, intelligent land use, intelligent water use and so forth.

Mrs. BLACKBURN. One of the things that I think has not been lost on any of us this morning is that you all seem to be in agreement that there is no silver bullet in addressing the situation; that whatever we do, it is going to be a mix. Part of you like nuclear, part of you don't.

TVA is in my district. Of course they are looking at moving up to 40 percent of their power generation to nuclear. Some of you like the coal to liquid, some of you don't. And some of you think that that is going to be an option, some of you don't. And I think that it points out why we do need to do some things that are going to be comprehensive in nature, that are going to take some time and are going to require some innovation.

And before I turn my time back, I think, Mr. Pope, I will come to you on this. Let's talk a little bit about ethanol. And you may have addressed this while I was out of the room for a meeting. Ethanol does in fact emit more VOCs than gasoline?

Mr. POPE. Yes, it does.

Mrs. BLACKBURN. It does. And don't the VOCs increase smog and affect human and animal health more than the gasoline emissions?

Mr. POPE. Well, there are some issues with ethanol in terms of air quality. They can be managed with vehicle design. We are going to need to redesign a system. If we are going to move, as I believe we should and I believe we probably will, to a system in which we have a mixture of petroleum-based fuels and alcohol-based fuels, we are going to have to redesign system components and pollution to deal with that. I believe it is manageable. But I don't believe ethanol is the silver bullet either. What she said is very important. We are going to need to do a number of things and I think ethanol will be one of them.

Mr. WOOLSEY. Congresswoman, those emissions vary with the mixture between ethanol and gasoline. One of the reasons many environmental groups have come to support E85, 85 percent ethanol, but have not been particularly enthusiastic about lower levels of the mixture, is when you get up to that substantial share, ethanol does not, the mixture, E85 does not emit worse than gasoline. And in any case, one is replacing oil with ethanol if one manages the emissions properly. And that in turn means that you are not putting other things into the atmosphere, such as the so-called aromatics, benzene, toluene, xylene, which are extremely carcinogenic and which are present in our gasoline today.

So it does have to be managed. One can't just randomly mix wherever one wants. But there is a way to go at this and move toward not only ethanol, butanol, renewable diesel and others of these renewable fuels without having these negative environmental impacts.

Mrs. BLACKBURN. Thank you. I yield back.

The CHAIRMAN. The gentlelady's time has expired. The gentleman from New York, Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman.

And thank you all on our illustrious panel. I am sorry I missed so much of your spoken testimony, but I did read it last night, and it is very informative.

Just quickly, I want to just comment on the remarks that were made by Mr. Woolsey and Admiral McGinn, among others, about the challenges of using nuclear power. I have in my district a plant which is currently leaking strontium and tritium into the groundwater and into the Hudson River, which has shut down accidentally twice in the last week, one time because of a fire and an explosion in a transformer that was not reported to the local authori-

ties for 40 minutes, and which was also noted by Mohammed Atta on documents that were found after 9/11 as one of the targets that he had speculated about flying a plane into.

Against that backdrop and knowing with the 103 nuclear sites currently, commercial nuclear sites operating in this country where we have vast quantities of high-level waste being stored de facto, where citizens never originally intended to be a nuclear waste site in their towns, and knowing that every city and State in between there and Yucca Mountain has threatened legal action to try to stop transit by rail or highway to get there, if we increase the transit of either spent fuel or enriched fuel to and from hundreds or thousands of new nuclear plants around the world, not just in this country but around the world, in reference to that safety regime, that security regime that I believe the admiral referred to, aren't we virtually guaranteeing that sooner or later there will be a diversion and at least a dirty bomb as a result?

Admiral MCGINN. It is possible. However, I think that nuclear—the generation nuclear plant in your district is very much an older one. The experience of the Navy with naval reactors has been very, very positive. The evolution of nuclear science and nuclear power plant design has proceeded at a much lower level than it was back in the 1960s and 1970s, but progressed nevertheless.

So I believe that from an operational safety standpoint, we can put out nuclear power plants that are at least 10 times safer, perhaps even 100 times safer than the current generation.

That said, there are the security concerns about transporter fuel, conversion of fuel, the waste disposal of fuel, and attendant to all of those security concerns and the design and construction concerns is what does it cost. What is the ultimate cost for a kilowatt hour of nuclear power compared to other forms? The key point, though, is—and one of the reasons I am not ready to reject nuclear power at all—is that right now 20 percent of our electricity is from nuclear power plants, 2 percent is from renewable fuels. To try to displace that is a very, very daunting challenge.

Mr. HALL. I understand, General.

Admiral MCGINN. We need to have a fair hearing.

Mr. HALL. Excuse me. I have limited time. I appreciate your comments and I am just throwing some ideas out here. We haven't talked about low-head hydroelectric at all. The Idaho National Laboratory, part of our own Energy Department, says that in my State of New York alone there are 4,000-plus low-head hydro sites, dams and waterfalls where, every day, tons of water are going over, being wasted. And that by putting turbines where the water is falling and wiring them into the grid, we could harvest greater than 1,200 megawatts of power, which happens to be 60 percent of the Indian Point Nuclear Point's peak output.

So I am just curious about your comments about low-head hydro tidal power, wavepower or hydrogen as a storage mechanism for off-peak time when the capacity needs to be stored somewhere.

Mr. WOOLSEY. Congressman, I think the most promising sets of developments are the lowering costs going to first thin film and then nanosolar and the lowering costs from distributed—that is, small-scale wind generators which can operate at, say, three or four miles an hour instead of the eight or nine miles an hour that

you need for the large turbines, which is why they are up in mountain passes and out in the ocean. I know of only one tidal system. It is functioning on a commercial basis in France. It seems to work reasonably well, but I think the tidal situation has to be pretty much ideal. And some of the ocean current ideas are really very intriguing and there is some good research going on on them.

Hydrogen is not a bad way to store energy if you can't do anything else, and it does have—let's say you generate from a wind farm in the Great Plains and you can't get the electricity out because there aren't transmission lines, turning that into hydrogen for, let's say, the chemical industry or something like that might have real utility. Trying to use that hydrogen to power family automobiles, as I said earlier, I think is one of the craziest ideas this country has ever gotten off onto.

The CHAIRMAN. The gentleman's time has expired. The gentlelady from California, Ms. Solis.

Ms. SOLIS. Thank you, Mr. Chairman. And I appreciate the testimony that we heard from all of you, from the witnesses this morning. And I am intrigued about the discussion regarding reliability with renewable energy. And in particular, in the State I represent, California, I just learned of a project that is underway right now that is looking at wind power being provided up in the Tehachapi. And maybe, Mr. Pope, you know something about this. But what is occurring is that they are going to be working with the PUC and Southern Cal Edison and some other folks, and it is actually going back to similar lines that have been put in place since the 1920s, so they are not actually going outside of what has already been established during the past few decades.

And the reliability there that they are proposing is that they are going to be able to provide about 60 percent more of our electricity once this project is completed. And it is based primarily on wind energy and reliability. And for us in California, I think it means a great deal because we have had such tremendous problems in the past with shortages, brownouts, blackouts, and the whole problems with the grid, and then trying to find reliability. And our population continues to grow.

So, Carl Pope, I would ask you if you know anything about that or if you want to comment.

Mr. POPE. Well, one of the interesting things is that if you diversify, as California has worked on doing, your electricity sources, you are actually building yourself in a lot of security against disruptions. So these new retrofitted wind systems are very important.

An opportunity we are not taking advantage of, we have a great deal of natural gas capacity in California that needs to be repowered. It is wasting half of the gas which it burns every day, and at today's gas prices that doesn't make sense.

Another opportunity we have in California that deals with some of the storage issues with renewable is if we can make central station solar thermal cost competitive, it is relatively easy to store the heat. It is easier to store heat than it is to store electricity. So even though the sun doesn't shine at night, a central station thermal solar electric plant—and we have a lot of sunshine and a lot of desert in California where we could do this—those plants can gen-

erate electricity at night. So we have a lot of opportunities if we consciously diversify.

Ms. SOLIS. My next question really is for any of the panelists. We talk about security, energy security in other countries, particularly underdeveloped countries. What can we do as a Nation to help provide for leadership, and perhaps that partnership that you touch on here, and I am thinking particularly in places like the Middle East.

I recently visited Iraq and saw a project that is underway there, a wastewater, waste management system that is being put in place right now. And I think, wow, what a great overture to folks there to let them know that we are sharing our technology. And I just want to get some comments from you on that. General Sullivan?

General SULLIVAN. I think Nunn-Lugar, I think there are some efforts going on, in fact I know there are with the former Soviet Union, to get some control of their spent nuclear fuel and weapons. I think that is productive, reasonably productive. That is in the security arena. Other than that, I am not qualified.

Mr. HAASS. I would say, funnily enough, for the oil producing countries, many of them, they need help dealing with their windfall. There has been a lot of writing about the oil curse, and for a lot of these countries, it overwhelms their capacity to have the normal evolution of a country, to develop normal markets, the rule of law, democracy.

Demanding that countries such as Nigeria and others put in place real accounting, transparency, essentially not allowing the oil windfall to become a major source of corruption which actually undermines their governance is something that not simply the U.S. Government but oil companies and NGOs can help with. That is a way that we can essentially help the so-called wealthy countries deal with their own energy security situation.

Mr. WOOLSEY. There is a historical identification in a number of these countries in the developing world with local self-sufficiency. That is what that spinning wheel is doing in the middle of the Indian flag. It was Gandhi's way of saying the villages ought to spin their own cotton and be self-sufficient.

And when you look at what is potentially available, I think, from solar wind and biomass for villages in India or, for that matter, settlements in the Iraqi desert, to be able to produce enough energy locally to, say, pump water or clean water up, and with battery developments to have some kind of capability to use even in areas of the world that don't have oil or ready access to it, to use electricity for powering vehicles, for plows and the like. These developments are coming, and they are coming in part because battery technology has moved so quickly.

And finally, Congresswoman, in California one thing to remember is although you all had some very serious problems out there with respect to your electricity, California as a whole over the last 20 years has held its efficiency with respect to electricity such that the average Californian pays about the same amount as I do in Maryland for his electricity, but he pays at rates that are about double because he is using about half as much. And California has been the leader in the country with its PUC and the rest, and

steering us in a direction the rest of the country ought to follow with respect to that.

Ms. SOLIS. Thank you.

The CHAIRMAN. The gentlelady's time has expired. Can I ask you—I am going to ask each one of you in reverse order to give us a one-minute summation of what it is you want us to remain the big point as we are moving forward on the select committee.

And I would like while we are thinking about that, just General Sullivan, could you just talk about Diego Garcia briefly? It is in your report, and what is happening to that atoll out in the Indian Ocean?

General SULLIVAN. You want me to do it right now?

The CHAIRMAN. Yes. Could you do that?

General SULLIVAN. Diego Garcia, as you know, is an atoll in the Indian Ocean. It is a strategic base that the United States has used for a number of years. Because it is an atoll, it is almost at sea level. Any rise in the sea level could obviously cause dislocation and dislocation would, in fact, require alternative basing somewhere.

The CHAIRMAN. It has a security implication for the United States?

General SULLIVAN. Yes. Yes it does. Prepositioned ships are kept there and other equipment.

The CHAIRMAN. And your conclusion is that it is at risk now?

General SULLIVAN. Well, my conclusion is if the oceans were in fact to rise, if what people are suggesting, if they were to—if oceans were to rise even inches, it would have an effect on Diego Garcia.

The CHAIRMAN. Okay. Thank you. So let's begin the summations with you, Mr. Woolsey.

Mr. WOOLSEY. Thank you, Mr. Chairman. I think with respect to policy and Congress' role of legislation, two things are important. One is the CAFE standards, as you have proposed, in order to keep progress steady with respect to reducing oil use. And the other is removing barriers so that alternative fuels can be used—flexible fuel vehicles, pumps and any regulatory barriers that might be in the way of plug-in hybrids, and particularly the vehicle to grid that is plugging the hybrid back in after it is fully charged so it can supply some of the power to the grid. There is so much energy in vehicles that this really creates remarkable financial and other opportunities.

The CHAIRMAN. Okay. Thank you, Mr. Woolsey.

Admiral McGinn.

Admiral MCGINN. Mr. Chairman, thank you. This is an American challenge. It is one that Americans together will meet. It doesn't have partisan labels on it. The solutions are available today. They need to be guided by leadership and good policy which enables us to advance our energy efficiency and to increase our choices of clean renewable fuels in order to create opportunity for our economy, create opportunity and raise our level of national security and also to be a leader in the global sense in meeting this energy challenge. Thank you.

The CHAIRMAN. Thank you, Rear Admiral. Mr. Pope.

Mr. POPE. In order to solve this problem, the twin problems of oil addiction and global warming, all we need to do is reduce our

emissions of carbon dioxide by 2 percent a year and improve the reliance of our transportation fleet on oil at a rate of 4 percent a year. Those are rates of innovation lower than we accept in any other part of the American economy, lower than those we experience in any other part of the American economy.

So the big question this committee has to answer is, why aren't we doing it already? And I am going to offer an answer which may not be welcome. I believe that the largest single barrier to innovation and progress, to kicking our oil addiction and stopping global warming, is that the United States Congress has structured the American energy sector in such a way that those who benefit from innovation are frustrated by those who benefit from stagnation. I think you need to fix the way in which Congress thinks about energy.

The CHAIRMAN. Thank you, Mr. Pope. Dr. Haass.

Mr. HAASS. Thank you, Mr. Chairman. The short answer to your question is to continue doing what you are doing today. The more these issues gain salience and the more people see energy security and climate change as integrated in parts of a larger whole, I think you are beginning to win the debate. And encouraging that policy-making and the organization of policymaking come to reflect that will also help.

Three specific points. One is coal. Real estate is about location, location, location. An awful lot of this issue of climate change is about coal, coal, and coal. And to the extent we can create an environment in which clean coal production, as well as thinking through and ultimately realizing technologies for storage of the carbon that is produced from coal plants happens, that will go a long way towards the problem.

Secondly, to focus on the transportation sector and the sort of legislation you are introducing is good because it provides the predictability that Detroit and others need to know and innovators need to know so they can essentially—they are therefore aware what world they are operating in.

Lastly, we can't do it on our own. There will be no solution to the climate change problem without full participation by India and China above all.

Which brings me back to the importance of coming up with guidelines for a post-Kyoto, post-2012 world. Let's put aside the debate over Kyoto; love it, hate it. We need to get serious about what will be the principles that will inform U.S. policy and begin the conversation earlier rather than later with China, India, with Japan, with Europe, with Brazil, because the 4 or 5 years between now and 2012 will barely be enough to have that debate settled.

The CHAIRMAN. Thank you, Doctor. General Sullivan.

General SULLIVAN. Mr. Chairman, I believe that climate change, environmental health, energy dependence and national security are all interrelated. I think you are on the right track with this panel, addressing these issues. I applaud your endeavors to sponsor an NIE, National Intelligence Estimate, to look at these issues in depth, broadly, and to come up with a way forward.

The CHAIRMAN. Well, we thank you. We thank this extraordinary panel for its testimony today, not just for your testimony but also

for the judgment which you have brought to these issues here today.

I think that two things are quite clear. One, it is the size of the problem, and it is no longer acceptable for us to act incrementally. We now must find a way for the United States Congress and for the United States to be bold to deal with this issue. The time has now passed for incremental solutions, and while boldness has always been something that is synonymous with unpassable in terms of legislation in Washington, I think that quickly that time is passing on this issue. And secondly, that the solutions are there, and our panel has pointed to so many of them from fuel economy standards for vehicles to cellulosic energies, renewable sources for the generation of electricity, looking at the sequestration of carbon in the use of coal and so many others, the gentleman from Oregon pointing to the standards that we should have for buildings across our country. The list goes on and on but the solutions are available.

This is the kickoff to the 2-year Select Committee on Energy Independence and Global Warming. I can't think of a greater panel to have begun this discussion. We thank you very much. This hearing is adjourned.

[Whereupon, at 12:30 p.m., the committee was adjourned.]

The Power of Green

Ny times

April 15, 2007

By THOMAS L. FRIEDMAN

I.

One day Iraq, our post-9/11 trauma and the divisiveness of the Bush years will all be behind us — and America will need, and want, to get its groove back. We will need to find a way to reknit America at home, reconnect America abroad and restore America to its natural place in the global order — as the beacon of progress, hope and inspiration. I have an idea how. It's called "green."

In the world of ideas, to name something is to own it. If you can name an issue, you can own the issue. One thing that always struck me about the term "green" was the degree to which, for so many years, it was defined by its opponents — by the people who wanted to disparage it. And they defined it as "liberal," "tree-hugging," "sissy," "girlie-man," "unpatriotic," "vaguely French."

Well, I want to rename "green." I want to rename it geostrategic, geoeconomic, capitalistic and patriotic. I want to do that because I think that living, working, designing, manufacturing and projecting America in a green way can be the basis of a new unifying political movement for the 21st century. A redefined, broader and more muscular green ideology is not meant to trump the traditional Republican and Democratic agendas but rather to bridge them when it comes to addressing the three major issues facing every American today: jobs, temperature and terrorism.

How do our kids compete in a flatter world? How do they thrive in a warmer world? How do they survive in a more dangerous world? Those are, in a nutshell, the big questions facing America at the dawn of the

21st century. But these problems are so large in scale that they can only be effectively addressed by an America with 50 green states — not an America divided between red and blue states.

Because a new green ideology, properly defined, has the power to mobilize liberals and conservatives, evangelicals and atheists, big business and environmentalists around an agenda that can both pull us together and propel us forward. That's why I say: We don't just need the first black president. We need the first green president. We don't just need the first woman president. We need the first environmental president. We don't just need a president who has been toughened by years as a prisoner of war but a president who is tough enough to level with the American people about the profound economic, geopolitical and climate threats posed by our addiction to oil — and to offer a real plan to reduce our dependence on fossil fuels.

After World War II, President Eisenhower responded to the threat of Communism and the “red menace” with massive spending on an interstate highway system to tie America together, in large part so that we could better move weapons in the event of a war with the Soviets. That highway system, though, helped to enshrine America's car culture (atrophying our railroads) and to lock in suburban sprawl and low-density housing, which all combined to get America addicted to cheap fossil fuels, particularly oil. Many in the world followed our model.

Today, we are paying the accumulated economic, geopolitical and climate prices for that kind of America. I am not proposing that we radically alter our lifestyles. We are who we are — including a car culture. But if we want to continue to be who we are, enjoy the benefits and be able to pass them on to our children, we do need to fuel our future in a cleaner, greener way. Eisenhower rallied us with the red menace. The next president will have to rally us with a green patriotism. Hence my motto: “Green is the new red, white and blue.”

The good news is that after traveling around America this past year, looking at how we use energy and the emerging alternatives, I can report

that green really has gone Main Street — thanks to the perfect storm created by 9/11, Hurricane Katrina and the Internet revolution. The first flattened the twin towers, the second flattened New Orleans and the third flattened the global economic playing field. The convergence of all three has turned many of our previous assumptions about “green” upside down in a very short period of time, making it much more compelling to many more Americans.

But here’s the bad news: While green has hit Main Street — more Americans than ever now identify themselves as greens, or what I call “Geo-Greens” to differentiate their more muscular and strategic green ideology — green has not gone very far down Main Street. It certainly has not gone anywhere near the distance required to preserve our lifestyle. The dirty little secret is that we’re fooling ourselves. We in America talk like we’re already “the greenest generation,” as the business writer Dan Pink once called it. But here’s the really inconvenient truth: We have not even begun to be serious about the costs, the effort and the scale of change that will be required to shift our country, and eventually the world, to a largely emissions-free energy infrastructure over the next 50 years.

II.

A few weeks after American forces invaded Afghanistan, I visited the Pakistani frontier town of Peshawar, a hotbed of Islamic radicalism. On the way, I stopped at the famous Darul Uloom Haqqania, the biggest madrasa, or Islamic school, in Pakistan, with 2,800 live-in students. The Taliban leader Mullah Muhammad Omar attended this madrasa as a younger man. My Pakistani friend and I were allowed to observe a class of young boys who sat on the floor, practicing their rote learning of the Koran from texts perched on wooden holders. The air in the Koran class was so thick and stale it felt as if you could have cut it into blocks. The teacher asked an 8-year-old boy to chant a Koranic verse for us, which he did with the elegance of an experienced muezzin. I asked another student, an Afghan refugee, Rahim Kunduz, age 12, what his reaction was to the Sept. 11 attacks, and he said: “Most likely the attack came

from Americans inside America. I am pleased that America has had to face pain, because the rest of the world has tasted its pain." A framed sign on the wall said this room was "A gift of the Kingdom of Saudi Arabia."

Sometime after 9/11 — an unprovoked mass murder perpetrated by 19 men, 15 of whom were Saudis — green went geostrategic, as Americans started to realize we were financing both sides in the war on terrorism. We were financing the U.S. military with our tax dollars; and we were financing a transformation of Islam, in favor of its most intolerant strand, with our gasoline purchases. How stupid is that?

Islam has always been practiced in different forms. Some are more embracing of modernity, reinterpretation of the Koran and tolerance of other faiths, like Sufi Islam or the populist Islam of Egypt, Ottoman Turkey and Indonesia. Some strands, like Salafi Islam — followed by the Wahhabis of Saudi Arabia and by Al Qaeda — believe Islam should be returned to an austere form practiced in the time of the Prophet Muhammad, a form hostile to modernity, science, "infidels" and women's rights. By enriching the Saudi and Iranian treasuries via our gasoline purchases, we are financing the export of the Saudi puritanical brand of Sunni Islam and the Iranian fundamentalist brand of Shiite Islam, tilting the Muslim world in a more intolerant direction. At the Muslim fringe, this creates more recruits for the Taliban, Al Qaeda, Hamas, Hezbollah and the Sunni suicide bomb squads of Iraq; at the Muslim center, it creates a much bigger constituency of people who applaud suicide bombers as martyrs.

The Saudi Islamic export drive first went into high gear after extreme fundamentalists challenged the Muslim credentials of the Saudi ruling family by taking over the Grand Mosque of Mecca in 1979 — a year that coincided with the Iranian revolution and a huge rise in oil prices. The attack on the Grand Mosque by these Koran-and-rifle-wielding Islamic militants shook the Saudi ruling family to its core. The al-Sauds responded to this challenge to their religious bona fides by becoming outwardly more religious. They gave their official Wahhabi religious

establishment even more power to impose Islam on public life. Awash in cash thanks to the spike in oil prices, the Saudi government and charities also spent hundreds of millions of dollars endowing mosques, youth clubs and Muslim schools all over the world, ensuring that Wahhabi imams, teachers and textbooks would preach Saudi-style Islam. Eventually, notes Lawrence Wright in "The Looming Tower," his history of Al Qaeda, "Saudi Arabia, which constitutes only 1 percent of the world Muslim population, would support 90 percent of the expenses of the entire faith, overriding other traditions of Islam."

Saudi mosques and wealthy donors have also funneled cash to the Sunni insurgents in Iraq. The Associated Press reported from Cairo in December: "Several drivers interviewed by the A.P. in Middle East capitals said Saudis have been using religious events, like the hajj pilgrimage to Mecca and a smaller pilgrimage, as cover for illicit money transfers. Some money, they said, is carried into Iraq on buses with returning pilgrims. 'They sent boxes full of dollars and asked me to deliver them to certain addresses in Iraq,' said one driver. ... 'I know it is being sent to the resistance, and if I don't take it with me, they will kill me.'"

No wonder more Americans have concluded that conserving oil to put less money in the hands of hostile forces is now a geostrategic imperative. President Bush's refusal to do anything meaningful after 9/11 to reduce our gasoline usage really amounts to a policy of "No Mullah Left Behind." James Woolsey, the former C.I.A. director, minces no words: "We are funding the rope for the hanging of ourselves."

No, I don't want to bankrupt Saudi Arabia or trigger an Islamist revolt there. Its leadership is more moderate and pro-Western than its people. But the way the Saudi ruling family has bought off its religious establishment, in order to stay in power, is not healthy. Cutting the price of oil in half would help change that. In the 1990s, dwindling oil income sparked a Saudi debate about less Koran and more science in Saudi schools, even experimentation with local elections. But the recent oil windfall has stilled all talk of reform.

That is because of what I call the First Law of Petropolitics: The price of oil and the pace of freedom always move in opposite directions in states that are highly dependent on oil exports for their income and have weak institutions or outright authoritarian governments. And this is another reason that green has become geostrategic. Soaring oil prices are poisoning the international system by strengthening antidemocratic regimes around the globe.

Look what's happened: We thought the fall of the Berlin Wall was going to unleash an unstoppable tide of free markets and free people, and for about a decade it did just that. But those years coincided with oil in the \$10-to-\$30-a-barrel range. As the price of oil surged into the \$30-to-\$70 range in the early 2000s, it triggered a countertide — a tide of petroauthoritarianism — manifested in Russia, Iran, Nigeria, Venezuela, Saudi Arabia, Syria, Sudan, Egypt, Chad, Angola, Azerbaijan and Turkmenistan. The elected or self-appointed elites running these states have used their oil windfalls to ensconce themselves in power, buy off opponents and counter the fall-of-the-Berlin-Wall tide. If we continue to finance them with our oil purchases, they will reshape the world in their image, around Putin-like values.

You can illustrate the First Law of Petropolitics with a simple graph. On one line chart the price of oil from 1979 to the present; on another line chart the Freedom House or Fraser Institute freedom indexes for Russia, Nigeria, Iran and Venezuela for the same years. When you put these two lines on the same graph you see something striking: the price of oil and the pace of freedom are inversely correlated. As oil prices went down in the early 1990s, competition, transparency, political participation and accountability of those in office all tended to go up in these countries — as measured by free elections held, newspapers opened, reformers elected, economic reform projects started and companies privatized. That's because their petroauthoritarian regimes had to open themselves to foreign investment and educate and empower their people more in order to earn income. But as oil prices went up around 2000, free speech, free press, fair elections and freedom to form political parties and NGOs all eroded in these countries.

The motto of the American Revolution was “no taxation without representation.” The motto of the petroauthoritarians is “no representation without taxation”: If I don’t have to tax you, because I can get all the money I need from oil wells, I don’t have to listen to you.

It is no accident that when oil prices were low in the 1990s, Iran elected a reformist Parliament and a president who called for a “dialogue of civilizations.” And when oil prices soared to \$70 a barrel, Iran’s conservatives pushed out the reformers and ensconced a president who says the Holocaust is a myth. (I promise you, if oil prices drop to \$25 a barrel, the Holocaust won’t be a myth anymore.) And it is no accident that the first Arab Gulf state to start running out of oil, Bahrain, is also the first Arab Gulf state to have held a free and fair election in which women could run and vote, the first Arab Gulf state to overhaul its labor laws to make more of its own people employable and the first Arab Gulf state to sign a free-trade agreement with America.

People change when they have to — not when we tell them to — and falling oil prices make them have to. That is why if we are looking for a Plan B for Iraq — a way of pressing for political reform in the Middle East without going to war again — there is no better tool than bringing down the price of oil. When it comes to fostering democracy among petroauthoritarians, it doesn’t matter whether you’re a neocon or a radical lib. If you’re not also a Geo-Green, you won’t succeed.

The notion that conserving energy is a geostrategic imperative has also moved into the Pentagon, for slightly different reasons. Generals are realizing that the more energy they save in the heat of battle, the more power they can project. The Pentagon has been looking to improve its energy efficiency for several years now to save money. But the Iraq war has given birth to a new movement in the U.S. military: the “Green Hawks.”

As Amory Lovins of the Rocky Mountain Institute, who has been working with the Pentagon, put it to me: The Iraq war forced the U.S. military to think much more seriously about how to “eat its tail” — to

shorten its energy supply lines by becoming more energy efficient. According to Dan Nolan, who oversees energy projects for the U.S. Army's Rapid Equipping Force, it started last year when a Marine major general in Anbar Province told the Pentagon he wanted better-insulated, more energy-efficient tents in the Iraqi desert. Why? His air-conditioners were being run off mobile generators, and the generators ran on diesel, and the diesel had to be trucked in, and the insurgents were blowing up the trucks.

"When we began the analysis of his request, it was really about the fact that his soldiers were being attacked on the roads bringing fuel and water," Nolan said. So eating their tail meant "taking those things that are brought into the unit and trying to generate them on-site." To that end Nolan's team is now experimenting with everything from new kinds of tents that need 40 percent less air-conditioning to new kinds of fuel cells that produce water as a byproduct.

Pay attention: When the U.S. Army desegregated, the country really desegregated; when the Army goes green, the country could really go green.

"Energy independence is a national security issue," Nolan said. "It's the right business for us to be in. ... We are not trying to change the whole Army. Our job is to focus on that battalion out there and give those commanders the technological innovations they need to deal with today's mission. But when they start coming home, they are going to bring those things with them."

III.

The second big reason green has gone Main Street is because global warming has. A decade ago, it was mostly experts who worried that climate change was real, largely brought about by humans and likely to lead to species loss and environmental crises. Now Main Street is starting to worry because people are seeing things they've never seen before in their own front yards and reading things they've never read before in their papers — like the recent draft report by the United

Nations's 2,000-expert Intergovernmental Panel on Climate Change, which concluded that "changes in climate are now affecting physical and biological systems on every continent."

I went to Montana in January and Gov. Brian Schweitzer told me: "We don't get as much snow in the high country as we used to, and the runoff starts sooner in the spring. The river I've been fishing over the last 50 years is now warmer in July by five degrees than 50 years ago, and it is hard on our trout population." I went to Moscow in February, and my friends told me they just celebrated the first Moscow Christmas in their memory with no snow. I stopped in London on the way home, and I didn't need an overcoat. In 2006, the average temperature in central England was the highest ever recorded since the Central England Temperature (C.E.T.) series began in 1659.

Yes, no one knows exactly what will happen. But ever fewer people want to do nothing. Gov. Arnold Schwarzenegger of California summed up the new climate around climate when he said to me recently: "If 98 doctors say my son is ill and needs medication and two say 'No, he doesn't, he is fine,' I will go with the 98. It's common sense — the same with global warming. We go with the majority, the large majority. ... The key thing now is that since we know this industrial age has created it, let's get our act together and do everything we can to roll it back."

But how? Now we arrive at the first big roadblock to green going down Main Street. Most people have no clue — no clue — how huge an industrial project is required to blunt climate change. Here are two people who do: Robert Socolow, an engineering professor, and Stephen Pacala, an ecology professor, who together lead the Carbon Mitigation Initiative at Princeton, a consortium designing scalable solutions for the climate issue.

They first argued in a paper published by the journal *Science* in August 2004 that human beings can emit only so much carbon into the atmosphere before the buildup of carbon dioxide (CO₂) reaches a level unknown in recent geologic history and the earth's climate system starts

to go “haywire.” The scientific consensus, they note, is that the risk of things going haywire — weather patterns getting violently unstable, glaciers melting, prolonged droughts — grows rapidly as CO₂ levels “approach a doubling” of the concentration of CO₂ that was in the atmosphere before the Industrial Revolution.

“Think of the climate change issue as a closet, and behind the door are lurking all kinds of monsters — and there’s a long list of them,” Pacala said. “All of our scientific work says the most damaging monsters start to come out from behind that door when you hit the doubling of CO₂ levels.” As Bill Collins, who led the development of a model used worldwide for simulating climate change, put it to me: “We’re running an uncontrolled experiment on the only home we have.”

So here is our challenge, according to Pacala: If we basically do nothing, and global CO₂ emissions continue to grow at the pace of the last 30 years for the next 50 years, we will pass the doubling level — an atmospheric concentration of carbon dioxide of 560 parts per million — around midcentury. To avoid that — and still leave room for developed countries to grow, using less carbon, and for countries like India and China to grow, emitting double or triple their current carbon levels, until they climb out of poverty and are able to become more energy efficient — will require a huge global industrial energy project.

To convey the scale involved, Socolow and Pacala have created a pie chart with 15 different wedges. Some wedges represent carbon-free or carbon-diminishing power-generating technologies; other wedges represent efficiency programs that could conserve large amounts of energy and prevent CO₂ emissions. They argue that the world needs to deploy any 7 of these 15 wedges, or sufficient amounts of all 15, to have enough conservation, and enough carbon-free energy, to increase the world economy and still avoid the doubling of CO₂ in the atmosphere. Each wedge, when phased in over 50 years, would avoid the release of 25 billion tons of carbon, for a total of 175 billion tons of carbon avoided between now and 2056.

Here are seven wedges we could chose from: “Replace 1,400 large coal-fired plants with gas-fired plants; increase the fuel economy of two billion cars from 30 to 60 miles per gallon; add twice today’s nuclear output to displace coal; drive two billion cars on ethanol, using one-sixth of the world’s cropland; increase solar power 700-fold to displace coal; cut electricity use in homes, offices and stores by 25 percent; install carbon capture and sequestration capacity at 800 large coal-fired plants.” And the other eight aren’t any easier. They include halting all cutting and burning of forests, since deforestation causes about 20 percent of the world’s annual CO₂ emissions.

“There has never been a deliberate industrial project in history as big as this,” Pacala said. Through a combination of clean power technology and conservation, “we have to get rid of 175 billion tons of carbon over the next 50 years — and still keep growing. It is possible to accomplish this if we start today. But every year that we delay, the job becomes more difficult — and if we delay a decade or two, avoiding the doubling or more may well become impossible.”

IV.

In November, I flew from Shanghai to Beijing on Air China. As we landed in Beijing and taxied to the terminal, the Chinese air hostess came on the P.A. and said: “We’ve just landed in Beijing. The temperature is 8 degrees Celsius, 46 degrees Fahrenheit and the sky is clear.”

I almost burst out laughing. Outside my window the smog was so thick you could not see the end of the terminal building. When I got into Beijing, though, friends told me the air was better than usual. Why? China had been host of a summit meeting of 48 African leaders. Time magazine reported that Beijing officials had “ordered half a million official cars off the roads and said another 400,000 drivers had ‘volunteered’ to refrain from using their vehicles” in order to clean up the air for their African guests. As soon as they left, the cars returned, and Beijing’s air went back to “unhealthy.”

Green has also gone Main Street because the end of Communism, the rise of the personal computer and the diffusion of the Internet have opened the global economic playing field to so many more people, all coming with their own versions of the American dream — a house, a car, a toaster, a microwave and a refrigerator. It is a blessing to see so many people growing out of poverty. But when three billion people move from “low-impact” to “high-impact” lifestyles, Jared Diamond wrote in “Collapse,” it makes it urgent that we find cleaner ways to fuel their dreams. According to Lester Brown, the founder of the Earth Policy Institute, if China keeps growing at 8 percent a year, by 2031 the per-capita income of 1.45 billion Chinese will be the same as America’s in 2004. China currently has only one car for every 100 people, but Brown projects that as it reaches American income levels, if it copies American consumption, it will have three cars for every four people, or 1.1 billion vehicles. The total world fleet today is 800 million vehicles!

That’s why McKinsey Global Institute forecasts that developing countries will generate nearly 80 percent of the growth in world energy demand between now and 2020, with China representing 32 percent and the Middle East 10 percent. So if Red China doesn’t become Green China there is no chance we will keep the climate monsters behind the door. On some days, says the U.S. Environmental Protection Agency, almost 25 percent of the polluting matter in the air above Los Angeles comes from China’s coal-fired power plants and factories, as well as fumes from China’s cars and dust kicked up by droughts and deforestation around Asia.

The good news is that China knows it has to grow green — or it won’t grow at all. On Sept. 8, 2006, a Chinese newspaper reported that China’s E.P.A. and its National Bureau of Statistics had re-examined China’s 2004 G.D.P. number. They concluded that the health problems, environmental degradation and lost workdays from pollution had actually cost China \$64 billion, or 3.05 percent of its total economic output for 2004. Some experts believe the real number is closer to 10 percent.

Thus China has a strong motivation to clean up the worst pollutants in its air. Those are the nitrogen oxides, sulfur oxides and mercury that produce acid rain, smog and haze — much of which come from burning coal. But cleaning up is easier said than done. The Communist Party's legitimacy and the stability of the whole country depend heavily on Beijing's ability to provide rising living standards for more and more Chinese.

So, if you're a Chinese mayor and have to choose between growing jobs and cutting pollution, you will invariably choose jobs: coughing workers are much less politically dangerous than unemployed workers. That's a key reason why China's 10th five-year plan, which began in 2000, called for a 10 percent reduction in sulfur dioxide in China's air — and when that plan concluded in 2005, sulfur dioxide pollution in China had increased by 27 percent.

But if China is having a hard time cleaning up its nitrogen and sulfur oxides — which can be done relatively cheaply by adding scrubbers to the smokestacks of coal-fired power plants — imagine what will happen when it comes to asking China to curb its CO₂, of which China is now the world's second-largest emitter, after America. To build a coal-fired power plant that captures, separates and safely sequesters the CO₂ into the ground before it goes up the smokestack requires either an expensive retrofit or a whole new system. That new system would cost about 40 percent more to build and operate — and would produce 20 percent less electricity, according to a recent M.I.T. study, "The Future of Coal."

China — which is constructing the equivalent of two 500-megawatt coal-fired power plants every week — is not going to pay that now. Remember: CO₂ is an invisible, odorless, tasteless gas. Yes, it causes global warming — but it doesn't hurt anyone in China today, and getting rid of it is costly and has no economic payoff. China's strategy right now is to say that CO₂ is the West's problem. "It must be pointed out that climate change has been caused by the long-term historic emissions of developed countries and their high per-capita emissions," Jiang Yu, a

spokeswoman for China's Foreign Ministry, declared in February. "Developed countries bear an unshirkable responsibility."

So now we come to the nub of the issue: Green will not go down Main Street America unless it also goes down Main Street China, India and Brazil. And for green to go Main Street in these big developing countries, the prices of clean power alternatives — wind, biofuels, nuclear, solar or coal sequestration — have to fall to the "China price." The China price is basically the price China pays for coal-fired electricity today because China is not prepared to pay a premium now, and sacrifice growth and stability, just to get rid of the CO₂ that comes from burning coal.

"The 'China price' is the fundamental benchmark that everyone is looking to satisfy," said Curtis Carlson, C.E.O. of SRI International, which is developing alternative energy technologies. "Because if the Chinese have to pay 10 percent more for energy, when they have tens of millions of people living under \$1,000 a year, it is not going to happen." Carlson went on to say: "We have an enormous amount of new innovation we must put in place before we can get to a price that China and India will be able to pay. But this is also an opportunity."

V.

The only way we are going to get innovations that drive energy costs down to the China price — innovations in energy-saving appliances, lights and building materials and in non-CO₂-emitting power plants and fuels — is by mobilizing free-market capitalism. The only thing as powerful as Mother Nature is Father Greed. To a degree, the market is already at work on this project — because some venture capitalists and companies understand that clean-tech is going to be the next great global industry. Take Wal-Mart. The world's biggest retailer woke up several years ago, its C.E.O. Lee Scott told me, and realized that with regard to the environment its customers "had higher expectations for us than we had for ourselves." So Scott hired a sustainability expert, Jib Ellison, to tutor the company. The first lesson Ellison preached was that

going green was a whole new way for Wal-Mart to cut costs and drive its profits. As Scott recalled it, Ellison said to him, “Lee, the thing you have to think of is all this stuff that people don’t want you to put into the environment is waste — and you’re paying for it!”

So Scott initiated a program to work with Wal-Mart’s suppliers to reduce the sizes and materials used for all its packaging by five percent by 2013. The reductions they have made are already paying off in savings to the company. “We created teams to work across the organization,” Scott said. “It was voluntary — then you had the first person who eliminated some packaging, and someone else started showing how we could recycle more plastic, and all of a sudden it’s \$1 million a quarter.” Wal-Mart operates 7,000 huge Class 8 trucks that get about 6 miles per gallon. It has told its truck makers that by 2015, it wants to double the efficiency of the fleet. Wal-Mart is the China of companies, so, explained Scott, “if we place one order we can create a market” for energy innovation.

For instance, Wal-Mart has used its shelves to create a huge, low-cost market for compact fluorescent bulbs, which use about a quarter of the energy of incandescent bulbs to produce the same light and last 10 times as long. “Just by doing what it does best — saving customers money and cutting costs,” said Glenn Prickett of Conservation International, a Wal-Mart adviser, “Wal-Mart can have a revolutionary impact on the market for green technologies. If every one of their 100 million customers in the U.S. bought just one energy-saving compact fluorescent lamp, instead of a traditional incandescent bulb, they could cut CO₂ emissions by 45 billion pounds and save more than \$3 billion.”

Those savings highlight something that often gets lost: The quickest way to get to the China price for clean power is by becoming more energy efficient. The cheapest, cleanest, nonemitting power plant in the world is the one you don’t build. Helping China adopt some of the breakthrough efficiency programs that California has adopted, for instance — like rewarding electrical utilities for how much energy they get their customers to save rather than to use — could have a huge impact. Some

experts estimate that China could cut its need for new power plants in half with aggressive investments in efficiency.

Yet another force driving us to the China price is Chinese entrepreneurs, who understand that while Beijing may not be ready to impose CO₂ restraints, developed countries are, so this is going to be a global business — and they want a slice. Let me introduce the man identified last year by Forbes Magazine as the seventh-richest man in China, with a fortune now estimated at \$2.2 billion. His name is Shi Zhengrong and he is China's leading manufacturer of silicon solar panels, which convert sunlight into electricity.

“People at all levels in China have become more aware of this environment issue and alternative energy,” said Shi, whose company, Suntech Power Holdings, is listed on the New York Stock Exchange. “Five years ago, when I started the company, people said: ‘Why do we need solar? We have a surplus of coal-powered electricity.’ Now it is different; now people realize that solar has a bright future. But it is still too expensive. ... We have to reduce the cost as quickly as possible — our real competitors are coal and nuclear power.”

Shi does most of his manufacturing in China, but sells roughly 90 percent of his products outside China, because today they are too expensive for his domestic market. But the more he can get the price down, and start to grow his business inside China, the more he can use that to become a dominant global player. Thanks to Suntech's success, in China “there is a rush of business people entering this sector, even though we still don't have a market here,” Shi added. “Many government people now say, ‘This is an industry!’ ” And if it takes off, China could do for solar panels what it did for tennis shoes — bring the price down so far that everyone can afford a pair.

VI.

All that sounds great — but remember those seven wedges? To reach the necessary scale of emissions-free energy will require big clean coal or nuclear power stations, wind farms and solar farms, all connected to a

national transmission grid, not to mention clean fuels for our cars and trucks. And the market alone, as presently constructed in the U.S., will not get us those alternatives at the scale we need — at the China price — fast enough.

Prof. Nate Lewis, Caltech's noted chemist and energy expert, explained why with an analogy. "Let's say you invented the first cellphone," he said. "You could charge people \$1,000 for each one because lots of people would be ready to pay lots of money to have a phone they could carry in their pocket." With those profits, you, the inventor, could pay back your shareholders and plow more into research, so you keep selling better and cheaper cellphones.

But energy is different, Lewis explained: "If I come to you and say, 'Today your house lights are being powered by dirty coal, but tomorrow, if you pay me \$100 more a month, I will power your house lights with solar,' you are most likely to say: 'Sorry, Nate, but I don't really care how my lights go on, I just care that they go on. I won't pay an extra \$100 a month for sun power. A new cellphone improves my life. A different way to power my lights does nothing.'

"So building an emissions-free energy infrastructure is not like sending a man to the moon," Lewis went on. "With the moon shot, money was no object — and all we had to do was get there. But today, we already have cheap energy from coal, gas and oil. So getting people to pay more to shift to clean fuels is like trying to get funding for NASA to build a spaceship to the moon — when Southwest Airlines already flies there and gives away free peanuts! I already have a cheap ride to the moon, and a ride is a ride. For most people, electricity is electricity, no matter how it is generated."

If we were running out of coal or oil, the market would steadily push the prices up, which would stimulate innovation in alternatives. Eventually there would be a crossover, and the alternatives would kick in, start to scale and come down in price. But what has happened in energy over the last 35 years is that the oil price goes up, stimulating government

subsidies and some investments in alternatives, and then the price goes down, the government loses interest, the subsidies expire and the investors in alternatives get wiped out.

The only way to stimulate the scale of sustained investment in research and development of non-CO₂ emitting power at the China price is if the developed countries, who can afford to do so, force their people to pay the full climate, economic and geopolitical costs of using gasoline and dirty coal. Those countries that have signed the Kyoto Protocol are starting to do that. But America is not.

Up to now, said Lester Brown, president of the Earth Policy Institute, we as a society “have been behaving just like Enron the company at the height of its folly.” We rack up stunning profits and G.D.P. numbers every year, and they look great on paper “because we’ve been hiding some of the costs off the books.” If we don’t put a price on the CO₂ we’re building up or on our addiction to oil, we’ll never nurture the innovation we need.

Jeffrey Immelt, the chairman of General Electric, has worked for G.E. for 25 years. In that time, he told me, he has seen seven generations of innovation in G.E.’s medical equipment business — in devices like M.R.I.s or CT scans — because health care market incentives drove the innovation. In power, it’s just the opposite. “Today, on the power side,” he said, “we’re still selling the same basic coal-fired power plants we had when I arrived. They’re a little cleaner and more efficient now, but basically the same.”

The one clean power area where G.E. is now into a third generation is wind turbines, “thanks to the European Union,” Immelt said. Countries like Denmark, Spain and Germany imposed standards for wind power on their utilities and offered sustained subsidies, creating a big market for wind-turbine manufacturers in Europe in the 1980s, when America abandoned wind because the price of oil fell. “We grew our wind business in Europe,” Immelt said.

As things stand now in America, Immelt said, “the market does not work in energy.” The multibillion-dollar scale of investment that a company like G.E. is being asked to make in order to develop new clean-power technologies or that a utility is being asked to make in order to build coal sequestration facilities or nuclear plants is not going to happen at scale — unless they know that coal and oil are going to be priced high enough for long enough that new investments will not be undercut in a few years by falling fossil fuel prices. “Carbon has to have a value,” Immelt emphasized. “Today in the U.S. and China it has no value.”

I recently visited the infamous Three Mile Island nuclear plant with Christopher Crane, president of Exelon Nuclear, which owns the facility. He said that if Exelon wanted to start a nuclear plant today, the licensing, design, planning and building requirements are so extensive it would not open until 2015 at the earliest. But even if Exelon got all the approvals, it could not start building “because the cost of capital for a nuclear plant today is prohibitive.”

That’s because the interest rate that any commercial bank would charge on a loan for a nuclear facility would be so high — because of all the risks of lawsuits or cost overruns — that it would be impossible for Exelon to proceed. A standard nuclear plant today costs about \$3 billion per unit. The only way to stimulate more nuclear power innovation, Crane said, would be federal loan guarantees that would lower the cost of capital for anyone willing to build a new nuclear plant.

The 2005 energy bill created such loan guarantees, but the details still have not been worked out. “We would need a robust loan guarantee program to jump-start the nuclear industry,” Crane said — an industry that has basically been frozen since the 1979 Three Mile Island accident. With cheaper money, added Crane, CO₂-free nuclear power could be “very competitive” with CO₂-emitting pulverized coal.

Think about the implications. Three Mile Island had two reactors, TMI-2, which shut down because of the 1979 accident, and TMI-1, which is still operating today, providing clean electricity with virtually no CO₂

emissions for 800,000 homes. Had the TMI-2 accident not happened, it too would have been providing clean electricity for 800,000 homes for the last 28 years. Instead, that energy came from CO₂-emitting coal, which, by the way, still generates 50 percent of America's electricity.

Similar calculations apply to ethanol production. "We have about 100 scientists working on cellulosic ethanol," Chad Holliday, the C.E.O. of DuPont, told me. "My guess is that we could double the number and add another 50 to start working on how to commercialize it. It would probably cost us less than \$100 million to scale up. But I am not ready to do that. I can guess what it will cost me to make it and what the price will be, but is the market going to be there? What are the regulations going to be? Is the ethanol subsidy going to be reduced? Will we put a tax on oil to keep ethanol competitive? If I know that, it gives me a price target to go after. Without that, I don't know what the market is and my shareholders don't know how to value what I am doing. ... You need some certainty on the incentives side and on the market side, because we are talking about multiyear investments, billions of dollars, that will take a long time to take off, and we won't hit on everything."

Summing up the problem, Immelt of G.E. said the big energy players are being asked "to take a 15-minute market signal and make a 40-year decision and that just doesn't work. ... The U.S. government should decide: What do we want to have happen? How much clean coal, how much nuclear and what is the most efficient way to incentivize people to get there?"

He's dead right. The market alone won't work. Government's job is to set high standards, let the market reach them and then raise the standards more. That's how you get scale innovation at the China price. Government can do this by imposing steadily rising efficiency standards for buildings and appliances and by stipulating that utilities generate a certain amount of electricity from renewables — like wind or solar. Or it can impose steadily rising mileage standards for cars or a steadily tightening cap-and-trade system for the amount of CO₂ any factory or power plant can emit. Or it can offer loan guarantees and fast-track

licensing for anyone who wants to build a nuclear plant. Or — my preference and the simplest option — it can impose a carbon tax that will stimulate the market to move away from fuels that emit high levels of CO₂ and invest in those that don't. Ideally, it will do all of these things. But whichever options we choose, they will only work if they are transparent, simple and long-term — with zero fudging allowed and with regulatory oversight and stiff financial penalties for violators.

The politician who actually proved just how effective this can be was a guy named George W. Bush, when he was governor of Texas. He pushed for and signed a renewable energy portfolio mandate in 1999. The mandate stipulated that Texas power companies had to produce 2,000 new megawatts of electricity from renewables, mostly wind, by 2009. What happened? A dozen new companies jumped into the Texas market and built wind turbines to meet the mandate, so many that the 2,000-megawatt goal was reached in 2005. So the Texas Legislature has upped the mandate to 5,000 megawatts by 2015, and everyone knows they will beat that too because of how quickly wind in Texas is becoming competitive with coal. Today, thanks to Governor Bush's market intervention, Texas is the biggest wind state in America.

President Bush, though, is no Governor Bush. (The Dick Cheney effect?) President Bush claims he's protecting American companies by not imposing tough mileage, conservation or clean power standards, but he's actually helping them lose the race for the next great global industry. Japan has some of the world's highest gasoline taxes and stringent energy efficiency standards for vehicles — and it has the world's most profitable and innovative car company, Toyota. That's no accident.

The politicians who best understand this are America's governors, some of whom have started to just ignore Washington, set their own energy standards and reap the benefits for their states. As Schwarzenegger told me, "We have seen in California so many companies that have been created that work just on things that have do with clean environment." California's state-imposed efficiency standards have resulted in per-

capita energy consumption in California remaining almost flat for the last 30 years, while in the rest of the country it has gone up 50 percent. “There are a lot of industries that are exploding right now because of setting these new standards,” he said.

VII.

John Dineen runs G.E. Transportation, which makes locomotives. His factory is in Erie, Pa., and employs 4,500 people. When it comes to the challenges from cheap labor markets, Dineen likes to say, “Our little town has trade surpluses with China and Mexico.”

Now how could that be? China makes locomotives that are 30 percent cheaper than G.E.’s, but it turns out that G.E.’s are the most energy efficient in the world, with the lowest emissions and best mileage per ton pulled — “and they don’t stop on the tracks,” Dineen added. So China is also buying from Erie — and so are Brazil, Mexico and Kazakhstan. What’s the secret? The China price.

“We made it very easy for them,” said Dineen. “By producing engines with lower emissions in the classic sense (NOx [nitrogen oxides]) and lower emissions in the future sense (CO₂) and then coupling it with better fuel efficiency and reliability, we lowered the total life-cycle cost.”

The West can’t impose its climate or pollution standards on China, Dineen explained, but when a company like G.E. makes an engine that gets great mileage, cuts pollution and, by the way, emits less CO₂, China will be a buyer. “If we were just trying to export lower-emission units, and they did not have the fuel benefits, we would lose,” Dineen said. “But when green is made green — improved fuel economies coupled with emissions reductions — we see very quick adoption rates.”

One reason G.E. Transportation got so efficient was the old U.S. standard it had to meet on NOx pollution, Dineen said. It did that through technological innovation. And as oil prices went up, it leveraged more technology to get better mileage. The result was a cleaner, more efficient, more exportable locomotive. Dineen describes his factory as a

“technology campus” because, he explains, “it looks like a 100-year-old industrial site, but inside those 100-year-old buildings are world-class engineers working on the next generation’s technologies.” He also notes that workers in his factory make nearly twice the average in Erie — by selling to China!

The bottom line is this: Clean-tech plays to America’s strength because making things like locomotives lighter and smarter takes a lot of knowledge — not cheap labor. That’s why embedding clean-tech into everything we design and manufacture is a way to revive America as a manufacturing power.

“Whatever you are making, if you can add a green dimension to it — making it more efficient, healthier and more sustainable for future generations — you have a product that can’t just be made cheaper in India or China,” said Andrew Shapiro, founder of GreenOrder, an environmental business-strategy group. “If you just create a green ghetto in your company, you miss it. You have to figure out how to integrate green into the DNA of your whole business.”

Ditto for our country, which is why we need a Green New Deal — one in which government’s role is not funding projects, as in the original New Deal, but seeding basic research, providing loan guarantees where needed and setting standards, taxes and incentives that will spawn 1,000 G.E. Transportations for all kinds of clean power.

Bush won’t lead a Green New Deal, but his successor must if America is going to maintain its leadership and living standard. Unfortunately, today’s presidential hopefuls are largely full of hot air on the climate-energy issue. Not one of them is proposing anything hard, like a carbon or gasoline tax, and if you think we can deal with these huge problems without asking the American people to do anything hard, you’re a fool or a fraud.

Being serious starts with reframing the whole issue — helping Americans understand, as the Carnegie Fellow David Rothkopf puts it, “that we’re not ‘post-Cold War’ anymore — we’re pre-something totally

new.” I’d say we’re in the “pre-climate war era.” Unless we create a more carbon-free world, we will not preserve the free world. Intensifying climate change, energy wars and petroauthoritarianism will curtail our life choices and our children’s opportunities every bit as much as Communism once did for half the planet.

Equally important, presidential candidates need to help Americans understand that green is not about cutting back. It’s about creating a new cornucopia of abundance for the next generation by inventing a whole new industry. It’s about getting our best brains out of hedge funds and into innovations that will not only give us the clean-power industrial assets to preserve our American dream but also give us the technologies that billions of others need to realize their own dreams without destroying the planet. It’s about making America safer by breaking our addiction to a fuel that is powering regimes deeply hostile to our values. And, finally, it’s about making America the global environmental leader, instead of laggard, which as Schwarzenegger argues would “create a very powerful side product.” Those who dislike America because of Iraq, he explained, would at least be able to say, “Well, I don’t like them for the war, but I do like them because they show such unbelievable leadership — not just with their blue jeans and hamburgers but with the environment. People will love us for that. That’s not existing right now.”

In sum, as John Hennessy, the president of Stanford, taught me: Confronting this climate-energy issue is the epitome of what John Gardner, the founder of Common Cause, once described as “a series of great opportunities disguised as insoluble problems.”

Am I optimistic? I want to be. But I am also old-fashioned. I don’t believe the world will effectively address the climate-energy challenge without America, its president, its government, its industry, its markets and its people all leading the parade. Green has to become part of America’s DNA. We’re getting there. Green has hit Main Street — it’s now more than a hobby — but it’s still less than a new way of life.

Why? Because big transformations — women’s suffrage, for instance — usually happen when a lot of aggrieved people take to the streets, the politicians react and laws get changed. But the climate-energy debate is more muted and slow-moving. Why? Because the people who will be most harmed by the climate-energy crisis haven’t been born yet.

“This issue doesn’t pit haves versus have-nots,” notes the Johns Hopkins foreign policy expert Michael Mandelbaum, “but the present versus the future — today’s generation versus its kids and unborn grandchildren.” Once the Geo-Green interest group comes of age, especially if it is after another 9/11 or Katrina, Mandelbaum said, “it will be the biggest interest group in history — but by then it could be too late.”

An unusual situation like this calls for the ethic of stewardship. Stewardship is what parents do for their kids: think about the long term, so they can have a better future. It is much easier to get families to do that than whole societies, but that is our challenge. In many ways, our parents rose to such a challenge in World War II — when an entire generation mobilized to preserve our way of life. That is why they were called the Greatest Generation. Our kids will only call us the Greatest Generation if we rise to our challenge and become the Greenest Generation.

Thomas L. Friedman is a columnist for The New York Times specializing in foreign affairs.

Mr. Richard Haass
Answers to Questions for the Record

Of course terrorism, illegal drug trade, and slavery already exist independent of global warming. Their existence reflects a myriad of causes ranging from ideology to greed. My point is simply that global climate change (in addition to all else that it will cause) brings with it the potential to increase strains on governments, leading to a greater degree of state failure and a larger number of failed states. Such failure will in turn create additional opportunities for terrorists and those who traffic in drugs or people. This reality only strengthens the argument that the United States needs to adopt a comprehensive, ambitious, and sustained approach to climate change at the same time it addresses other national security challenges.

Additional Questions for the Record for Vice Admiral McGinn

1. You said in your statement that it would cost about \$7-8 billion for a coal-to-liquid plant that produces 80,000 barrels of oil per day. Currently, total costs amount to \$40 to produce one barrel of oil using this method, so right now this plant would make about \$25 per barrel produced which amounts to \$730 million in profits per year. Is this not an acceptable return for the investment?
 - By your estimation, the coal industry stands to make billions – why then is Congress considering providing it with billion dollar subsidies?
 - The coal executives anticipate potentially huge profits and coal industry lobbying has reached a fever pitch. The coal industry spent \$6 million in 2005 and 2006, three times what it spent each year from 2000 through 2004, according to calculations by Politicalmoneyline.com.¹
 - Every public or private dollar invested in liquid coal is a dollar unavailable for investment in energy efficiency, renewable energy resources, public transportation and consumer incentives that will yield real reductions in oil dependency and global warming pollution. Energy solutions involving coal to liquid conversion should compete on a level playing field with other potential solutions to our oil dependency and climate change challenges. All potential solutions, including coal to liquid, should carefully consider total cost, technology hurdles, infrastructure cost and “well to wheels” environmental impact.
 - A new study released by the [Massachusetts Institute of Technology](http://www.mit.edu) entitled “The Future of Coal,” estimates that it would cost \$70 billion to build enough plants to replace 10 percent of American gasoline consumption. The study estimates that the construction costs for coal-to-liquid plants are almost four times higher than the costs for comparable petroleum refineries, and it argues that cost estimates for synthetic fuel plants in the past turned out to be “wildly optimistic.”²
 - The societal costs of coal-to-liquid fuels will be huge: coal-based fuels produce twice as much global warming pollution per gallon of fuel as compared to the petroleum based fuels we use today. In addition to the carbon dioxide emitted while using the fuel, the production process creates almost a ton of carbon dioxide for every barrel of liquid fuel.³
 - Recently the Environmental Protection Agency released an analysis confirming that liquid coal would result in *100 percent more emissions* than gasoline.⁴

¹ Andrews, Edmund L. “Lawmakers Push for Big Subsidies for Coal Process.” *New York Times*, May 29, 2007.

² Ibid

³ Ibid

⁴ <http://www.epa.gov/otaq/renewablefuels/420f07035.htm>

- Even with carbon capture and disposal at the production end, liquid coal fuels would still result in nearly ten percent more global warming pollution overall.
 - No company has built a commercial-scale plant that also captures carbon, and MIT experts caution that many obstacles lie ahead. “At best, you’re going to tread water on the carbon issue, and you’re probably going to do worse,” said Howard Herzog, a principal research engineer at the Massachusetts Institute of Technology.⁵
2. What is your opinion on Congress authorizing DoD to establish a 15 year contract at \$65 per CTL barrel that will return a reasonable investment return and a predictable price for military operations fuel costs?
- As noted above, coal-to-liquid fuels produce almost twice the volume of greenhouse gases as ordinary petroleum-based fuels. Recently, EPA released analysis confirming that liquid coal would result in *100 percent more emissions* than gasoline.⁶
 - Global warming poses serious national security risks making it critical that we address our energy security issues within the context of global warming. If we address one issue by exacerbating another, we will increase not decrease our national security risks.
3. The earth's average temperature has increased over the past 100 years, but only by 1 degree Fahrenheit. But over the past 2000 years, temperatures have risen and fallen many times and have contributed to violence and instability in human civilizations. But did not almost all of these changes occur before the industrial age, long before significant increases of greenhouse gas emissions by fossil fuels?
- The world’s leading scientific panel on climate change -- including more than 200 scientists and officials from more than 120 countries and the U.S. -- has concluded that global warming is real, it is human induced and if actions are not taken to reduce greenhouse gas emissions the impacts will be devastating.
 - Our nation’s leading military experts have called climate change a threat multiplier in some of the world’s most volatile regions.
 - Human civilization has reached a new apex of technological achievement bringing people of different cultures, religions and races in greater contact with each other than any time in history. We have also reached a new nadir in worldwide conflict, as world population increases to above 6.5 billion and ready access to resources decrease.
 - Without action to reduce greenhouse gas emissions, projected temperature increases will be unlike any military threat we have faced before because, as Vice Admiral Richard Truly said, instead of some localized or regional hot

⁵ NYT, May 29, 2007

⁶ <http://www.epa.gov/otaq/renewablefuels/420f07035.htm>

spot we're trying to handle, "It's going to happen to every country and every person in the whole world at the same time."⁸

4. Page 4 of your testimony states that "flooding could imperil low lying islands and crowded river deltas of southern Asia." Doesn't it follow that China and India should be very concerned about global warming also? How do you suggest we engage these growing carbon emitters in the debate, which could impact them so severely? Is China even capable of enforcing an agreement on carbon if it is signed?
 - Yes, all major greenhouse gas emitters must join in the effort to reduce emissions but those who have lead the world in both technology and in creating the problem must lead the world in finding a solution. Unlike China which is a relatively new emitter, the United States has been the world's leading greenhouse gas emitter throughout history and is responsible for 29.3% of the world's greenhouse gas emissions, while China is responsible for only 7.6%.⁹
 - China, unlike the United States, has passed very stringent fuel economy standards and plans to produce 16% of all its electricity from renewable sources by 2020, while reducing the energy intensity of its economy by a further 20%. China improved its energy intensity by more than 60% between 1980 and 2004.¹⁰
 - As retired Marine Corps General Anthony C. Zinni, former commander of U.S. Central Command said "The intensity of global temperature change can be mitigated somewhat if the U.S. begins leading the way in reducing global carbon emissions." He concluded "We will pay now to reduce greenhouse gas emissions today...or we will pay the price later in military terms and that will involve human lives."¹¹

5. On page 3 of your written statement, you note that US crude and gasoline stockpiles are much lower than analysts had forecasted. How much lower, and what do you think the adequate levels are?
 - If you review the cited source for this statistic (New York Times article by Matt Chambers, entitled "Crude, Gasoline Prices Surge/Decline in Imports/Helps Cut Reserves; Temporary Blip?" published March 8, 2007) you will learn that when the Energy Information Administration announced in March that crude stockpiles slumped by 4.8 million barrels to 324.2 million

⁷ CNA Report on "National Security and the Threat of Climate Change"
<http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf> (April 16, 2007).

⁸ "Military on Climate Change" *Washington Post* (April 15, 2007).

⁹ World Resources Institute, "Navigating Numbers"; Cumulative Emissions, Chapter 6.

¹⁰ Vidal, John. *The Guardian*. "China could overtake US" (April 25, 2007)

¹¹ *Washington Post* "Military on Climate Change" (April 15, 2007).

- barrels, it sent the price of crude soaring more than \$1 a barrel. That drop reversed expectations of a two-million-barrel build up.
- The important point is that the world oil supply is tightening as demand surges leaving little elasticity in a very volatile market and creating increased U.S. reliance on the Middle East. This is both a near and far term challenge. The supply and demand curves for oil will continue to diverge, with increasingly adverse consequences, if we persist in a “business as usual” approach.
6. You talk about raising CAFE standards for cars; I will take that as a personal thought rather than one of expertise, since you come from a military background. So I would like to go a bit off testimony here and ask if you are aware of Navy programs to reduce the amount of fuel that is consumed by military vehicles. I will note that the Army does have an active program to increase the fuel efficiency of HUMVEES and to promote the development of better batteries – technology which could eventually be applied to private markets as well. Are you aware of any Navy work in these areas?
- There are many military programs, in all Services, attempting to increase the fuel efficiency of their vehicles and platforms. The Navy has an ongoing and successful program to reduce operational fuel consumption for ships and aircraft, as well as for support vehicles ashore. Additionally, for more than a year, the Defense Science Board has been conducting a detailed analysis of DoD’s energy consumption with a goal of significantly reducing it. The study focuses on four key areas; policy, platforms (ships, aircraft, combat vehicles), base installations and technology. The security risks of inefficient fleets are multifold – from the larger national security concerns to the very real, on-the-ground or at-sea operational reality of troops in harm’s way who can ill afford to shoulder the burden of inefficient fuel consumption.
7. You say that coal-to-liquid is not an answer and increases emissions, but there are technologies being developed to make that a cleaner burning fuel. Don’t you think it is premature to dismiss it as an option if there is a possibility that this technology will work?
- As noted above, as presently produced, coal-to-liquid fuels produce twice the volume of greenhouse gas emissions of petroleum based fuels. Without global warming emissions tailpipe standards, companies who develop coal-to-liquid fuels have no reason to reduce greenhouse gas (GHG) emissions emitted while burning them. Given the serious national security risks posed by global warming, no federal dollars should be spent to promote coal-to-liquid production without first establishing strict GHG and air pollution reduction standards. Current congressional proposals contain billions of dollars in subsidies for companies that stand to make billions with no incentive to even begin to develop the kind of technology to which you refer.
 - As also noted above, to date no company has built a commercial-scale coal-to-liquid plant that also captures carbon, and MIT experts caution that many

obstacles lie ahead. “At best, you’re going to tread water on the carbon issue, and you’re probably going to do worse,” said Howard Herzog, a principal research engineer at the Massachusetts Institute of Technology.¹²

8. You say that “Every public or private dollar invested in liquid coal is a dollar unavailable for investment in efficiency, renewable energy resources, public transportation and consumer incentives that will yield real reductions in global warming.” But can’t the same be said for investing in CAFE standards when there are cars moving into the market place that offer hybrids, plug-ins and flex-fuel vehicles? Why shouldn’t we promote investing in those technologies instead of trying to meet arbitrary standards for CAFE?
 - CAFE standards and technology investment are not mutually exclusive. In fact, tough CAFE standards will motivate investment in the fuel efficiency technology that you mention. I believe the government should not be in the business of choosing technology – but instead, become well informed about technology costs, risks and benefits, and then set goals and let the market place and manufacturers choose how they will reach those goals. Without government mandates for the automotive industry many years ago, we would today not have seat belts, airbags, anti-lock brakes deployed fleet-wide, and, without previous CAFE standards, we would be wasting even more imported oil on much less fuel efficient vehicles.

¹² NYT, May 29, 2007

R. James Woolsey
Answers to Questions for the Record

1. That's correct. Hydrogen fuel cells for general vehicular transportation, in my view, are so far behind both battery development for plug-in hybrids and even electric vehicles, and also so far behind alternative liquid fuels, that investment in them should be limited to a small-scale r&d program and the funds used where they can do much more good more quickly. To power the family car with a hydrogen fuel cell takes just under 2.5 times more energy (e.g. converting electricity to hydrogen via electrolysis and then converting the hydrogen back to electricity in the fuel cell) than by using the energy directly. A hydrogen fueling infrastructure for family cars will cost tens of billions to hundreds of billions of dollars whereas the fueling infrastructure for plug-in hybrids will consist, for many consumers, of one standard extension cord per car.

2. Pacific Northwest National Laboratory has done a detailed study of this. According to their work about ¾ of the vehicles on the road could be plug-in hybrids before a single new power plant would be required. The electric grid is very under-utilized at night when most plug-ins would be fueling. Fueling needs would depend on the battery capacity, but to take one example: the Chevrolet Volt, now scheduled to be in dealers' showrooms 2 ½ years from now, would reportedly carry about a 10 kwh battery. This means it could be fully charged overnight for a forty-mile all-electric drive the next morning (over ¾ of the nation's cars travel less than 40 miles a day) at a cost of somewhere in the range of 1-3 cents a mile, depending on the part of the country and whether there is differential off-peak pricing. As gasoline driving costs head above 15 cents a mile (for a standard 25 mpg car) electricity will approach being an order of magnitude less costly.

3. Net metering is already the law in 40 out of 50 states and others seem to be following suit – when the batteries in my basement are full I can watch, on a sunny day, my electric meter run in reverse. A number of utilities are already experimenting with utilizing net metering so that plug-ins can provide ancillary services for the grid, replacing principally natural gas for grid regulation and spinning reserves. The work of FERC Commissioner Wellinghoff shows substantial benefit to the vehicle owner by his providing such services to the grid – well over \$1,000 per vehicle per year according to his calculations and briefings.

4. It would be a good idea to provide federal and state tax credits to speed the introduction of plug-in hybrids, and it is true that the provision of ancillary services may come earlier for fleet vehicles than for individual ones, but it is my understanding that all that is required is modest software changes for the utility.

The owner of a plug-in needs no solar panels to do net metering of his sale of ancillary services to his local utility – he needs only his car and an extension cord. GM currently says that the Volt in 2010 will cost under \$30,000, so anyone who can afford to own or lease a vehicle of that price can take advantage of the net metering laws to sell ancillary services to the local utility. This is why Commissioner Wellinghoff calls plug-in hybrids “cash-back hybrids”.

5. No, I disagree. The 22 states of the Arab League, together with Iran, have a population approximating that of the US and Canada together -- yet these 23 states export to the world, other than hydrocarbons (almost all oil), less than Finland: a nation of 5 million people. These are the states that either themselves fund terrorism or are the home of those who do – so virtually all of the funders’ resources come directly or indirectly from oil. Moreover, the work of Professor Paul Collier of Oxford and many other scholars have illuminated the close tie between the huge economic rent from oil and the concentration of power in the dictatorships and autocratic kingdoms that constitute the vast majority of the world’s oil exporters (there are exceptions, such as Norway, but not many). As Tom Friedman of the NYT puts it, “the price of oil and the path of freedom run in opposite directions.”

6. Yes, protecting oil infrastructure in, say, Saudi Arabia is a major concern of the Saudi government. It is an issue on which the US and some of the governments of oil exporters cooperate. But that doesn’t mean we can relax about these vulnerabilities. Two years ago when al Qaeda, in spite of Saudi efforts, got a truck bomb into Abqaiq (the largest oil production facility in the world), they failed to rig the bomb correctly. Had they succeeded in taking out the sulfur-clearing towers they could have taken 5-6 million barrels a day out of production for many months and almost certainly sent oil to around \$200/barrel. The latter figure, bin Laden has said, is his target price for oil.

7. With oil above \$100/barrel we have shot past borrowing a billion dollars a day to import oil and are heading above a billion and a half a day. This is much larger than our trade deficit with China, which is itself quite substantial. This debt as a whole weakens the dollar and gives foreign governments, including China, the ability to make investments in the US that can be to our strategic disadvantage. But the largest share of this problem is caused by our oil dependence.

8. My best judgment would be that it will prove to be technically feasible – probably in large deep salt water aquifers – but that it will be quite expensive. Professor Ernie Moniz of MIT has studied this issue thoroughly. His estimate as of a few months ago was that proving out such sequestration would take about ten years and cost about \$10 billion, and that to sustain such sequestration it

would take a CO2 price of \$35-40/ton. This is around 5 times the CO2 price in Europe as of a few weeks ago.

9. I believe a mandate for FFV's that can use a range of alternative fuels – ethanol, methanol, butanol – is warranted and practical. The cost is only around \$100 a car in the manufacturing process. The Brazilians have already fully implemented such a mandate for all new cars – I believe it took them only about two years to do so early in this decade. There is no good reason to delay on this that I know of.

10. No I have not. I am relying principally on the detailed research done on this subject by the Rocky Mountain Institute.

11. No, I have not seen any detailed calculations. But I agree that moving quickly to plug-in hybrids, via improved batteries, e.g., has a higher priority.

12. I think we should focus first and foremost on removing barriers to competition with oil. Requiring flexible fuel vehicles (FFV's) and pumps at filling stations for alternative fuels, for example, has the effect of making it possible for alternative fuels to compete with petroleum products.

13. I have generally relied on the Institute for the Analysis of Global Strategy (IAGS) for these cost assessments. I would be willing to see the USG spend considerably more than this -- \$3 billion is not even 3 days of oil imports.

14. I'm not familiar with the stratified fuel injection. At a panel I chaired for the Aspen Institute just over a year ago, one of our participants, Vinod Khosla, used a figure of \$132 dollars for one major US manufacturer, but indicated that nearly \$100 of that total was for an oxygen sensor that was required in any case. I have subsequently heard GM estimates of approximately \$100/vehicle. If that figure is substantially low for any new category of vehicles I would be delighted to have the full facts.