UNITED STATES
HOUSE OF REPRESENTATIVES

SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING

FINAL STAFF REPORT
FOR THE 110TH CONGRESS

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EXECUTIVE SUMMARY

Global climate change presents one of the gravest threats not only to our planet's health, but also to the United States' economy, national security, and public health. Scientists warn that we may be approaching a tipping point, after which it will become increasingly difficult, or perhaps impossible, to halt global warming and its catastrophic effects. The United States confronts this issue at the same time it faces a deepening energy crisis—characterized by skyrocketing prices, an increasing dependence on foreign oil, and continued reliance on high-carbon fuels that worsen the climate crisis.

We are at a watershed moment in the history of energy production—and the choices we make at this juncture will determine the fate of our planet and the national security and economic future of the United States. Between now and 2030, over $20 trillion will be invested in energy infrastructure worldwide, and an estimated $1.5 trillion will be invested in the U.S. power sector alone. This new infrastructure is long-lived and costly, and the decisions made in the next decade will set the course of the global and U.S. energy system—and of the global climate—for the next century and beyond. This transition also presents an unprecedented opportunity for economic growth and job creation in the clean energy technology sector. But the United States must act now if it is to be a leader in this rapidly developing global market.

Recognizing the urgency of these challenges, Speaker Pelosi announced at the outset of the 110th Congress her intention to create a select committee to tackle them. On March 8, 2007, the House passed Resolution 202, establishing the Select Committee on Energy Independence and Global Warming and directing it to "investigate, study, make findings, and develop recommendations on policies, strategies, technologies and other innovations, intended to reduce the dependence of the United States on foreign sources of energy and achieve substantial and permanent reductions in emissions and other activities that contribute to climate change and global warming."[1] In keeping with this mandate, the Select Committee has worked to identify balanced and workable solutions to the urgent challenge of securing America's energy independence while combating global warming.

Over the past 18 months, the Select Committee has held over 50 hearings on a broad array of subjects ranging from the security, economic, and environmental threats posed by climate change, to advanced vehicle and renewable energy technologies, to policy options for lowering prices at the gasoline pump. These hearings are listed in Appendix A of this report. Many were groundbreaking "firsts"—including the first congressional hearing on the national security implications of climate change, the first "green jobs" hearing, the first hearing at which the head of the Intergovernmental Panel on Climate Change testified, the first hearing on U.S. cities' efforts to combat climate change, the first hearing with the Administrator of the Environmental Protection Agency on the implications of the Supreme Court's decision in *Massachusetts v. EPA*, the first hearing on the Department of the Interior's handling of the decision whether to list the polar bear as an endangered species, and the first hearing on the voluntary carbon offset market—to name a few. In addition, the Select Committee has held field hearings atop Cannon Mountain in New Hampshire, at the U.S. Conference of Mayors' meeting

[1] H.Res. 202, § 4(c), 110th Cong. (2007).

in Seattle, Washington, and in Hartford, Connecticut. Meanwhile, it has hosted numerous briefings to educate House staff on a broad array of key energy and climate issues.

The Select Committee has aggressively pursued oversight of the Bush Administration's energy and climate policies, including through oversight hearings, letters, and information requests focusing on the Environmental Protection Agency, the Department of Energy, the Department of the Interior, the National Highway Traffic Safety Administration, the Department of State, and the Centers for Disease Control and Prevention.

The Select Committee organized or participated in several major Congressional delegations focused on energy security and climate change issues. These include delegations led by Speaker Pelosi to Greenland and the European Union in May 2007 and to India in March 2008, as well as a Select Committee delegation to Brazil in February 2008. In addition, Select Committee staff delegations have traveled to the UN Climate Change Conference in Bali, Indonesia in December 2007 and to the National Center for Atmospheric Research, the National Ocean and Atmospheric Administration's Earth Systems Research Laboratory, and the National Renewable Energy Laboratories in Colorado.

Finally, the Select Committee has worked to communicate directly with the American public about energy security and climate change issues—principally through its website, which has won the prestigious "Golden Dot" Award for the best website in all federal, state, and local government (presented by the School of Political Management at George Washington University), an Honorable Mention from the Webby Awards, a Pollie Award from the American Association of Political Consultants, and a Silver Mouse Award, presented by the Congressional Management Foundation. Chairman Markey—by "avatar"—delivered the first international address on climate using virtual world ("Second Life") technology to the UN climate change conference in Bali, Indonesia, in December 2007.

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This Final Staff Report details the findings and recommendations of the Select Committee staff. Part I of the report addresses the challenges posed by the climate crisis and America's growing energy needs. Part II provides recommendations on a series of "win-win" solutions that will bolster America's energy security while achieving the reductions in global warming pollution needed to save the planet. Part III presents the findings and recommendations resulting from the Select Committee's oversight activities. Part IV discusses international issues, and reviews the findings of the Select Committee Congressional delegations to Greenland and the EU, Brazil, and India.

The Report's key findings and recommendations are as follows:

KEY FINDINGS

The scientific debate on the cause of climate change is over. A clear scientific consensus now holds that global warming is happening, that manmade greenhouse gas emissions are largely responsible, and that failure to dramatically reduce those emissions in

the coming decades will result in catastrophic impacts. Human activities have changed the atmosphere as much in 200 years as natural variations changed it over 20,000 years. Atmospheric concentrations of carbon dioxide—a key heat-trapping gas—have increased from 280 parts per million to 380 parts per million since 1750, and are higher than any level seen in the last 650,000 years. These concentrations could exceed 700 parts per million by 2100—leading to an increase in global average surface temperature of over 11 ºF—if current trends in emission growth continue.

Among the more alarming predictions regarding the likely near- to medium-term impacts of unchecked global warming are the following:

- **Increasingly severe water scarcity in the United States and globally, resulting in massive economic damages in the United States and subjecting up to 1.2 billion additional people in Asia, up to 220 million people in Africa, and up to 80 million people in Latin America to water stress by 2030.**

- **Increasing warming and acidification of the oceans, contributing to the collapse of coral reefs around the world and severely impacting global fisheries.**

- **Sea level rise of at least 1-2 feet—and possibly much more—by 2100, subjecting the roughly 1 billion people living in coastal areas around the world to increased risk of inundation, storm surges, coastal erosion, and saltwater intrusion into drinking water supplies.**

- **Increased heavy precipitation events and flooding in the United States and globally, as well as the potential for more frequent and more intense hurricanes and extreme weather events.**

- **A broad range of adverse effects on public health including more frequent and more intense heat waves, thousands of additional deaths and millions of additional cases of respiratory illness due to ground-level ozone air pollution, as well as increased risk of infectious disease in the United States and many other regions of the world.**

- **More frequent and more intense wildfires, and a longer fire season, throughout the Western United States, together with a decline in forest health due to increased infestation from pests.**

- **Forty percent of the world's species could face extinction by the latter half of this century as a result of global climate change.**

Tragically, these impacts will fall disproportionately on vulnerable communities, particularly in the developing world, that are least responsible for climate change and least able to adapt to it. However, the United States and other wealthy countries will also suffer devastating economic, environmental, and human costs if global warming continues unabated.

The potential costs of global warming—both globally and here in the United States—are staggering. Economic studies suggest that global warming could cost the global economy from 5 to 20 percent of gross domestic product (GDP). Here in the United States, preliminary studies suggest that even a narrow range of global warming impacts could slash GDP by 1.8 to 3.6 percent by 2100. These costs far outweigh the potential costs of economy-wide legislation to reduce global warming pollution.

There is a growing consensus that climate change presents a serious and growing risk to the United States' national security interests around the world, acting as a "threat multiplier." Climate change impacts will increase the risk of water and food scarcity, mass migration, and resource conflict in the developing world, with the potential for destabilization in many regions. Climate change impacts will also affect military and strategic infrastructure and energy supplies, both here in the United States and abroad.

To avert catastrophic global warming, it will be necessary to reduce global greenhouse gas emissions by at least 50-85 percent by 2050—including a reduction by the United States and other developed countries of at least 80 percent by 2050. Strong interim targets, including a reduction of U.S. emissions by at least 20 percent by 2020, will be needed to achieve these goals. This will require an unprecedented transformation of the U.S. and global economy and energy systems—an energy technology revolution, which the United States must lead.

In the face of this crisis, the Bush Administration's approach to climate change has been marked by pervasive delay, obfuscation, and political interference in scientific research and agency decision making. In addition to its well-documented attempts to censor government climate scientists, the Bush Administration has worked aggressively to prevent the EPA from fulfilling its legal obligation under the Clean Air Act to regulate greenhouse gas emissions and has blocked California and over a dozen other states from implementing greenhouse gas emission standards for motor vehicles. Further, the Administration has delayed progress in international climate talks, undermining the United Nations negotiations and refusing to agree to binding emission reduction targets.

At the same time, the United States is confronting a deepening energy security crisis—characterized by skyrocketing energy prices, growing dependence on foreign oil, and a widening gap between rising energy demand and stagnant supply.

The United States' continuing "addiction" to oil presents a serious and growing threat to our national security and economy. The United States is the largest consumer of oil in the world, accounting for 25 percent of global demand—principally to power our transportation system, which is 95 percent dependent on oil. In the past 40 years, the United States has gone from importing 21 percent of the oil it consumes to importing nearly 70 percent. The vast majority of the world's oil—and virtually all of its spare production capacity—is located in countries that are members of OPEC. As a result, the United States' national security and economy is increasingly threatened by the potential for a supply disruption or market manipulation by sometimes unfriendly foreign governments.

Oil and gasoline prices have skyrocketed in the past year, and are predicted to remain at historically high levels for the foreseeable future, primarily as a result of rising global demand. Crude oil prices have increased by over 300 percent since 2001, and gasoline prices increased by 150 percent in this period. Even with the recent drop in prices, oil remains very expensive and volatile. While oil market speculation and the weak U.S. dollar have undoubtedly played an important role in the recent price run-up, experts agree that growing global demand—mostly in rapidly growing developing countries—is likely to result in sustained high prices for the foreseeable future. Soaring prices have had a crippling effect on American consumers—with mid-2008 gasoline expenses eating up nearly 10 percent of an average American worker's pre-tax income. The oil and gas industry, meanwhile, is raking in record-breaking profits—$123 billion in 2007 and on track for $150 billion in 2008—while reducing investment in new exploration and putting little or no investment into alternative energy sources or research and development.

We cannot drill our way out of this problem. While the United States consumes 25 percent of the world's oil, it accounts for only 10 percent of global production and has less than 3 percent of global reserves. While the past year was marked by strident calls to open new areas of the Outer Continental Shelf (OCS) and the Arctic National Wildlife Refuge to drilling—and by the expiration of the 27-year moratorium on OCS drilling off the East and West Coasts of the United States—the facts make clear that increased drilling will have a negligible impact on crude oil supply or prices.

U.S. electricity demand is rising faster than new supply is coming online, our electricity transmission and distribution infrastructure is outdated and overtaxed, and uncertainty about climate regulation is stalling new investment. U.S. electricity demand is predicted to increase by 29 percent by 2030, requiring the construction of over 290,000 megawatts of new generating capacity—or equivalent increases in efficiency. This rising demand is outstripping predicted increases in supply and in transmission capacity. Many regions of the country are predicted to see declining levels of reserve capacity—putting the reliability of the grid at greater risk. While coal remains the single largest source of electricity in the country (over 49 percent), the massive contribution of coal-fired power plants to global warming pollution and uncertainty regarding climate policy are making it increasingly inadvisable and difficult to build new conventional coal-fired plants. Natural gas and wind power, meanwhile, are experiencing strong growth. While many advocate nuclear power, massive expansion would be necessary even for it to maintain its current share of U.S. generation, and there are very substantial financial, market, and other obstacles to such an expansion.

Natural gas demand and prices have risen dramatically in recent years, but the United States is not highly dependent on natural gas imports and new "unconventional" onshore resources are expanding domestic supply. Natural gas has become the fuel of choice for new power plants in the United States because of its low emissions and the comparatively low capital cost and short lead times for plant construction. Increased use of natural gas for residential and commercial heating is also contributing to rising demand. Natural gas prices have shot up over the past several years, with adverse impacts on residential and industrial consumers. Although the United States has less than 4 percent of global reserves, over 80 percent of the natural gas we consume is domestically produced, with most of the remainder coming from Canada. Rising

prices are contributing to a boom in "unconventional" domestic production from shales and coalbed methane, boosting domestic supply and putting downward pressure on prices. Completion of the Alaska Natural Gas Pipeline would further expand access to domestic resources. In contrast, opening previously closed areas of the OCS to gas production area will not significantly increase supply or reduce prices.

The energy security and climate challenges now facing us present a critical opportunity for economic growth and job creation. The policies recommended by this report will unleash an energy technology revolution that will far outstrip the information technology revolution of the past two decades in generating economic growth and American jobs. By contrast, if the United States does not seize this opportunity, it will become a laggard, instead of a leader, in what promises to be the largest global market of this century.

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ACHIEVEMENTS OF THE 110TH CONGRESS

The 110th Congress has taken a number of major steps towards addressing the climate and energy security challenges.

Most importantly, the enactment of the Energy Independence and Security Act of 2007 (EISA):

- Fuel Economy Standards: Raised corporate average fuel economy (CAFE) standards for the first time since 1975, to at least 35 miles per gallon by 2020—a minimum 40 percent increase over current standards—in keeping with the proposal advocated by Chairman Markey for the prior seven years.

- Renewable Fuel Standard: Established a renewable fuel standard that requires inclusion in the U.S. fuel supply of at least 36 billion gallons of renewable fuels by 2022, over half of which must come from next-generation biofuels including cellulosic ethanol and biodiesel.

- Lighting, Appliance, and Federal Building Efficiency Standards: Established lighting and appliance efficiency standards, as well as new efficiency standards for federal buildings.

- Green Jobs Training: Established a comprehensive "green jobs" training program for workers in the renewable energy and energy efficiency industries and authorized $125 million per year for this program.

Taken together, these policies are predicted to reduce U.S. oil consumption by 4 million barrels per day by 2030, equivalent to more than twice the oil we import from the Persian Gulf. They are predicted to reduce greenhouse gas emissions by 1.3 billion metric tons carbon dioxide equivalent annually by 2030—equivalent to 24 percent of the reductions needed by 2030 to keep us on track to reduce total U.S. emissions by 80 percent by 2050. They are expected to produce

$475 billion in net consumer savings by 2030—including $230 billion from fuel economy standards alone—and will create hundreds of thousands of new jobs.

In addition, as part of the economic rescue plan enacted on October 3, 2008 (H.R. 1424), Congress enacted the "Energy Improvement and Extension Act of 2008"—which provides an $18 billion package of tax credits for clean energy and energy efficiency. Included in this package were the following:

- Production Tax Credits for Renewable Electricity: A two-year extension of the production tax credit (PTC) for electricity generated from biomass, geothermal, hydropower, landfill gas and solid waste, and a one-year extension of the PTC for electricity generated from wind. For the first time, projects generating electricity from river and ocean currents, waves, tides, and thermal energy conversion are also eligible for the PTC.

- Investment Tax Credits for Renewable Electricity: An eight year-extension of investment tax credits (ITC) for up to 30 percent of the cost of residential and commercial-scale solar energy projects, together with removal of the $2,000 cap on residential photovoltaic solar investments, previously a significant barrier to growth in the residential market.

- Plug-In Hybrid Tax Credits: Tax credits on the purchase of fuel-efficient, plug-in hybrid electric vehicles. The tax credit starts at $2,500 and increases based on battery capacity and vehicle size to up a maximum of $7,500 for cars and $15,000 for heavy-duty trucks.

- Carbon Capture and Storage Credits: Tax credits for carbon capture and sequestration demonstration projects. Facilities would be eligible to receive a $20 tax credit for each metric ton of carbon dioxide captured and disposed of in secure geological storage and a $10 tax credit for each metric ton captured and used for qualified enhanced oil or natural gas recovery projects.

- Biofuel Credits: Incentives for the production of homegrown renewable fuels like biodiesel, and for the installation of E-85 pumps for consumers to fill up flexible-fuel vehicles.

- Efficiency and Smart Grid Incentives: Incentives for energy conservation in commercial buildings, residential structures, energy efficient clothes washers, dishwashers and refrigerators, and accelerated depreciation for smart electric meters and grid equipment.

- Clean Renewable Energy Bonds: $800 million worth of new clean renewable energy bonds for electric cooperatives and public power providers to finance facilities that generate electricity from renewable resources.

- Energy Conservation Bonds: $800 million worth of new Energy Conservation Bonds for State and local governments to make energy conservation investments in public infrastructure and invest in research.

The 110th Congress also enacted a number of measures aimed at protecting American consumers from high energy prices, including the following:

- LIHEAP Funding: Funding the Low-Income Home Energy Assistance Program (LIHEAP) at its full authorization level of $5.1 billion.

- Weatherization Assistance Program Funding: Increasing funding to the Weatherization Assistance Program, which supports weatherization of low-income homes to reduce energy costs, to $478 million—nearly double historic levels.

- Strategic Petroleum Reserve Fill Suspension: Enacting H.R. 6022, the "Strategic Petroleum Reserve Fill Suspension and Consumer Protection Act of 2008," which avoids wasteful spending and reduces pressures on oil prices by blocking the Department of Energy from buying oil for the Strategic Petroleum Reserve during a period of historically high oil prices.

Finally, the House passed several important energy security and climate measures that were not enacted into law, including the following:

- A national renewable electricity standard that would have required 15 percent of the national electricity supply to be generated using renewable resources by 2020 (up to 4 percent of which could be satisfied through efficiency measures).

- Federal model building standards that would have required a 30 percent improvement in the energy efficiency of new residential and commercial buildings by 2010 and a 50 percent improvement by 2020.

- "Use-it-or-lose-it" provisions that would require oil and gas companies to diligently pursue production on the 68 million acres of federal lands already leased to them.

- Recovery of $5.8 billion in Outer Continental Shelf oil and gas lease royalties lost due to erroneous omission of price caps for royalty relief in certain leases issued in 1998 and 1999.

- H.R. 6604, the Commodity Markets Transparency and Accountability Act of 2008, which would have addressed excessive speculation in energy markets by closing the so-called "London Loophole," which allowed traders to avoid regulation by offshoring their trades, requiring greater information be made public on trading activities in energy markets, and requiring the Commodity Futures Trading Commission to set position limits for energy futures markets.

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RECOMMENDATIONS

The 111th Congress and the next Administration should prioritize the implementation of the following recommendations, organized based on eight core objectives:

1. **Enact Economy-Wide "Cap-and-Invest" Legislation Based on the Following 10 Principles:**
   - Science-Based Emission Targets: Climate legislation must achieve a reduction in greenhouse gas emissions of at least 20 percent by 2020 and at least 80 percent by 2050.
   - Market-Based, Economy-Wide Cap-and-Trade System: To maximize cost savings, climate legislation should implement a market-based cap-and-trade system that covers as great a proportion of U.S. emissions as is practicable.
   - Ensure Fairness and Effectiveness by Auctioning Pollution Allowances: Climate legislation should auction 100 percent of pollution allowances, to ensure fairness and effectiveness of the cap-and-invest system and to minimize social costs.
   - Consumer Focused: Climate legislation should return at least half of allowance auction proceeds directly to low- and middle-income households to offset any increase in energy costs.
   - Invest in Efficiency, Clean Energy Technology, and American Workers: Climate legislation should spur the transition to a low-carbon economy by investing auction proceeds in energy efficiency programs, in the development, demonstration, and deployment of clean energy technologies, and in helping American workers to transition to good jobs in the new low-carbon economy.
   - Ensure Global Participation: Climate legislation should include an integrated system of "carrots" and "sticks" to ensure that other countries join with us in reducing greenhouse gas emissions.
   - Smart Offsets and Incentives for Supplemental Emission Reductions: Climate legislation should establish rigorous standards governing the award of offset credits, and should provide robust financial incentives for supplemental reductions in "uncapped" emissions not eligible to generate offset credits.
   - Rigorous Carbon Market Oversight: Climate legislation should establish a rigorous framework for oversight and regulation of the market for emission allowances, offset credits, and derivatives—ensuring transparency, fairness, and stability.
   - Build Resilience to Climate Change Impacts: Climate legislation should build resilience to unavoidable impacts of climate change, both in the United States and in the most vulnerable developing countries. This must include investment in the necessary capacity to provide a robust Earth observation and prediction system.
   - Integrate Complementary Policies and State and Local Roles: Climate legislation should integrate complementary policies (especially in the area of power sector, building, and transportation sector efficiency) to reduce the overall cost of reducing emissions, and should preserve appropriate roles for State and local action.

2. **Boost the Efficiency of the Power Sector and Residential and Commercial Buildings:**
   - National Building Efficiency Standards: Enact federal building efficiency standards requiring at least a 30 percent improvement in new building efficiency by 2010 and a 50 percent improvement by 2020.
   - Incentives for Building Efficiency Retrofits: Provide funding for the zero net-energy commercial buildings initiative created under EISA, and promote building efficiency labeling standards for existing buildings.
   - National Appliance Standards: Authorize new national appliance standards for high energy-consuming appliances such as flat-screen televisions, servers, and computers, and encourage the Department of Energy to promptly issue and/or update appliance efficiency standards under existing authority.
   - National Energy Efficiency Resource Standard: Adopt a national energy efficiency resource standard that requires utilities to achieve gradually increasing level of annual efficiency gains.
   - Performance-Based Incentives for State and Local Governments: Provide performance-based federal incentives—potentially funded through cap-and-invest auction proceeds or a national wires charge—to encourage utilities, States, and local governments to adopt energy efficiency measures.
   - Fund Combined Heat and Power, Fuel Cell, and Smart Grid RD&D Programs: Fully fund initiatives authorized under EISA to promote research, development, demonstration, and deployment of combined heat and power, fuel cells, and smart grid technologies.

3. **Expand Renewable Electricity Generation:**
   - National Renewable Electricity Standard: Establish national Renewable Electricity Standard requiring that 20 percent of U.S. electricity be supplied by renewable sources by 2020.
   - 5-8 Year Extension of Renewable Energy Tax Credits: Enact a five- to eight-year extension of the production tax credit for renewable electricity generation.
   - Double Federal RD&D: Double current levels of federal investment in RD&D on renewable electricity generation.
   - Develop a National Green Transmission and Distribution Policy: Encourage or require the Department of Energy and the Federal Energy Regulatory Commission to formulate a national policy to encourage construction of transmission lines connecting renewable resources with population centers.

4. **Drive the Development of Carbon Capture and Sequestration (CCS) Technology:**
   - Fund CCS Demonstration Projects and R&D: Fully fund the CCS demonstration program authorized under Sections 702 and 703 of EISA and increase funding for CCS-related R&D efforts.
   - Performance Standards for New Plants: Enact legislation, either in tandem with cap-and-invest legislation or as a precursor to it, to require all new coal-fired power plants to implement CCS by 2020.
   - Administration Task Force: Encourage or require the new administration to establish an interagency task force to address and make recommendations to Congress on

regulatory and legal barriers to the commercial deployment of CCS, including a proposed framework for long-term liability issues.

5. **Transform the U.S. Transportation System Through Fuel Efficiency, Electric-Drive Vehicles, Low-Carbon Fuels, and Transportation Choices:**
   - Ensure Rigorous Implementation of CAFE Authority: Require NHTSA to use realistic estimates of fuel prices and technologies in determining the "maximum feasible" fuel economy standards for the U.S. fleet.
   - Low-Carbon Fuel Standard: Enact a federal low-carbon fuel standard that requires gradual and continuous reductions in the carbon intensity of the U.S. fuel supply, is harmonized with the existing renewable fuel standard from the present through 2022, and replaces the renewable fuel standard after 2022.
   - Expand Tax Credits for Plug-In Hybrids and Other Advanced Vehicles: Provide tax credits for conversion of hybrid vehicles to plug-in hybrids.
   - Fund Loan Guarantees for Advanced Battery Development: Fully fund loan guarantees for advanced battery development under Section 135 of EISA.
   - Fund Electrification of State Vehicle Fleets: Establish a grant program to assist States with conversion of their vehicle fleets to plug-in hybrids and electric vehicles.
   - Double Federal RD&D: Double current levels of federal investment in RD&D on biofuels and advanced vehicle technologies.
   - Promote Mass Transit and Smart Growth: Make promotion of mass transit and smart growth policies to reduce vehicle miles traveled a priority for transportation reauthorization and other relevant federal policies.

6. **Support Green Jobs and Clean Tech Growth**
   - Fund Green Jobs Training: Fully fund the green jobs training program established under Section 1002 of EISA.
   - Clean Tech Investment Support: Consider the establishment of institutions and mechanisms, such as a clean energy investment bank, to encourage private investment in clean energy technology.

7. **Provide Short-Term Energy Relief to American Consumers:**
   - Fully Fund LIHEAP and the Weatherization Assistance Program: Fund the Low-Income Home Energy Assistance Program and the Weatherization Assistance Program at full authorization levels.
   - Manage Strategic Petroleum Reserve to Protect Taxpayers and Consumers: Require the Department of Energy to swap 10 percent of the light crude in the SPR for heavy crude to better balance the Reserve. Provide guidance to the Department of Energy on management of the SPR during periods of high oil prices to avoid wasteful spending and to utilize the Reserve to provide short-term relief to consumers.
   - Provide New Authority to Crack Down on Speculation: Amend the Commodities Exchange Act to close loopholes in the existing regulatory regime. Provide funding for 100 additional staff for the Commodities Futures Trading Commission to oversee energy commodities futures markets.

8. Responsibly Manage Expanded Domestic Oil and Gas Production:

- Encourage Diligent Development of Existing Leases: Enact legislation to require oil and gas leaseholders that fail to develop such leases diligently to surrender them to the Department of the Interior so that they can be offered to other producers.
- Responsibly Address Outer Continental Shelf Drilling: Revisit the issue of Outer Continental Shelf oil and gas exploration and drilling to ensure that environmentally and economically sensitive areas are protected and that States' rights are respected in future OCS drilling activities.
- Encourage Development of the Alaska Natural Gas Pipeline: Encourage presidential leadership in completion of the Alaska Natural Gas Pipeline, which could expand domestic supply of natural gas to the lower 48 States by 7 percent of current levels.

I. THE CLIMATE AND ENERGY CHALLENGE

A. THE CLIMATE CRISIS

The scientific debate on the cause of global warming is over. A clear scientific consensus now holds that global warming is happening, that manmade greenhouse gas emissions are largely responsible, and that the consequences of failing to reduce such emissions will be catastrophic.

1. The Scientific Consensus on Climate Change

Global warming refers to the global temperature rise and subsequent impacts from the increase of heat-trapping gases in the atmosphere from human activities, primarily the combustion of fossil fuels. This additional pollution enhances the so-called "greenhouse effect" and warms the Earth. The Intergovernmental Panel on Climate Change (IPCC) declared in its Fourth Assessment Report released in 2007 that the evidence for warming is "unequivocal"[2] and that most of the observed warming is very likely—greater than 90 percent certainty—due to the increase of global warming pollution from human activities.[3] Over the last century, the global average temperature has increased 1.4°F, with almost 90 percent of the warming occurring over the last 50 years.[4]

Just like the glass of a greenhouse traps warm air inside, certain gases in the atmosphere trap heat that would otherwise escape into space. There are a number of such "greenhouse gases": water vapor,[5] carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), high-altitude ozone, and certain man-made industrial gases, including chlorofluorocarbons, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

The impact of each gas on global warming is a combination of its ability to trap heat, its concentration in the atmosphere, and how long it stays in the atmosphere. For example, while one molecule of methane traps more heat than one molecule of CO_2, the higher concentration and longer atmospheric lifetime of CO_2 means it has contributed more to global warming than methane has. Most efforts to control global warming pollution have focused on the CO_2 emissions from the burning of fossil fuels because they have the greatest effect and we have the greatest control over them.

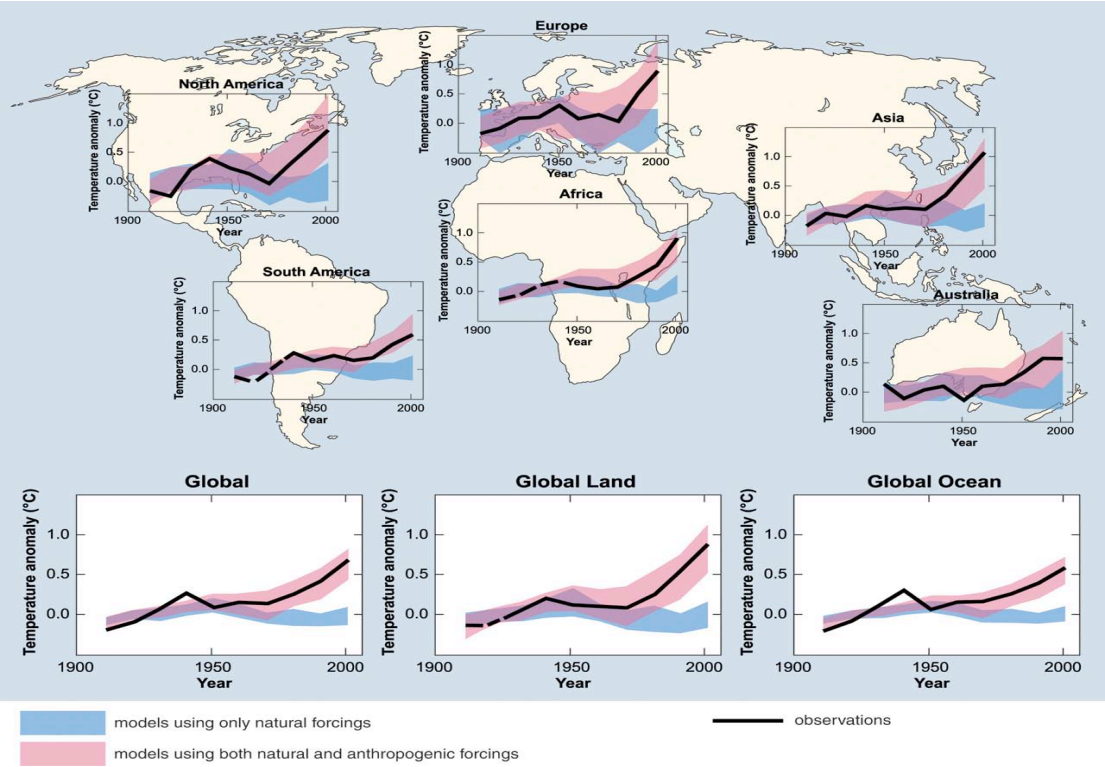
Since the Industrial Revolution, the concentration of CO_2 in the atmosphere has increased from 280 parts per million (ppm) to over 380 ppm.[6] This 100 ppm change is the same increase

[2] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 5 (2007).
[3] Id. at 3.
[4] Id. at 5.
[5] Water vapor is different from the other greenhouse gases primarily because of the much shorter time it stays in the atmosphere—days rather than years, decades or centuries. As noted below, the quantity of water vapor in the atmosphere depends primarily on temperature, rather than human activities.
[6] The total CO_2-equivalent concentration of all greenhouse gases is 455 ppm. Intergovernmental Panel on Climate Change, 2007: Mitigation of Climate Change, Summary for Policymakers, at 27 (2007).

as the world experienced from the last ice age about 20,000 years ago until just before the 1800's.[7] Human activities have changed the atmosphere as much in 200 years as natural variations changed it over 20,000 years. The current level is higher than any level seen in the last 650 thousand years.[8]

Scientists can model the temperature effects of natural and human-induced, or anthropogenic, changes in the global temperature. The results show that natural variations alone cannot explain the observed temperature rise of the last decades. The changes from human activities are necessary to fully explain the observed warming. Indeed, the IPCC has estimated that of the processes that can change global temperature, what they call "radiative forcings," the components from human activities are cumulatively 10 times larger than the best estimates of the changes from solar activity.[9] A 2007 study found that all the trends in the Sun's activity that could influence the temperature of the Earth have been in the opposite direction needed to explain the rise in temperature over the last 20 years.[10]

Correlation Between Human Forcings and Observed Temperature Increases



[7] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 112 (2007).
[8] Urs Siegenthaler, et al., Stable Carbon Cycle–Climate Relationship During the Late Pleistocene, 310 Science 1313 (2005).
[9] Intergovernmental Panel on Climate Change, 2007, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 4 (2007).
[10] Lockwood and Froehlich, Recent Oppositely Directed Trends in Solar Climate Forcings and the Global Mean Surface Air Temperature, 463, Proceedings of the Royal Society, 24427 (2007).

Source: Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers (2007) (Figure 2-5).

Scientists predict that if greenhouse gas emissions continue to grow unchecked, global warming—and resulting climate change—will accelerate. The IPCC's estimate of the likely increase in global average surface temperature by 2100 ranges from 2 ˚F to 11.5 ˚F above 2000 levels, depending on the scenario for greenhouse gas emissions growth.[11] It should be emphasized, however, that current trends in emissions growth are consistent with or higher than the scenarios on the high end of this range. Business-as-usual emissions growth could result in atmospheric CO_2 concentrations of well above 700 ppm by 2100,[12] yielding a likely temperature increase of 8.8 to 11 ˚F.[13] These levels of warming will result in disastrous impacts for the planet, as the following sections explain.

Further, many scientists are increasingly concerned that, because of "positive feedback" mechanisms associated with climate change, we are approaching a "tipping point" beyond which climate change will accelerate and will become increasingly difficult to reverse. As Dr. James Hansen explained at a briefing before the Select Committee held 20 years after his historic first testimony before Congress that human activities were altering the climate:

> "Elements of a 'perfect storm,' a global cataclysm, are assembled. Climate can reach points such that amplifying feedbacks spur large rapid changes. Arctic sea ice is a current example. Global warming initiated sea ice melt, exposing darker ocean that absorbs more sunlight, melting more ice. As a result, without any additional greenhouse gases, the Arctic soon will be ice-free in the summer."[14]

Another worrisome climate feedback involves the methane stored in frozen arctic soils. Although it is hard to quantify, there is likely five times, if not more, carbon trapped in these soils than humans have released into the atmosphere from the burning of fossil fuels since the Industrial Revolution.[15] As these soils warm and release methane, temperatures will increase, causing more soil to melt and more methane to be released. How quickly this warming and release happens is a critical question. As Dr. Jack Fellows said about this question in testimony before the Select Committee, "If it is released quickly, it could be the end of civilization."[16]

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[11] Intergovernmental Panel on Climate Change, 2007, Climate Change 2007: The Physical Science Basis, Summary for Policymakers, at 13, 69-70 (2007).

[12] See, e.g., Environmental Protection Agency, EPA Analysis of Bingaman-Specter Request on Global CO2 Concentrations at 7 (Oct. 1, 2007), available at http://www.epa.gov/climatechange/downloads/s1766analysispart1.pdf.

[13] See Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change, Summary for Policymakers at 39 (Table TS.2) (2007).

[14] James Hansen, "Global Warming Twenty Years Later: Tipping Points Near," Briefing of the Select Committee on Energy Independence and Global Warming, June 23, 2008, available at http://www.columbia.edu/~jeh1/2008/TwentyYearsLater_20080623.pdf.

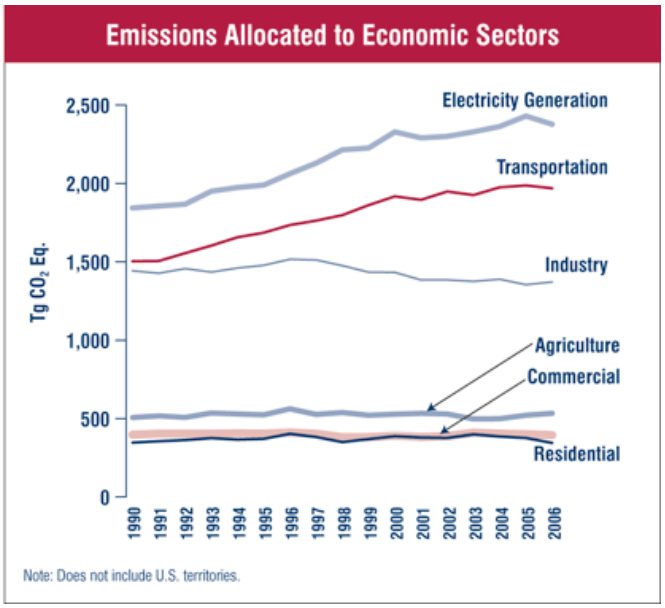
[15] Sergey A. Zimov, et al., Permafrost and the Global Carbon Budget, 312 Science 1612 (2006).

[16] Transcript of Select Committee on Energy Independence and Global Warming hearing on "Investing in the Future: R&D Needs to Meet America's Energy and Climate Challenges, Sept. 10, 2008, at 57

2. Greenhouse Gas Emissions Sources and Trends

The United States accounts for roughly 20 percent of global CO_2 emissions, and U.S. emissions have grown steadily over the past two decades at a rate of roughly 1 percent per year. In 2006 (the most recent year for which data is available), the United States emitted 7,054 million metric tons CO_2 equivalent in greenhouse gases—a 14.7 percent increase since 1990 (the earliest year for which EPA data are available). Net emissions, including sources and sinks, similarly increased from 1990 to 2006, from 5,411 to 6,171 million metric tons CO_2 equivalent.[17] Absent policy interventions, U.S. emissions are expected to increase between 20 and 52 percent by 2025 from 2000 levels.[18]

In 2006 U.S. emissions were dominated by emissions from the electric power sector (comprising 34 percent of total U.S. emissions), transportation sector (28 percent), and industrial sector (19 percent). The remaining emissions were due to the agricultural (8 percent), commercial (6 percent), and residential (5 percent) sectors. Emissions from the electric power, transportation, and agricultural sectors have increased since 1990, while emissions from the industrial, commercial, and residential sectors have held steady or declined over the same period. If emissions from the generation of electric power are instead attributed to the end-use sectors, these proportions shift somewhat: The industrial (29 percent), commercial (17 percent), and residential (17 percent) sectors play an increasing role, while contributions from the transportation (28 percent) and agriculture (8 percent) sectors remain relatively constant.[19]



[17] Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, at ES-4 to ES-6 (April 15, 2008) [hereinafter "EPA Inventory"], available at http://www.epa.gov/climatechange/emissions/downloads/08_CR.pdf.

[18] Kevin A. Baumert et al., World Resources Institute, Navigating the Numbers: Greenhouse Gas Data and International Policy at 18 (2005) [hereinafter "WRI Navigating the Numbers"], available at http://pdf.wri.org/navigating_numbers.pdf.

[19] EPA Inventory, supra note 17, at ES-15 to ES-16.

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, USEPA #430-R-08-005 (2008).

In 2006, 80 percent of U.S. emissions were CO_2 from the combustion of fossil fuels. Additional CO_2 emissions (representing 5 percent total U.S. emissions) were generated from other activities, such as the manufacture of iron and steel and cement. Remaining emissions were comprised of CH_4 (8 percent) and N_2O (5 percent), largely from agricultural activities, landfills, natural gas systems, and coal mines, and HFCs (2 percent) used as a substitute for ozone-depleting substances. PFCs and SF_6 each comprised less than 1 percent U.S. emissions. Net carbon sequestration (primarily in U.S. forests and agricultural soils) was 884 million metric tons CO_2 equivalent—offsetting 13 percent of total U.S. emissions.[20]

Global greenhouse gas emissions grew by 24 percent between 1990 and 2004,[21] have accelerated since then, and are now running above the IPCC's worst case scenario. While a slowing global economy in 2007 was expected to slow energy consumption and subsequent greenhouse gas emissions, global CO_2 output instead rose 3 percent from 2006 to 2007. Anthropogenic CO_2 emissions are growing four times faster since 2000 than during the previous decade, and are now running above the worst case emission scenario of the IPCC.[22] In 2006, China surpassed the United States in total annual CO_2 emissions,[23] with each country accounting for more than 20 percent of the global total.[24] The EU-25 countries accounted for an additional 15 percent. India is on track to become the world's third largest emitter in 2008, surpassing Russia.[25] When the United Nations Framework Convention on Climate Change was drafted in 1992, the 38 countries initially agreeing to limit their greenhouse gas emissions were responsible for 62 percent of all carbon dioxide emissions. Today this number has fallen to around 47 percent, demonstrating the transformation of the global economy and the rapid growth occurring in many parts of the developing world.[26]

Electricity and heat account for 25 percent of global emissions, followed by industry (21 percent), land use change and forestry (18 percent), buildings (15 percent), agriculture (15 percent), transport (14 percent), and waste (4 percent).[27] The International Energy Agency's (IEA's) Reference Scenario projects global greenhouse gas emissions to increase 44 percent between 2006 and 2030. Emissions from China and India are expected to grow by 86 and 104 percent, respectively, while emissions from the United States are expected to grow by 25 percent

[20] EPA Inventory, supra note 17, at ES-4 to ES-6.
[21] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change, Summary for Policymakers at 27 (2007).
[22] Global Carbon Project, Carbon budget and trends 2007 (2008), at http://www.globalcarbonproject.org/carbontrends/index.htm (last visited Oct. 20, 2008).
[23] Id.
[24] International Energy Agency, Key World Energy Statistics 2008 at 45, 50, 56 (2008), available at: http://www.iea.org/textbase/nppdf/free/2008/key_stats_2008.pdf.
[25] Oak Ridge National Laboratory Press Release, "CO_2 emissions booming, shifting east, researchers report" (Sept. 24, 2008), available at http://www.globalcarbonproject.org/global/pdf/Press%20Release_OakRidge%20NationalLab_USA_final.pdf.
[26] Id.
[27] WRI Navigating the Numbers, supra note 18, at 57.

over the same time period.[28] Emissions from the EU have stayed relatively flat since 1990, and the EU has unilaterally committed to reduce emissions by 20 percent by 2020—and up to 30 percent with cooperation from the international community.

While China has now overtaken the United States as the largest greenhouse gas emitter on an annual basis, the United States continues to have one of the highest per capita emission rates—far greater than India, China, or the EU. In 2005, the United States emitted 20 tons of CO_2 per capita annually, compared to 12 tons per capita in Russia, 10 tons in Japan and the United Kingdom, and 8 tons per capita for the EU. The worldwide average per capita CO_2 emissions level is 4.3 tons, and the average person in China and India is responsible for 4 tons and 1 ton of CO_2 emissions per year, respectively.[29]

Moreover, the United States is responsible for nearly a third of the cumulative greenhouse gas emissions in the atmosphere—nearly four times as much as China and over 14 times as much as India. Developing countries with 80 percent of the world's population still account for 20 percent of the cumulative emissions since 1751. The poorest countries in the world—where 800 million people live—have contributed less than 1 percent of these cumulative emissions.[30] For most industrialized countries, their historic (i.e., cumulative) share of global emissions is much higher than their current (i.e., annual) share. For the period between 1850 and 2002, the United States contributed 29 percent world's CO_2 emissions, leading all other countries. EU-25 follows closely behind, with a contribution of 27 percent world's CO_2 emissions, but no other country contributes more than 10 percent. For example, China's cumulative contribution is 8 percent, and India's is only 2 percent.[31]

The IPCC has concluded that, to have even a 50-50 chance of avoiding the dangerous climate change associated with a 3.6 ºF increase in global average surface temperature, global emissions must be reduced by 50-85 percent by 2050. This requires the United States and other developed countries to reduce emissions by at least 80 percent by 2050.[32] Given the current trajectory of rapidly rising greenhouse gas emissions, both here in the United States and globally, a substantial change of course is required in the very near term to avoid the catastrophic impacts outlined below.

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[28] International Energy Agency, World Energy Outlook (2006); and International Energy Agency, Key World Energy Statistics (2008).

[29] Energy Information Administration, International Energy Annual 2005, at Table H.1cco2 World Per Capita Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 1980-2005 (2007) available at: http://www.eia.doe.gov/pub/international/iealf/tableh1cco2.xls.

[30] Global Carbon Project, supra note 22.

[31] WRI Navigating the Numbers, supra note 18, at 32.

[32] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change, Summary for Policymakers at 38-39 (Table TS.2); Amy L. Luers et al., Union of Concerned Scientists, How to Avoid Dangerous Climate Change: A Target for U.S. Emission Reductions (Sept. 2007), available at http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/a-target-for-us-emissions.html.

3. The Catastrophic Impacts of Climate Change

a. Going Dry—Increasing Water Scarcity and Declining Water Quality

One of the most dramatic impacts of global warming in the 21st century will be the exacerbation of already severe water scarcity—both here in the United States and abroad. Freshwater scarcity and threats to water quality are increasing dramatically both in the United States and across the world. Over a billion people currently lack access to safe drinking water.[33] By 2025, 1.8 billion people are expected to be living in regions experiencing water scarcity and "two-thirds of the world's population could be living under water stressed conditions."[34] Climate change will greatly exacerbate current and future water stress. For example, the IPCC projects that by 2020, between 75 and 250 million people in Africa alone will experience an increase of water stress due to climate change.[35] For Asia, the number is between 120 million and 1.2 billion people, and for Latin American it is 12 to 81 million.[36]

Global warming is leading to rapid melting of land ice, glaciers, ice caps, and snow fields which over time will exacerbate water scarcity in many regions of the globe. One-sixth of the world population currently relies on meltwater from glaciers and snow cover for drinking water and irrigation for agriculture.[37] The IPCC's 2008 Climate Change and Water report projects widespread reductions in snow cover throughout the 21st Century, and a 60 percent volume loss in glaciers in various regions.[38] The melting of these ice reservoirs, which store 75 percent of the world's freshwater, will exacerbate water scarcity conditions.[39] While melting will temporarily increase freshwater supply, more winter precipitation falling as rain rather than snow, and an earlier snowmelt season will deplete frozen freshwater reserves.

Increased water stress due to climate change will disproportionately affect the dry tropics and dry regions at lower mid-latitudes—notably Southeast Asia, southern Africa, Brazil, and the American Southwest.[40] According to the 2008 IPCC Climate Change and Water Report, semi-arid and arid areas in Southeast Asia, Southern Africa, Brazil, and the western United States are "projected to suffer a decrease of water resources due to climate change."[41] In Asia, decreasing precipitation and rising temperatures result in increasing frequency and intensity of droughts.[42] In northwestern China and Mongolia, snow and glacier melt will cause

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[33] German Advisory Council on Global Change, Climate Change as a Security Risk Summary for Policy-makers at 2 (2007).
[34] United Nations Commission on Sustainable Development, The Food Crisis and Sustainable Development (May 2008), available at http://www.un.org/esa/sustdev/csd/csd16/documents/bgrounder_foodcrisis.pdf.
[35] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability, Summary for Policy Makers at 13 (2007).
[36] Testimony of Rajendra Pachauri before the Select Committee on Energy Independence and Global Warming, "Learning from a Laureate: Science, Security and Sustainability," Jan. 30, 2008; see also Intergovernmental Panel on Climate Change, Climate Change and Water at 36 (2008) [hereinafter "IPCC Climate Change and Water"].
[37] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation, and Vulnerability, Summary for Policymakers at 11 (2007).
[38] IPCC Climate Change and Water, supra note 36, at 28.
[39] Id. at 19-26.
[40] Id. at 3.
[41] Id. at 88.
[42] Id. at 86.

floods in the spring in the near term but result in freshwater shortages by the end of the century.[43] Global warming of 5.4 to 7.2 °F would result in more persistent El Niño conditions that would shift the Amazon rainforest from "tropical forest to dry savannah"[44]—imperiling an ecosystem that sustains thousands of people and is one of the greatest concentrations of biodiversity on Earth.[45]

The United States is already experiencing water stress, which will worsen severely in the coming decades due to climate change. In the American West, the Sierra Nevada snowpack is at its lowest level in 20 years and threatens most of the water supply to Northern California.[46] Experts warn that "even the most optimistic climate models for the second half of this century suggest that 30 to 70 percent of this snowpack will disappear."[47] The Southwest is already experiencing a severely reduced flow in the Colorado River—upon which 30 million people depend for water—as a consequence to decreasing snowmelt from the Rocky Mountains.[48] The Midwest is expected to experience "drought-like conditions resulting from elevated temperatures, which increases levels of evaporation, contributing to decreases in soil moisture and reductions in lake and river beds" as a result of climate change.[49] In addition to a range of other costs, agriculture in the Great Plains and the Southwest is likely to suffer massive economic losses due to increasing water scarcity.[50]

Climate change will also negatively impact the quality of freshwater resources. For example, reduced flows will reduce rivers' ability to dilute effluent, leading to increased pathogen or chemical loading.[51] In addition, increased heavy precipitation events due to climate change—discussed below—"may increase the total microbial load in watercourses and drinking-water reservoirs."[52] And warmer water temperature combined with higher phosphorus concentrations will increase the occurrence of freshwater algal blooms, with adverse impacts on freshwater ecosystems and fisheries. Fish habitat may also be compromised because altered water chemistry will promote the intrusion of invasive species.[53] These impacts will exacerbate the precarious state of freshwater fish species in North America, nearly 40 percent of which are already at risk.[54]

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[43] Id. at 87.
[44] Timothy M. Lenton et al., Tipping Elements in the Earth's climate system, 105 Proceedings of the National Academy of Sciences 1790 (2008).
[45] WWF Climate Change Programme, Climate Change Impacts in the Amazon: Review of Scientific Literature at http://assets.panda.org/downloads/amazon_cc_impacts_lit_review_final_2.pdf (last visited Oct. 20, 2008).
[46] Jon Gertner, "The Future is Drying Up", New York Times, Oct. 21, 2008, available at http://www.nytimes.com/2007/10/21/magazine/21water-t.html?_r=1&ref=todayspaper&oref=slogin.
[47] Id.
[48] Id.
[49] Id.
[50] Matthias Ruth et al., University of Maryland Center for Integrative Environmental Research, The US Economic Impacts of Climate Change and the Costs of Inaction at 24, 27 (2007), available at http://dl.klima2008.net/ccsl/us_economic.pdf.
[51] IPCC Climate Change and Water, supra note 36, at 67.
[52] Id. at 68.
[53] Environmental Protection Agency, National Water Program Strategy: Response to Climate Change at ii (Mar. 2008), available at http://www.epa.gov/water/climatechange/docs/TO5_DRAFT_CCR_Revised_10-16.pdf.
[54] Allison Winter, Fisheries: Freshwater species in steep decline – USGS, Greenwire, Sept. 10, 2008.

b. The Great Melt—Impacts on the Arctic and Antarctic

The Arctic is literally one of the hotspots of global warming. Over the past 50 years average temperatures in the Arctic have increased as much as 7° F, five times the global average.[55] In the next 100 years, some areas in the Arctic may see an increase in average temperatures as high as 13° F.[56]

As temperatures rise in the Arctic, sea ice and glaciers are melting at an unprecedented and alarming rate. In 2007, a record 386,000 square miles of Arctic sea ice melted away, an area larger than Texas and Arizona combined and as big a decline in one year as has occurred over the last decade.[57] In 2008, the sea ice extent was only slightly greater than in 2007, but the sea ice volume is likely the lowest on record due to the decline in multiyear old ice and the thinness of the remaining ice.[58] Recent observations suggest that Arctic sea ice could completely disappear during the summer as early as 2020.[59]

The Greenland ice sheet is melting at an alarming rate. Between 1979 and 2002, the extent of melting in Greenland has increased on average by 16 percent—an area roughly the size of Sweden.[60] In the record-breaking year of 2005, parts of Greenland melted that have never melted during the 27-year long satellite record.[61] In May 2007, members of the Select Committee observed firsthand the disintegration of the Jakobshavn Glacier at Ilulissat in western Greenland. According to the scientists that met with the delegation and who have been monitoring the glacier for almost two decades, the receding of this glacier has doubled in the past eight years, from 5 to nearly 9 miles per year, draining a large portion of the ice sheet.

A complete melting of Greenland would result in a rise in global sea level of over 20 feet,[62] with catastrophic consequences for coastal regions around the world. Furthermore, melting Arctic glaciers would contribute large amounts of fresh water into the ocean, potentially changing oceanic currents, damaging eco-systems and altering current weather conditions.

Parts of Antarctica, too, are melting fast. At the opposite end of world, massive amounts of water are trapped in the two ice sheets of Antarctica. The larger East Antarctic ice sheet covers the majority of the continent, while the West Antarctic ice sheet has significant ice shelves partially floating in the ocean. Taken together, they contain 90 percent of Earth's ice and

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[55] Arctic Climate Impact Assessment, Impacts of a Warming Arctic Highlights at 4 (2004), available at http://www.amap.no/acia/Highlights.pdf.
[56] Id.
[57] European Space Agency, "Satellites witness lowest Arctic ice coverage in history," Sept. 14, 2007, at http://www.esa.int/esaCP/SEMYTC13J6F_index_0.html (last visited Oct. 20, 2008).
[58] National Snow and Ice Data Center, Arctic Sea Ice Down to Second-Lowest Extent; Likely Record-Low Volume, Oct. 2, 2008, at http://nsidc.org/news/press/20081002_seaice_pressrelease.html (last visited Oct. 20, 2008).
[59] Julienne Stroeve et al. Arctic sea ice decline: Faster than forecast, 34 Geophysical Research Letters L09501 (2007).
[60] Arctic Climate Impact Assessment, supra note 55, at 6.
[61] Sebastian H. Mernild et al., Surface Melt Area and Water Balance Modeling on the Greenland Ice Sheet 1995–2005, Journal of Hydrometeorology: In Press (2008).
[62] USGS Fact Sheet 002-00, Sea Level and Climate (2000), available at http://pubs.usgs.gov/fs/fs2-00/.

70 percent of its freshwater and would raise sea level over 200 feet if they completely melted.[63] In the spring of 2002, scientists were shocked to discover that an ice shelf the size of Rhode Island had disintegrated from the West Antarctica ice sheet in just over a month.[64] The collapse of the Larsen B ice shelf was a wake-up call to scientists who had thought that these large areas of ice would take a millennium to disappear, not a month.

Dr. James Hansen testified before the Select Committee that, because the floating ice of the West Antarctic is subject to both warming air and ocean temperatures, it is especially vulnerable to global warming.[65] Until recently, it was believed that only coastal areas of the West Antarctic were vulnerable to melting. Satellite analysis has now revealed that large inland regions are also showing signs of the impacts of warming. NASA and university researchers have found clear evidence that an area the size of California melted in January 2005 in response to warm temperatures.[66] One reason that Antarctica has not experienced the same increase in temperatures as the Arctic is the cooling effect of the ozone hole. Scientists predict that as the atmosphere recovers from ozone depletion, the interior of Antarctica will warm with the rest of the world.[67]

c. Warming and Acidification of the World's Oceans

The world's oceans will suffer devastating impacts as a result of global climate change—as the Select Committee learned at its April 2, 2008 hearing entitled "Rising Tides, Rising Temperatures: Global Warming's Impacts on the Oceans."

Oceans are already warming due to climate change. The oceans cover 70 percent of the Earth's surface and are critical components of the climate system for redistributing heat around the world and absorbing CO_2 from the atmosphere. According to the IPCC, global ocean temperature has risen by 0.18°F from 1961 to 2003.[68] Since the ocean has a heat capacity 1,000 times greater than that of the atmosphere, it has taken up 20 times more heat than the atmosphere during this same period.[69] As a result of the ocean's relatively large heat capacity, it has a great effect on the Earth's heat balance and how energy from solar radiation is distributed throughout the global environment.

Increasing atmospheric CO_2 concentrations are causing acidification of the oceans. Elevated atmospheric CO_2 concentrations lead to higher absorption of CO_2 into the upper ocean, which makes the surface waters more acidic and reduces the concentration of carbonate ions.

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[63] USGS Fact Sheet 2005-3055, Coastal Change and Glaciological Maps of Antarctica (2007), available at http://pubs.usgs.gov/fs/2005/3055/index.html.
[64] N. F. Glasser & T.A. Scambos, A structural glaciological analysis of the 2002 Larsen B ice shelf collapse, 54 Journal of Glaciology 3–16 (2008).
[65] Testimony of James Hansen before the Select Committee on Energy Independence and Global Warming, "Danger Human-Made Interference with Climate", April 26, 2007, at 13.
[66] S. V. Nghiem et al., Snow Accumulation and Snowmelt Monitoring in Greenland and Antarctica, in Dynamic Planet (2007).
[67] Judith Perlwitz et al., Impact of stratospheric ozone hole recovery on Antarctic climate, 35 Geophysical Research Letters L08714 (2008).
[68] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis at 387 (2007).
[69] Id. at 389.

According to the National Oceanic and Atmospheric Administration (NOAA), ocean chemistry currently is changing at least 100 times more rapidly than it has changed during the 650,000 years preceding our industrial era.[70] If current emission trends continue, the ocean will experience acidification to an extent and at rates that have not occurred for tens of millions of years. Ocean acidification has serious implications for the calcification rates of organisms living at all levels within the global ocean, from corals to zooplankton that serve as the foundation of many ocean food chains. According to NOAA, when dissolved carbon dioxide was increased to two times pre-industrial levels, a decrease in the calcification rate by 5 to 50 percent was observed.[71]

Warming and acidification of ocean waters due to climate change are contributing to the collapse of coral reefs around the globe. Coral reefs are habitat for about a quarter of marine species, are the most diverse among marine ecosystems, and are already in a state of decline. Recent studies indicate that over a third of all coral species are already endangered.[72] When key temperature thresholds are exceeded, mass bleaching and complete coral mortality often result. By mid-century, these temperature thresholds are expected to be exceeded on an annual or bi-annual basis for the majority of reefs worldwide. After bleaching, algae quickly colonize dead corals and may make future coral growth and restoration more difficult. Other factors that influence the health of reefs are impacted by climate change, including sea level rise, storm severity and dust and mineral aerosols.[73] These, together with non-climate factors such as over-fishing, invasion of non-native species, pollution, and increased nutrient and sediment loads, add multiple stresses, increasing coral reefs' vulnerability to climate change. Corals could become rare on tropical and subtropical reefs by 2050 due to the combined effects of acidification and increasing frequency of extreme temperature events that cause bleaching.

NOAA estimates the commercial value of United States fisheries from coral reefs is over $100 million,[74] and the total economic value of coral is estimated to be $30 billion.[75] Coastal states, like Florida, would be especially harmed where reef-based tourism in the Florida Keys generates $1.2 billion in annual revenue.[76] Healthy coral reefs provide other benefits, as well, including shoreline protection, beach sand supply, potential pharmaceuticals, biodiversity, and fish habitat.

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[70] Richard Feeley et al., Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, Carbon Dioxide and Our Ocean Legacy (April 2006), available at http://www.pmel.noaa.gov/pubs/PDF/feel2899/feel2899.pdf

[71] Kathy Tedesco et al., National Oceanic and Atmospheric Administration, Impacts of Anthropogenic CO2 on Ocean Chemistry and Biology, at http://www.oar.noaa.gov/spotlite/spot_gcc.html (last visited Oct. 20, 2008).

[72] Krent E. Carpenter et al., One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts, Science Express, July 10, 2008.

[73] R.A. Cropp and A.J. Gabric, Evidence for global coupling of phytoplankton and atmospheric aerosols, 4 Oceans 2003. Proceedings 2341 (2003).

[74] National Oceanic and Atmospheric Administration, NOAA Ocean Service Education, Importance of Coral Reefs, at http://oceanservice.noaa.gov/education/kits/corals/coral07_importance.html (last visited Oct. 20, 2008).

[75] Elizabeth Weise, Scientists: Global Warming could kill coral reefs by 2050, USA Today, Dec. 13, 2007, available at http://www.usatoday.com/weather/climate/globalwarming/2007-12-13-coral-reefs_N.htm.

[76] Thomas Damassa, World Resources Institute, The Value of Ecosystems (Dec. 5, 2006), available at http://www.wri.org/stories/2006/12/value-coastal-ecosystems.

Climate change threatens global fisheries. Warmer water and acidification not only harm coral reefs that function as fish hatcheries, but could also change the circulation of the world's ocean currents. Most fish species have a fairly narrow range of optimum temperatures due to temperature effects on their basic metabolism and the availability of food sources that have their own optimum temperature ranges.[77] A given species' geographic range may expand, shrink, or be relocated with changes in ocean conditions caused by climate change.[78] The United Nations Environment Programme found that "climate change may slow down ocean thermohaline circulation crucial to coastal water quality and nutrient cycling in more than 75 percent of the world's fishing grounds."[79] Less hospitable waters would have a significant effect on the global fishing industry. In the United States alone, commercial and recreational fisheries contribute $60 billion to the economy each year and employ more than 500,000 people.[80]

Finally, there is growing concern that the oceans' capability to absorb atmospheric CO_2 may be declining—reducing a critical buffer against further climate change. The oceans are the largest natural reservoir for carbon, absorbing approximately one-third of the CO_2 added to the atmosphere by human activities each year.[81] Recent research suggests that the vast Southern Ocean's capability to absorb atmospheric CO_2 may be declining, due in part to saturation of surface waters.[82] In addition, as water warming increases so does ocean stratification which "reduces vertical mixing . . . leading to slower removal of excess carbon from the surface ocean."[83] This is yet another positive feedback mechanism that could speed climate change.

d. Sea Level Rise and Coastal Impacts

Sea levels are already rising, and are predicted to rise by at least 1-2 feet by 2100—with the potential for a nearly 40-foot rise in sea level if the Greenland and West Antarctica ice sheets were to melt completely. The IPCC predicts that sea levels will rise by 8 to 24 inches above current levels by 2100, primarily due to thermal expansion from rising ocean temperatures[84]—with current emissions trends more consistent with the higher end of this range. However, how much and how quickly the polar ice sheets will melt in response to global

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[77] National Oceanic and Atmospheric Administration, Pacific Fisheries and Environmental Laboratory, Climate Variability and Marine Fisheries: How Does Climate Affect Fish Populations?, at http://www.pfeg.noaa.gov/research/climatemarine/cmffish/cmffishery.html (last visited Oct. 20, 2008).

[78] James R. McGoodwin, "Effects of climate variability on three fisheries economies in high-altitude regions: Implications for fisheries policies," 31 Marine Policy 40-55 (2007)

[79] United Nations Environmental Programme, Press Release, Warmer World May Mean Less Fish, Feb. 22, 2008, at http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=528&ArticleID=5751 (last visited Oct. 20, 2008).

[80] Testimony of James L. Connaughton on the Reauthorization of Magnuson-Stevens, Senate Commerce Committee, Nov. 16, 2005.

[81] Tedesco et al., supra note 71.

[82] Testimony of Vikki Spruill, before the Select Committee on Energy Independence and Global Warming, "Global Warming's Impacts on the Oceans," April 29, 2008, at 9; Corinne Le Quéré et al., Saturation of the Southern Ocean CO_2 Sink Due to Recent Climate Change, 316 Science 1735-38 (2007).

[83] Inez Y. Fung et al., "Evolution of carbon sinks in a changing climate," 102 Proceedings of the National Academy of Sciences 11203 (2005).

[84] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 70 (2007).

warming is a critical question. Many scientists are increasingly concerned that the Greenland and West Antarctic ice sheets are melting at a greater rate than previously predicted. Because scientists do not fully understand the dynamics of ice sheet melting, the IPCC found that larger values of sea level rise could not be excluded.[85] A complete melting of the Greenland ice sheet alone would cause a 20-foot rise in sea level, and complete melting of the West Antarctic ice sheet would cause a 16-foot sea level rise. We know from geological history that as the massive ice sheets of the last Ice Age melted, sea level rose as fast as 15 feet per century.[86]

Sea level rise will have severe impacts on the world's coastal populations, including here in the United States. Rising sea levels are already causing inundation of low-lying lands, erosion of wetlands and beaches, exacerbation of storm surges and flooding, and increases in the salinity of coastal estuaries and aquifers. The most dramatic near-term effects of sea level rise are being felt by inhabitants of small island states, the very existence of which is now endangered. Further, about one billion people live within 75 feet elevation of today's sea level, including many U.S. cities on the East Coast and Gulf of Mexico, almost all of Bangladesh, and areas occupied by more than 250 million people in China.[87] In total, more than 70 percent of the world's population lives on coastal plains, and 11 of the world's 15 largest cities are on the coast.

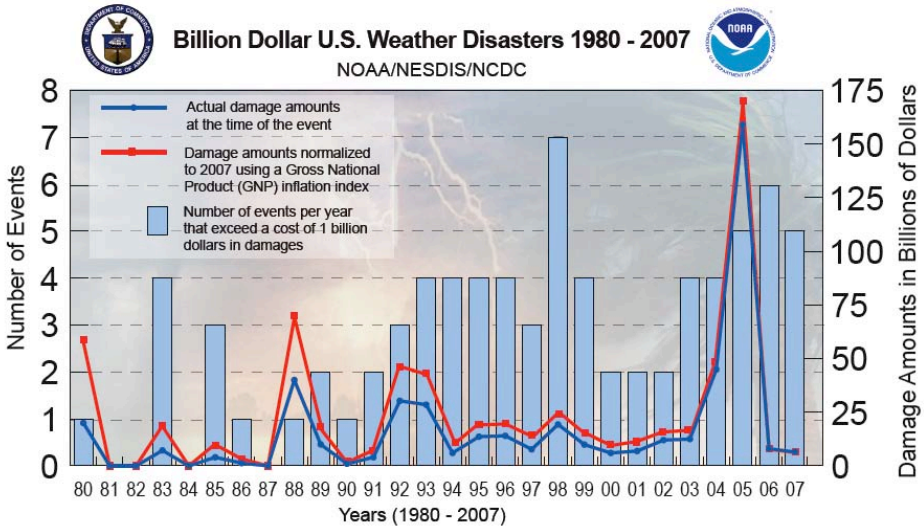
In addition, rising sea level due to climate change will threaten drinking water supplies in coastal areas—causing intrusion of saltwater into both surface water and ground water.[88] New York City, Philadelphia, and much of California's Central Valley obtain some of their water from portions of rivers that are just upstream from the point where water currently turns salty during droughts.[89] If sea level rise pushes salty water further upstream, existing water intakes might draw on salty water during dry periods. The freshwater Everglades currently recharge Florida's Biscayne aquifer, the primary water supply to the most populous counties in South Florida, including the cities of Miami and Fort Lauderdale. As rising water levels submerge low-lying portions of the Everglades, portions of the aquifer would become saline.[90] Aquifers in New Jersey east of Philadelphia are recharged by the Delaware River which also may become saline in parts in the future, leading to a degradation of drinking water quality.[91]

e. Extreme Weather Events

Global warming has already changed the intensity, duration, frequency, and geographic range of a variety of weather patterns and will continue to do so—with potentially severe impacts on the United States and the world.[92] There is a broad scientific consensus that

[85] Id. at 14.
[86] Testimony of James Hansen, before the Select Committee on Energy Independence and Global Warming on "Dangerous Human-Made Interference with Climate," April 26, 2007, at 11.
[87] Id. at 12.
[88] Environmental Protection Agency, Coastal Zones and Sea Level Rise, at http://www.epa.gov/climatechange/effects/coastal/index.html (last visited Oct. 20, 2008).
[89] Id.
[90] Id.
[91] Id.
[92] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis at 8 (2007); see generally U.S. Climate Change Science Program, Synthesis Assessment Product 3.3, Weather and Climate Extremes in a Changing Climate: Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands at 8 (June 2008).

the United States is vulnerable to weather hazards that will be exacerbated by climate change. The cost of damages from weather disasters has increased markedly from the 1980's, rising to over 100 billion dollars in 2007. In addition to a rise in total cost, the frequency of weather disasters costing over one billion dollars has increased.[93] In the United States, several hundred people already die from flooding and extreme heat events every year.



Source: National Climatic Data Center, Billion Dollar U.S. Weather Disasters, at http://www.ncdc.noaa.gov/oa/reports/billionz.html.

Global warming will lead to more extreme precipitation events and flooding. As the atmosphere warms, it is able to hold more water vapor. When a storm occurs, this higher concentration of water vapor leads to rainfall occurring in larger quantities, which can result in flooding. The IPCC has found that "[t]he frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapor."[94] The U.S. Climate Change Science Program has concluded that heavy precipitation events averaged over North America have increased over the past 50 years.[95] In the future, it is very likely that North America will experience more frequent and intense heavy downpours and higher levels of total rainfall in extreme precipitation events.

Flooding and extreme precipitation events cost lives and can cause massive damages to infrastructure, property, and agricultural lands, as was highlighted by the flooding in the Midwestern United States in the summer of 2008. Those floods washed away nearly 2 percent of the nation's corn crop. The American Farm Bureau Federation estimated that crop losses

[93] See National Climatic Data Center, Billion Dollar U.S. Weather Disasters, at http://www.ncdc.noaa.gov/oa/reports/billionz.html (last visited Oct. 20, 2008).
[94] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 8 (2007).
[95] U.S. Climate Change Science Program, supra note 92, at 4.

would exceed $8 billion across the Midwest, with half of the total occurring in Iowa.[96] An additional $1.5 billion in property damage occurred in Iowa[97] and $1 billion in Indiana.[98]

Increased sea surface temperatures are a critical determining factor in the strength of hurricanes, and some scientists predict that global warming will result in an increase in hurricane and tropical cyclone frequency and intensity. The IPCC has found observational evidence for the increase in intense hurricanes in the North Atlantic since the 1970s, correlated with increasing sea surface temperatures.[99] Some researchers have argued that there is evidence for increased hurricane intensity around the world and emerging evidence for an increase in frequency of hurricanes in the Atlantic.[100] Stronger hurricanes lead to more destructive winds and higher storm surges, increasing the risk to coastal communities in their paths. As sea level rises and storm surges increase, the vulnerability of cities to flooding, and the related impacts, increases significantly.

Severe thunderstorms, hail, tornados, and winter storms may also increase. The current observational record for these smaller scale storms is insufficient to determine whether there are trends correlated to warming temperatures.[101] However, these phenomena are often associated with heavy precipitation events and hurricanes; as the latter storms become more frequent and possibly increase in intensity, then the probability of thunderstorms, hail, and tornadoes should also increase. Warming temperatures may also expand the range over which tornados occur. Over the last few years, tornados have occurred earlier in the year and further north than what is typically thought of as "tornado alley."[102] Finally, strong cold season storms are also likely to become more frequent, with stronger winds and more extreme wave heights.[103]

Climate change will lead to more frequent and more intense heat waves in the United States and globally.[104] The impacts of heat waves are discussed further in the public health section that follows.

f. Public Health

There is a broad consensus among experts within the worldwide public health community that climate change poses a serious risk to public health. The IPCC's Fourth Assessment report concluded that climate change's likely impacts on public health include:

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[96] National Climatic Data Center, Climate of 2008: Midwestern U.S. Flood Overview (updated July 9, 2008), at http://www.ncdc.noaa.gov/oa/climate/research/2008/flood08.html#impacts

[97] Id.

[98] Phillip Fiorini, Purdue researchers to assess damage from Midwestern floods, Lafayette Online, Sept. 29, 2008, at http://www.lafayette-online.com/purdue-news/2008/09/purdue-researchers-assess-flood-impact/.

[99] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 9 (2007).

[100] Testimony of Dr. Judith Curry before the Select Committee on Energy Independence and Global Warming hearing on "Dangerous Climate Change," April 26, 2007.

[101] Intergovernmental Panel on Climate Change, Climate Change 2007: The Physical Science Basis, Summary for Policymakers at 9 (2007); U.S. Climate Change Science Program, supra note 92, at 7.

[102] Nicholas Riccardi, "Twisters 'on a record pace'", L.A. Times, May 13, 2008, at A12, available at http://articles.latimes.com/2008/may/13/nation/na-tornado13.

[103] U.S. Climate Change Science Program, supra note 92, at 7.

[104] Id. at 4.

- More frequent and more intense heat waves, leading to marked short-term increases in mortality.
- Increased numbers of people suffering from death, disease, and injury from floods, storms, fires and droughts.
- Increased cardio-respiratory morbidity and mortality associated with ground-level ozone pollution.
- Changes in the range of some infectious disease vectors.
- Increased malnutrition and consequent disorders, including those relating to child growth and development.[105]

This assessment included a specific analysis of regional impacts to health, including in the United States.[106] In addition, EPA,[107] the Centers for Disease Control and Prevention (CDC), [108] and NOAA have all concluded climate change poses a serious public health risk. The World Health Organization (WHO) released a quantitative assessment concluding that the effects of climate change may have caused over 150,000 deaths in 2000 and that these impacts are likely to increase in the future.[109] According to the IPCC, climate change contributes to the global burden of disease, premature death and other adverse health impacts.[110]

Heat waves will increase in intensity and frequency in the United States and globally. According to the National Weather Service, heat waves kill on average 170 people per year in the United States, and 253 people died in 2006 alone.[111] According to the CDC, from 1979 to 2003 more people died from heat waves in the United States than from all other natural disasters.[112] The European heat wave of August 2003 is estimated to have killed up to 45,000 people.[113] In France alone, nearly 15,000 people died due to soaring temperatures, which reached as high as 104 °F and remained extreme for two weeks.

There is consensus that heat waves "have become more frequent over most land areas" and there is confidence that climate change will result in the "very likely increase in frequency of

[105] Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report, Summary for Policymakers at 48 (2007).
[106] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability at 617-652 (2007).
[107] Environmental Protection Agency, Climate Change—Health and Environmental Effects, at http://www.epa.gov/climatechange/effects/health.html (last visited Oct. 20, 2008).
[108] Centers for Disease Control and Prevention, CDC Policy on Climate Change and Public Health, at http://www.cdc.gov/climatechange/pubs/Climate_Change_Policy.pdf (last visited Oct. 20, 2008).
[109] World Health Organization, Fact Sheet No. 266, Climate and health (Aug. 2007), at http://www.who.int/globalchange/en/.
[110] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability at 391-431 (2007).
[111] National Weather Service, Natural Hazard Statistics: Weather Fatalities, at http://www.weather.gov/os/hazstats.shtml (last visited Oct. 20, 2008).
[112] Centers for Disease Control and Prevention, Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety, at http://www.bt.cdc.gov/disasters/extremeheat/heat_guide.asp (last visited Oct. 20, 2008).
[113] European Commission, Directorate General for Health and Consumer Protection, The 2003 European heat wave, at http://ec.europa.eu/health/ph_information/dissemination/unexpected/unexpected_1_en.htm (last visited Oct. 20, 2008).

hot extremes."[114] There is evidence that present day heat waves over Europe and North America "coincide with a specific atmospheric circulation pattern that is intensified by ongoing increases in greenhouse gasses."[115] The intensity, duration and frequency of heat waves will increase in western and southern regions of the United States and in the Mediterranean region.[116] Other areas not currently as susceptible, such as northwest North America, France, Germany, and the Balkans will also experience "increased heat wave severity in the 21st century."[117] With continued warming by 2100, Washington, D.C. will experience the temperatures that Houston does today, Denver will be as warm as Memphis is today, and Anchorage will be as warm as New York City is today.[118] The populations most at risk of dying in a heat wave are the elderly and people in underserved communities, and as growth in the U.S. population over the age of 65 coincides with warmer temperatures, more deaths can be anticipated.

Global warming will exacerbate ground-level ozone pollution, leading to substantial increases in deaths and respiratory illness. Ground-level ozone (O_3), unlike other primary pollutants, is not emitted directly into the atmosphere, but is a secondary pollutant produced by reaction between nitrogen dioxide (NO_2), hydrocarbons, and sunlight. The ozone forming reaction occurs at a higher rate with more intense sunlight and higher temperatures. Thus, as temperatures rise from global warming, ground level ozone is expected to increase. Ozone is a known public health threat that can damage lung tissue causing respiratory illness, and exacerbate pre-existing respiratory conditions. The IPCC predicts increased levels of ozone across the eastern United States, "with the cities most polluted today experiencing the greatest increase in ozone pollution."[119] The increase in temperature in urban areas specifically and increases in ozone can increase rates of cardiovascular and pulmonary illnesses as well as temperature-related morbidity and mortality for children and the elderly.[120] Similar impacts will be felt in urban areas around the globe. By mid-century, ozone related deaths from climate change are predicted to increase by approximately 4.5 percent from the 1990s levels.[121] Even modest exposure to ozone may encourage the development of asthma in children.[122] Recently, an analysis linking CO_2 emissions to mortality revealed that for each increase of 1.8°F caused by

[114] Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report, Summary for Policymakers at 2, 8 (2007).
[115] Gerald A. Meehl & Claudia Tebaldi, More Intense, More Frequent, and Longer Lasting Heat Waves in the 21st Century, 305 Science 994 (2004).
[116] Id.
[117] Id.
[118] Frank Ackerman & Elizabeth Stanton, Natural Resources Defense Council, The Cost of Climate Change: What We'll Pay if Global Warming Continues Unchecked at vi (May 2008), available at http://www.nrdc.org/globalwarming/cost/cost.pdf.
[119] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability at 632 (2007).
[120] U.S. Climate Change Science Program, Synthesis and Assessment Product 4.6, Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems at ES-6 (2008).
[121] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability at 632 (2007).
[122] R. K. McConnell et al., Asthma in exercising children exposed to ozone: A cohort study, 359 The Lancet 386 (2002); J.F. Gent et al., Association of low-level ozone and fine particles with respiratory symptoms in children with asthma, 29 J. Am. Med. Assoc. 1859 (2003).

CO_2, the resulting air pollution would lead annually to about a thousand additional deaths and many more cases of respiratory illness and asthma in the United States.[123]

Climate change will lead to changes in geographic distribution of infectious diseases, with potentially serious impacts on public health in the United States and globally. The WHO estimates that climate change was responsible in 2000 for approximately 2.4 percent of worldwide diarrhea, and 6 percent of malaria in some middle-income countries.[124] While in the United States, diarrheal illnesses rarely result in death, the WHO estimates that worldwide there are approximately four billion cases of diarrhea each year, and 2.2 million deaths resulting from diarrheal illnesses. It is one of the leading causes of death among children in the developing world. Given the relationship between elevated temperatures and the incidence of diarrheal diseases if average global temperature increases by a further 1.8° F (1° C), this could result in an additional 320 million cases and 176,000 deaths from diarrheal illnesses annually.[125]

According to EPA, "Climate change may increase the risk of some infectious diseases, particularly those diseases that appear in warm areas and are spread by mosquitoes and other insects."[126] For example, the IPCC has concluded that the global population at risk from vector-borne malaria will increase by between 220 million and 400 million in the next century.[127] Similarly, the IPCC predicts that climate change is likely to increase risk and geographic spread of the West Nile virus—another mosquito-borne disease.[128] West Nile virus was first identified in the United States during the summer of 1999, and has since killed 1112 people.[129] Shifting patterns of temperature may also redistribute ticks that transmit pathogens causing Lyme disease.[130]

g. Forests and Wildfires

The clearing and degradation of tropical forests is a major driver of global climate change. Forests cover about 30 percent of the Earth's land surface and hold almost half of the world's terrestrial carbon.[131] They can act both as a source of carbon emissions to the atmosphere when cut, burned, or otherwise degraded and as a sink when they grow, removing carbon dioxide from the air through photosynthesis. Between 1990 and 2005, carbon in forest biomass decreased in Africa, Asia, and South America primarily from deforestation, but

[123] Mark Jacobson, On the Causal Link Between Carbon Dioxide and Air Pollution Mortality, 35 Geophysical Research Letters L03809 (2008).
[124] World Health Organization, World Health Report 2002: Reducing risks, promoting healthy life (2002).
[125] W. Checkley et al., Effect of El Niño and ambient temperature on hospital admissions for diarrhoeal diseases in Peruvian children, 355 The Lancet 442 (2000).
[126] Environmental Protection Agency, Climate Change – Health and Environment Effects: Health, at http://www.epa.gov/climatechange/effects/health.html#climate (last visited Oct. 20, 2008).
[127] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability at 409 (Table 8.2) (2007).
[128] Id. at 619.
[129] Center for Disease Control, West Nile Virus Human Case Counts for 1999-2008, available at http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm (last visited Oct. 26, 2008).
[130] U.S. Climate Change Science Program, supra note 120, at 2-18.
[131] Richard A. Houghton, "Tropical Deforestation as a source of greenhouse gas emissions," in Tropical Deforestation and Climate Change at 13 (P. Moutinho & S. Schwartzman eds., 2005), available at http://www.edf.org/documents/4930_TropicalDeforestation_and_ClimateChange.pdf.

increased in all other regions as previously cleared land in Europe and North America reverted from agriculture uses to forests.[132]

Since the 1950s, greenhouse gas emissions from land use change, including deforestation and degradation, have been significant, on the order of 20 to 50 percent of fossil fuel emissions.[133] Deforestation and degradation currently account for 20 to 25 percent of global anthropogenic greenhouse gas emissions, roughly equivalent to the total fossil fuel emissions from the United States.[134] These emissions come predominantly from deforestation of tropical rainforests.

Tropical forests play an especially crucial role. Tropical forests encompass a variety of forest types around the equatorial region of the world. Nearly all the nutrient and carbon content of a tropical forest is in the living plants and the decomposing vegetation on the forest floor. Trees in tropical forests hold, on average, about 50 percent more carbon per acre than trees outside of the tropics.[135] When forests are destroyed by fire, much of the carbon they store returns to the atmosphere, enhancing global warming. When a forest is cleared for crop or grazing land, the soils can become a large source of global warming emissions, depending on how farmers and ranchers manage the land. In places such as Indonesia, the soils of swampy lowland forests are rich in partially decayed organic matter, known as peat. During extended droughts, such as during El Niño events, the forests and the peat become flammable, especially if they have been degraded by logging or accidental fire. When they burn, they release huge volumes of CO_2 and other greenhouse gases.

Rainforests also play another important part in the climate system—generating rainfall. Up to 30 percent of the rain that falls in tropical forests is generated by the forest itself.[136] Water evaporates from the soil and vegetation, condenses into clouds, and falls again as rain in a perpetual self-watering cycle. Recent studies have also indicated that rainforests play an important role in rainfall well beyond the borders of the forest. The evaporation and rainfall in tropical forests helps cool the Earth's surface. In many computer models of future climate, replacing tropical forests with pasture and croplands creates a drier, hotter climate in the tropics.[137] Some models also predict that tropical deforestation will disrupt rainfall patterns far outside the tropics, including in China, northern Mexico, and the south-central United States.[138]

In contrast to the emissions from deforestation in the tropical regions, forests in North America have been growing and acting as sinks for carbon in the last few decades. Growing vegetation in North America removed the equivalent of approximately 30 percent of the fossil

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[132] United Nations Food and Agriculture Organization, Forest Resource Assessment 2005: Key Findings, at http://www.fao.org/forestry/32250/en/.
[133] Richard A. Houghton, "Carbon Flux to the Atmosphere from Land-Use Changes: 1850-2005," in TRENDS: A Compendium of Data on Global Change (2008), available at http://cdiac.ornl.gov/trends/trends.htm.
[134] Houghton, supra note 131.
[135] Id.
[136] NASA, Earth Observatory, Tropical Deforestation: Climate Impacts, at http://earthobservatory.nasa.gov/Library/Deforestation/deforestation_update2.html (last visited Oct. 20, 2008).
[137] Id.
[138] David Werth & Ron Avissar, The local and global effects of Southeast Asian deforestation, 32 Geophysical Research Letters L20702 (2005).

fuel emissions produced from North America, and 50 percent of this sink was due to forest growth in the United States and Canada.[139]

Forests are vulnerable to climate change. The climate strongly influences forest productivity, compositions, and disturbances such as forest fire, insect outbreaks and droughts. The impacts of climate change on many aspects of forest ecology are not well understood. In areas with adequate water availability, warmer temperatures have likely increased forest growth and will continue to do so. Increasing CO_2 concentrations will likely increase photosynthesis but will only increase wood production in young forests where adequate nutrients and water are available. The impact on carbon storage in forest soils from rising temperatures and CO_2 remains unclear.[140] Increasing global temperatures are already affecting tropical forests, with droughts provoking forest fires in Amazonia and Indonesia. The combination of degraded forests from logging and agriculture with more extreme climate events suggests that forest fires are likely to play an even more important role in the future of tropical forests and their contribution of global warming pollution.[141]

There is growing scientific consensus that climate change is already increasing the frequency and intensity of wildfires in the United States, and this trend is likely to worsen in the coming decades. Scientists have concluded that from 1986 to 2006 longer, warmer summers have resulted in a four-fold increase in major wildfires and a six-fold increase in the area of forest burned, compared to the period from 1970-1986.[142] Similar results were published on wildfire activity in Canada from 1920-1999.[143] In addition to more intense and more frequent fires, the length of the fire season and the burn duration of large fires have also increased. Models of future climate have consistently concluded that the areas burned will increase in the coming years and decades. For example, wildfire burn areas in Canada are expected to increase by 74 to 118 percent in the next century,[144] and similar increases are predicted for the western United States. With more wildfires come more greenhouse gas emissions. Although estimates vary widely, wildfires may represent up to 10 percent of total U.S. greenhouse gas emissions.[145]

Scientists have identified several mechanisms through which climate change is lengthening the fire season and increasing the frequency and intensity of wildfires. One extremely important factor is the impact of global warming on snowmelt. Warmer temperatures cause an earlier snowmelt which can lead to an earlier and longer dry season.[146] This provides

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[139] U.S. Climate Change Science Program, Synthesis and Assessment Product 2.2, The First State of the Carbon Cycle Report: North American Carbon Budget and Implications for the Global Carbon Cycle at vii (2007).
[140] U.S. Climate Change Science Program, Synthesis and Assessment Product 4.3, The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States at 7 (2008).
[141] Ane Alencar et al., "Carbon emissions associated with forest fires in Brazil," in Tropical Deforestation and Climate Change at 23 (P. Moutinho & S. Schwartzman eds. 2005), available at http://www.edf.org/documents/4930_TropicalDeforestation_and_ClimateChange.pdf.
[142] Anthony L. Westerling et al., Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity 313 Science 940 (2006).
[143] N. P. Gillett et al., Detecting the effect of climate change on Canadian forest fires, 31 Geophysical Research Letters L18211 (2004).
[144] M. D. Flannigan et al., Future Area Burned in Canada, 72 Climatic Change 1 (2005).
[145] Guido R. Van der Werf et al, Continental-Scale Partitioning of Fire Emissions During the 1997 to 2001 El Niño/La Niña Period, 303 Science 73 (2004).
[146] Westerling et al., supra note 142.

more opportunities for large fires by creating a longer period in which ignitions can occur and by increasing the drying of soils and vegetation making them more prone to fire. This has also expanded the range in which serious wildfires occur to higher elevations in mountainous regions.

Global warming is also exacerbating insect infestations (most notably bark beetles), which in turn make forests more susceptible to wildfire. Drought stress makes trees and vegetation more susceptible to attack by insects, and warmer winter temperatures allow a higher number of insects to survive and increase their populations. Warmer temperatures can also increase reproductive rates of insects, resulting in two generations in a single year. Finally, warmer temperatures allow insects to invade areas previously outside their natural range, as has happened with the mountain pine beetle in the western United States. Research has clearly demonstrated the link between warmer temperatures and drought on extensive insect outbreaks in southwestern forests and Alaska.[147]

h. Wildlife and Endangered Species

If climate change goes unchecked, it could lead to the extinction of up to 40 percent of the world's species by the latter half of this century. The International Union for the Conservation of Nature's 2008 annual report lists 38 percent of catalogued species as *already* threatened with extinction—including nearly 25 percent of all mammals.[148] According to the IPCC's Fourth Assessment Report, "the resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances, (e.g. flooding, drought, wildfire, insects, ocean acidification), and other global change drivers."[149]

According to the IPCC: "Approximately 20-30% of plant and animal species assessed so far are likely to be at an increased risk of extinction if increases in global average temperature exceed 1.5 – 2.5º C [2.7 – 4.5 º F]."[150] Additional warming could lead to "significant extinctions around the globe," including the loss of more than 40 percent of all plant and animal species.[151] A 2004 study suggests that 15 to 37 percent of terrestrial species may be "committed to extinction" by 2050 due to climate change.[152]

The species most vulnerable to climate change have a specialized habitat, a narrow environmental tolerance that is likely to be exceeded due to climate change, and dependence on specific environmental triggers or interactions that are likely to be disrupted by climate change. The IPCC identifies "coral reefs, the sea-ice biome, and other high-latitude ecosystems (e.g. boreal forests), mountain ecosystems and mediterranean-climate ecosystems" as the systems

[147] U.S. Climate Change Science Program, supra note 140, at 81-82.
[148] International Union for the Conservation of Nature, Press Release, IUCN Red list Reveals world's mammals in crisis, Oct. 6, 2008, at http://www.iucn.org/news_events/events/congress/index.cfm?uNewsID=1695.
[149] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability, Summary for Policy Makers at 11 (2007).
[150] Id.
[151] Id.; see also Testimony of Dr. Camille Parmesan before the Select Committee on Energy Independence and Global Warming, hearing on "Dangerous Climate Change," April 26, 2007.
[152] C.D. Thomas et al., Extinction risk from climate change, 427 Nature 145 (2004).

most vulnerable to the impacts of climate change.[153] One tragic and iconic example is the polar bear. Polar bear populations are expected to decline by 30 percent in the next 35 to 50 years—and to disappear from Alaska altogether—due to disappearing habitat resulting from global warming.[154]

4. National Security Impacts

The current and projected impacts of global warming have serious national security consequences for the United States and our allies, in many cases acting as "threat multipliers." The security issues raised by global warming have received increasing scrutiny in the last few years both in Congress and in international venues, including a debate at the UN Security Council in April 2007. The first-ever U.S. government analysis of the security threats posed by global climate change was issued in June 2008 as the National Intelligence Assessment (NIA), *National Security Implications of Global Climate Change to 2030.* The 2008 NIA was the result of a process initiated, in part, by Chairman Markey's April 2007 introduction of H.R. 1961, the "Climate Change Security Oversight Act," which required the U.S. Intelligence Community to analyze the national security implications of global climate change. In addition, U.S. and European military and security policy analysts have issued a number of public reports exploring the security consequences of global warming and potential responses. All of these reports emphasize concerns over a few key security impacts, including migration, water scarcity, infrastructure at risk from extreme weather, and new economic routes and access to new energy resources. In most cases, global warming is not creating "new" security threats, but rather is acting as a "threat multiplier."[155]

Numerous impacts of global warming could ultimately increase both the temporary and permanent migration of people inside and across existing national borders—increasing risks of geopolitical instability. Nations dealing with an influx may have neither the resources nor the desire to support climate migrants.[156] As in the past, movement of people into new territory can increase the likelihood of conflict and the potential need for intervention from U.S. and allied military forces.

Rising sea levels threaten low-lying island nations and populous coastal areas. Even if not totally inundated, rising sea levels can render these areas uninhabitable due to sea water incursion into fresh water resources and increased exposure to storms. For example, the risk of coastal flooding in Bangladesh is growing and could force 30 million people to search for higher ground in a country already known for political violence. India is already building a wall along

[153] Intergovernmental Panel on Climate Change, Fourth Assessment Report, Working Group II Report "Impacts, Adaptation and Vulnerability", Chapter 4, "Ecosystems, their Properties, Goods and Services," P. 214.
[154] See, e.g., Blaine Harden, "Experts Predict Polar Bear Decline," Washington Post, Thursday, July 7, 2005; Page A03, available at http://www.washingtonpost.com/wp-dyn/content/article/2005/07/06/AR2005070601899.html.
[155] Testimony of Gen. Gordon Sullivan (retired), before the Select Committee, hearing on "Geopolitical Implications of Rising Oil Dependence and Global Warming," April 18, 2008, at 2.
[156] Testimony of Thomas Fingar before the Select Committee on Energy Independence and Global Warming and the House Intelligence Community Management Committee, Joint Hearing on "The National Security Implications of Climate Change," June 25, 2008, at 14.

its border with Bangladesh.[157] The densely-populated and oil-rich Niger Delta is already the scene of conflict over the sharing of oil revenues. Land loss and increased risk of storms will exacerbate these tensions as well as the challenge of maintaining the existing oil infrastructure. Other important economic and agricultural coastal areas, like Egypt's Nile Delta and China's southeast coast, are also threatened from rising sea-levels and severe storms. Similar impacts in Central America and the Caribbean could add pressure to pre-existing migration patterns from those areas to the United States.

Increased water scarcity due to climate change exacerbates the risk of conflict over water resources. As discussed above, changing precipitation patterns and increasing temperatures are likely to increase the risk of water scarcity and degraded water quality in many areas. Security experts have long been concerned about the prospects for conflict over water resources in many regions of the developing world, which will be exacerbated by climate change. Water scarcity will also increase the pressure on groups to migrate to areas perceived to have more resources.

Rapidly melting glaciers in the Andes and the Tibetan Plateau threaten the water supply for some of the most populous countries in the world. The major rivers of India and China originate in the Tibetan Plateau glaciers and are an important component of their summer flows. Dwindling water resources or changes in the flow regime could heighten existing tensions within the countries and between the two and their neighbors. For transnational watersheds, even projects designed to adapt to climate change, like new reservoirs, will have to be managed in a way to allow equitable water distribution and governance systems that minimize the possibility of their use for strategic leverage.

Climate change is already contributing to current conflicts. For example, scientists have traced declines in rainfall in the Darfur region to disruption in the African monsoon due to warming sea surface temperatures.[158] As their lands failed, tension between African farmers and Arab herders increased and became a contributing factor to the genocide that has occurred there. In the Select Committee's first hearing, General Gordon Sullivan, the Army Chief of Staff during U.S. operations in Somalia in 1993, testified that drought and food scarcity allowed the Somali warlords to use incoming food aid as leverage over the population, necessitating the intervention of U.S. military forces.[159] He cautioned that the U.S. military will have to prepare to deal with more situations of this kind due to the impacts of global warming.

Global warming will directly impact U.S. military infrastructure at risk of damage from extreme weather and melting permafrost. Infrastructure upgrades, repair and replacement to increase resilience to global warming impacts, and rebuilding after extreme weather events will be costly. For example, the East and Gulf Coasts will be at increased risk from storm surge, and U.S. naval shipbuilding facilities have already been damaged by Hurricanes Katrina and Rita. Many active U.S. coastal military installations around the world are at a significant and

[157] George Black, "The Gathering Storm", OnEarth, Summer 2008, available at http://www.onearth.org/article/the-gathering-storm?page=all.
[158] Alessandra Giannini et al., A Global Perspective on African Climate, 90 Climatic Change 359 (2008).
[159] Transcript of Select Committee hearing on "Geopolitical Implications of Rising Oil Dependence and Global Warming," April 18, 2007, at 61.

increasing risk of damage from storm surges and associated flooding and damages.[160] For example, the U.S. airbase at Diego Garcia in the Indian Ocean, which is critical to operations in Iraq and the surrounding region, is an average of four feet above sea level and is threatened by sea level rise and storm surges.[161]

Global warming impacts also threaten energy supplies, as demonstrated in the devastating hurricane season in 2005. The paths of Hurricane Katrina and Hurricane Rita passed through three-quarters of the oil platforms and two-thirds of the natural gas platforms in the Gulf of Mexico and a major concentration of refining capacity on land. Together they destroyed over a hundred offshore platforms and damaged 183 pipelines. Over 1.5 million barrels of oil and 10 billion cubic feet of natural gas production per day was taken off-line for both hurricanes. Katrina also significantly affected electricity supply with 2.7 million customers and other critical infrastructure losing power.[162] In Alaska, melting permafrost and fewer days with an adequate amount of snow for exploration purposes could hinder oil production and transport of oil from fields on the North Slope.

Finally, accelerating melting of Arctic sea ice is impacting the United States' strategic interests in the region. Russia has moved to stake claim to over 460,000 square miles of territory, including areas with potential oil and natural gas resources.[163] With the opening of the Northwest Passage for the first time in recorded history, the Prime Minister of Canada announced his intention to increase his country's military presence in the Arctic.[164] Other circumpolar nations, including the United States, have begun to examine their potential claims on Arctic territory and identify necessary preparations for increased maritime traffic in the area. Given that the 2008 melt was almost as great as 2007, this issue will remain one of immediate concern. As new economic routes and energy resources become available, the United States will have to adapt and perhaps redeploy resources to deal with the changing physical and economic landscape.

5. The Economic Costs of Climate Change

Climate change impacts of the types described above will have staggering economic impacts in the United States and the rest of the world in the coming decades. Measuring these impacts in dollars is a unique challenge, requiring analysis of local and global impacts, long time horizons, quantification of risk and uncertainty, and capturing the possibility of tipping points that induce major, catastrophic change. While the variables are many and complex, estimates of potential economic impacts are massive. The Stern Review—one of the most in-depth and

[160] Testimony of Thomas Fingar before the Select Committee on Energy Independence and Global Warming and the House Intelligence Community Management Committee, Joint Hearing on "The National Security Implications of Global Warming," June 25, 2008, at 15.
[161] The CNA Corporation, National Security and the Threat of Climate Change at 37 (2007), available at http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf.
[162] Testimony of Secretary of Energy Samuel Bodman, before Senate Energy and Natural Resources Committee, Oct. 27, 2005.
[163] Scott Borgerson, "Arctic Meltdown: The Economic and Security Implications of Global Warming," Foreign Affairs, March/April 2008.
[164] Id.

respected economic impact analyses on climate change conducted thus far—used formal economic models to estimate that unabated climate change will cost at least 5 percent of global gross domestic product (GDP) each year, now and forever.[165] This amounts to around $3.3 trillion per year at the current value of the global economy.[166] If a wider range of risks and impacts is taken into account, the damages could rise to 20 percent of GDP or more annually over the next two centuries.

In the United States, the economic impacts of climate change will be felt throughout the country and within all sectors of the economy. The greatest economic impacts will stem from stress to fresh water supply networks, changes to the agricultural sector, threats to coastal infrastructure from storms and sea level rise, effects on energy supply and demand, increased risk to human health, and more frequent and extensive forest fires.[167] Tourism and other weather-dependent industries will continue to be hit especially hard as well. Modeling results from a recent Tufts University and Natural Resources Defense Council study show that if present trends continue, the total cost of four global warming impacts alone—hurricane damage, real estate losses, energy costs, and water costs—will cost the United States nearly $1.9 trillion annually by 2100 (in constant 2008 dollars), or 1.8 percent of U.S. GDP. Factoring in a wider range of harms such as health impacts and wildlife damages, these costs could reach 3.6 percent of GDP annually in the United States by 2100.[168]

6. Impacts on Vulnerable Communities

While the ramifications of climate change will be felt in every community, the greatest impacts will be borne by those already most economically vulnerable and who have contributed least to climate change. This makes climate change not only an issue of the environment, but also one of justice and human rights. Left unabated, climate change will exacerbate deep inequalities within countries and between them. The human face of the climate story is one in which communities least responsible for the climate crisis are the first pushed to the edge of survival, and then ultimately over the edge if they are unable to adapt to climate changes. This was underscored at the Select Committee's October 18, 2007 hearing entitled "Energy and Global Warming Solutions for Vulnerable Communities," at which it heard from representatives of communities, both here in the United States and overseas, particularly vulnerable to the impacts of climate change.

Climate change will have devastating impacts on the developing world, reversing gains in poverty reduction, food security and nutrition, health, and basic services and putting millions of lives at risk. Poor communities are especially vulnerable because they have less capacity to adapt to changes in climate and are more dependent on climate-sensitive resources such as local water and food supplies.[169] Increased exposure to drought and water scarcity, more intense storms, floods, and other environmental pressures will hold back the efforts of the

[165] Stern Review: The Economics of Climate Change (2006).
[166] CIA World Fact Book. available at https://www.cia.gov/library/publications/the-world-factbook/geos/xx.html#Econ.
[167] Ruth et al., supra note 50, at 10-15.
[168] Ackerman & Stanton, supra note 118.
[169] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability, Summary for Policymakers at 7, 22 (2007).

world's poor to build a better life for themselves and their children. Climate change is likely to reverse many of the recent gains in poverty alleviation around the world, adding to the total of 2.6 billion people now living on $2 a day or less. By the end of the century, an additional 145-220 million people in South Asia and Sub Saharan Africa could fall below the $2 per day poverty level as a result of climate change impacts.[170] According to the Stern Review, unchecked climate change could turn 200 million people into refugees this century, precipitating the largest migration in history as entire countries and regions succumb to drought or flood. In addition, increased frequency and severity of droughts and floods will affect crop productivity and food production, disproportionately affecting the 850 million people already experiencing food scarcity.[171]

This prospective devastation is more easily grasped through actual experiences. In testimony before the Select Committee, Amjad Abdulla, representing the Republic of the Maldives, explained how his island country is dealing with both the long and short term challenges of global warming. Rising ocean temperatures, coupled with increasing acidification from CO_2 dissolved in sea water, threaten what are considered to be some of the most beautiful and productive coral reefs in the world. These reefs are the foundation of the Maldives' economy, driving a productive fishing industry and attracting large numbers of tourists. In the long term, rising sea-levels represent a truly existential threat. With the highest point on the islands little more than six feet above sea level, all 1,190 islands making up the Maldives could eventually be rendered uninhabitable.

Poor communities and communities of color within the United States are vulnerable to climate change impacts as well, and suffer disproportionately from illnesses due to the social determinants of health. According to the U.S. Census Bureau, around 39 million citizens in the United States are impoverished, over 50 percent living in urban settings. As the devastation of Hurricane Katrina in 2005 demonstrated, poorer communities are especially vulnerable to extreme weather events. Poorer communities and communities of color are also more vulnerable to public health impacts of climate change. As explained above, the frequency of respiratory diseases like asthma is directly related to high concentrations of ground level ozone, which are known to increase as a result of global warming and often accumulate in unsafe levels in urban environments. Today, over 70 percent of African Americans live in counties in violation of federal air pollution standards,[172] and 78 percent of African Americans and Latinos live within 30 miles of a coal-fired power plant, compared to 56 percent of non-Hispanic whites.[173] In all of the largest 44 major metropolitan areas in the United States, African Americans are more likely than whites to be exposed to higher air toxic concentrations. As a result, African Americans are nearly three times as likely to be hospitalized or killed by asthma.[174] In Harlem, New York, 25 percent of children now have asthma.[175] Latinos—66 percent of whom live in areas that violate

[170] Stern Review, supra note 165, at 55.
[171] Id. at 59.
[172] Congressional Black Caucus Foundation, Climate Change and Extreme Weather Events: An Unequal Burden on African Americans (Sept. 2005), available at http://www.cbcfinc.org/pdf/climatechange_issuebrf.pdf.
[173] Environmental Justice and Climate Change Initiative, Climate of Change: African Americans, Global Warming, and a Just Climate Policy for the U.S. at 12 (2008), available at http://www.ejcc.org/climateofchange.pdf.
[174] Id. at 2.
[175] Richard Perez-Pena, Study Finds Asthma in 25% of Children in Central Harlem, New York Times, April 19, 2003.

federal air quality standards—face disproportionate health impacts as well.[176] These impacts are exacerbated by their disproportionate lack of health insurance and lower utilization of health services compared with both non-Hispanic whites and African Americans.

The WHO has found that negative public health impacts of climate change, discussed above, will likely disproportionately impact communities that are already vulnerable. In 2007, more than 46 million Americans lacked health insurance. Minorities are more likely to be uninsured regardless of income level and often experience greater challenges in accessing health care services. Consequently, they are more likely to suffer as a result of public health impacts related to climate change.

Vulnerable Alaskans are already dealing with the harsh reality of global warming. According to the U.S. Army Corps of Engineers, at least three Alaskan villages—Shishmaref, Kivalina, and Newtok—will be lost to coastal erosion due to rising sea levels in the next 8 to 13 years.[177] With flooding and erosion currently affecting 184 out of 213, or 86 percent, of Alaska Native villages to some extent,[178] the number of villages needing major assistance is sure to swell over the next century. The cost of saving these villages through either man-made erosion protection or total community relocation could be up to $200 million or more per village.[179] As devastating as it may be to watch a town fall in to the sea, the more destructive and irreplaceable transformation occurring within these native communities is to cultures and traditional ways of life. As Mike Williams, Vice-Chairman of the Alaska Inter-Tribal Council, eloquently testified before the Select Committee:

> "Global warming is undermining the social identity and cultural survival of Alaska Natives and American Indians. As we watch our ice melt, our forests burn, our villages sink, our sea level rise, our temperatures increase, our oceans acidify, and our animals become diseased and dislocated, we recognize that our health and our traditional ways of life are at risk. Our elders, in particular, are deeply concerned about what they are witnessing. In Alaska, unpredictable weather and ice conditions make travel and time-honored subsistence practices hazardous, endangering our lives."[180]

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[176] Adrianna Quintero-Somaini et al., Natural Resources Defense Council, Hidden Danger: Environmental Health Threats in the Latino Community at vii, 14 (2004), available at http://www.nrdc.org/health/effects/latino/english/latino_en.pdf.

[177] U.S. Army Corps of Engineers, Alaska Village Erosion Technical Assistance Program (April 2006), available at: http://housemajority.org/coms/cli/AVETA_Report.pdf

[178] Government Accountability Office. Alaska Native Villages, Report No. GAO-04-895T (June 29, 2004), available at: http://www.gao.gov/new.items/d04895t.pdf.

[179] U.S. Army Corps of Engineers, supra note 177.

[180] Testimony of Mike Williams before the Select Committee on Energy Independence and Global Warming, hearing on "Energy and Global Warming Solutions for Vulnerable Communities," October 18, 2007.

B. THE ENERGY CRISIS

Even as the impending climate crisis looms before us, the United States is already facing a deepening energy crisis. The most critical aspect of that crisis is our growing dependence on foreign oil, coupled with the skyrocketing prices of oil and gasoline. But in a range of other key areas, including natural gas and electricity generation and transmission, the United States is facing challenges arising from growing demand, limits on supply, and rising global prices. At the same time, we find ourselves on the cusp of an unprecedented wave of investment in infrastructure and technology, which will benefit those workers and companies positioned to answer the challenge. Between now and 2030, over $20 trillion will be invested in energy infrastructure worldwide, and an estimated $1.5 trillion will be invested in the U.S. power sector alone. This places us at a critical decision point in the development of the U.S. and global energy economies.

1. The Oil Challenge

The single greatest energy security challenge facing the United States in the 21st century is our growing dependence on foreign oil. The United States imported 4.9 billion barrels oil in 2007, or 58.2 percent of its total oil consumption. This import figure is up from 52.9 percent of total consumption in 2000 and 42.2 percent in 1990. The dramatic rise in oil prices over the past several years—driven primarily by rising global demand—has highlighted the growing urgency of this challenge. At the same time, combustion of oil in the United States accounts for nearly a third of our greenhouse gas emissions—more than the total emissions of the Russian Federation (which ranks third in the world in emissions).[181]

Oil and gasoline prices have skyrocketed over the past several years. The price of oil has risen from $18 per barrel in January 2002, to $147 per barrel in July of 2008, an increase of over 700 percent.[182] Prices doubled in just 12 months between July 2007 and July 2008, before declining to under $80 per barrel by October 2008 in the face of an expanding global financial crisis.[183] Similarly, gasoline prices soared from under $1.50 per gallon in January 2001 to over $4.11 in July 2008, before declining to under $3.00 in October 2008.[184]

These price hikes have had a crippling impact on American consumers. Each $1 per gallon increase in the average cost of gasoline adds nearly $600 to an average American's annual transportation fuel bill.[185] For the average American worker, who makes $30,000 a year, $3.75

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[181] For U.S. petroleum-related emissions, see Energy Information Administration, International Energy Annual 2005, Table H.2co2, "Carbon Dioxide Emissions from the Consumption of Petroleum, 1980-2005," available at http://www.eia.doe.gov/pub/international/iealf/tableh2co2.xls. For total greenhouse gas emissions by country, see UNFCCC, Subsidiary Body for Implementation, National greenhouse gas inventory data for the period 1990–2005, at 17 (Table 4) (Oct. 27, 2007), available at http://unfccc.int/resource/docs/2007/sbi/eng/30.pdf.

[182] Energy Information Administration, Daily Cushing, OK WTI Spot Price FOB (spot prices for Cushing, OK West Texas Intermediate crude oil, the benchmark price for the United States), available at http://tonto.eia.doe.gov/dnav/pet/hist/rwtcd.htm.

[183] Id.

[184] Energy Information Administration, Weekly U.S. Regular All Formulations Retail Gasoline Prices, available at http://tonto.eia.doe.gov/dnav/pet/hist/mg_rt_usw.htm.

[185] This is based on EPA estimates of fuel economy and miles driven of an average U.S. passenger vehicle. See

per gallon gasoline consumes about 8 percent of that person's total pre-tax income.[186] Witnesses at the Select Committee's May 9, 2007 hearing on the "Economics of Dependence on Foreign Oil – Rising Gasoline Prices" testified that, even as of May of 2007 (with gasoline prices at just above $3.00 per gallon), American consumers, businesses, and local governments were experiencing severe impacts—including school districts eliminating school bus service or charging parents for such service, and farmers and small businesses facing substantial losses due to rising fuel prices. At the Select Committee's September 25, 2008 hearing on "The Future of LIHEAP Funding: Will Families Get the Cold Shoulder this Winter?," discussed at greater length below, the Select Committee learned that the 8 million American households that rely on heating oil to warm their homes should expect to pay an average $2,524 in heating costs during the 2009-2010 winter, an increase of 30 percent over the previous winter.

As consumers suffer, oil company profits soar. This was underscored by the Select Committee's April 2008 hearing entitled "Drilling for Answers: Oil Company Profits, Runaway Prices, and the Pursuit of Alternatives," at which top executives from the five largest independent oil companies testified. In 2002, these five companies—ExxonMobil, ConocoPhillips, Shell, BP, and Chevron—had a combined net income of over $28 billion. By 2007, these same companies recorded yearly profits of over $123 billion. In 2008, they are projected to make over $150 billion in profits. Average CEO compensation at the five oil majors is over $23 million per year.

Meanwhile, the major oil companies fail to invest in either new supplies or oil alternatives on the scale needed. Instead of favoring greater exploration or alternative energy investments, the oil majors have increased stock buybacks from $10 billion in 2003 to $60 billion in 2006.[187] As the Select Committee learned on June 11, 2008 in a hearing entitled "The Future of Oil," the exploration spending of the five largest oil companies was flat or decreased between 1998 and 2006. Despite professing a strong commitment to development of renewable energy sources, the largest U.S. oil company—ExxonMobil, with 2007 profits of over $40 billion—revealed at a Select Committee hearing that it invests only $10 million annually in renewable energy research and projects, or less than three hundredths of one percent of ExxonMobil's annual profits. The other four companies estimated their investments in renewable energy at $100-200 million per year over the past five years. As the Select Committee heard at a September 10, 2008 hearing entitled, "Investing in the Future: R&D Needs to Meet America's Energy and Climate Challenge," research and development (R&D) investments by the major oil companies is miniscule compared to other sectors. While companies in sectors like biotech, information technology, and semiconductors routinely invest 13 to 18 percent of revenues in R&D, the major oil companies invest only 0.002 percent.

Environmental Protection Agency, Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle, Fact Sheet EPA420-F-05-004 (Feb. 2005), available at http://www.epa.gov/oms/climate/420f05004.htm.

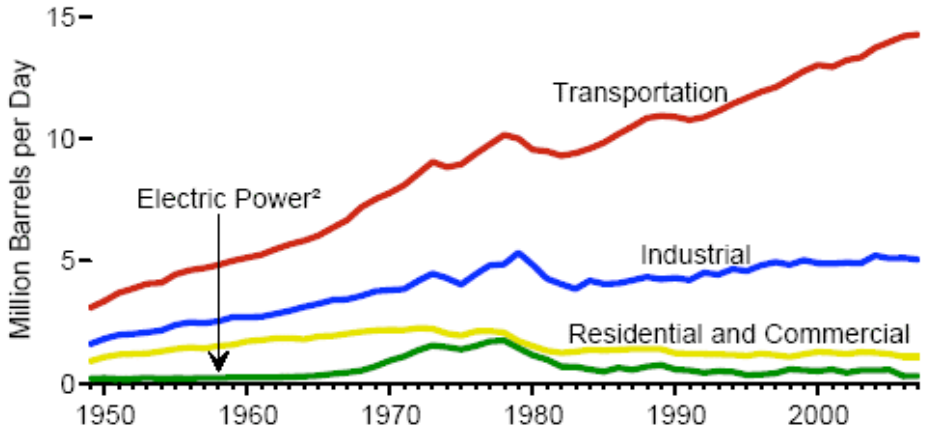
[186] According to the Department of Transportation, U.S. cars, vans, pickups, and SUVs in 2005 traveled an average of 11,856 miles and used 594 gallons of gasoline over the course of the year. U.S. Department of Transportation, Federal Highway Administration, Annual Vehicle Distance Traveled in Kilometers and Related Data – 2005, By Highway Category and Vehicle Type (Table VM-1M) (Nov. 2006), available at http://www.fhwa.dot.gov/policy/ohim/hs05/pdf/vm1m.pdf. Based on those figures, with gasoline prices at $3.75 per gallon, the average consumer would spend $2,227.50.

[187] See Select Committee Staff Report, "Big Oil: Where Have All the Profits Gone?" (May 21, 2008), available at http://globalwarming.house.gov/tools/2q08materials/files/0045.pdf.

Although excessive speculation and a weak U.S. dollar undoubtedly played a role in the recent run-up in oil prices, experts forecast sustained high prices for the foreseeable future—largely due to limited supply and dramatically increasing global demand, especially in China, India, and the Middle East. Many experts believe that market fundamentals indicate that the oil market has entered a period of sustained high prices.[188] The world's oil spigots are close to fully open, and spare production capacity has nearly disappeared around the world. By 2030, global demand for oil is expected to expand by 30-38 percent above current levels of 84 million barrels per day (mbd).[189] Most of the increase in demand is anticipated to come from China, India, and the Middle East. Demand from China alone grew 5.1 percent per year between 1980 and 2004 and is expected to continue to grow rapidly.[190] In the United States, absent significant changes in driving habits or in vehicle fuel efficiency beyond what is already required by EISA, demand for oil is expected to grow from 20.7 mbd today to 22.8 mbd in 2030—an 11 percent increase.[191]

The oil crisis is basically a transportation challenge. The transportation sector accounts for approximately 69 percent of U.S. oil consumption, and motor vehicles alone account for roughly 59 percent of consumption.[192] The U.S. transportation system is over 95 percent dependent on oil as a fuel source.

U.S. Petroleum Consumption by Sector[1]



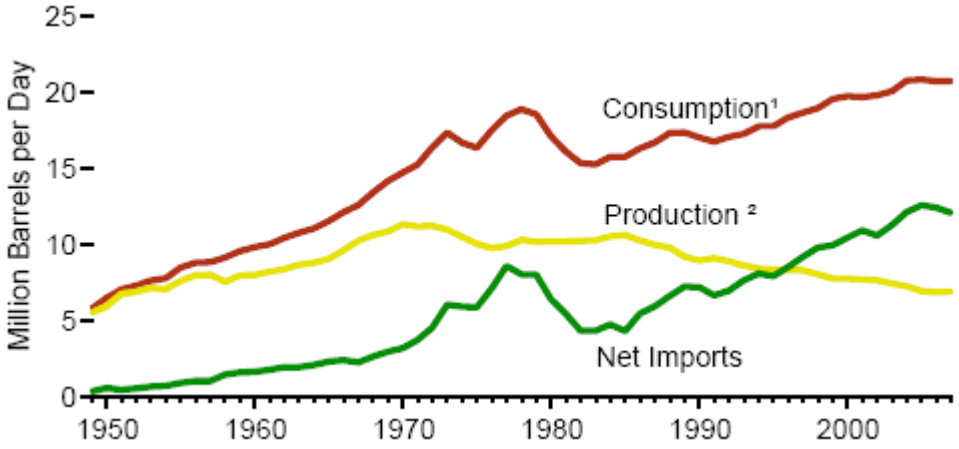
[1]Petroleum products supplied is used as an approximation for consumption.
[2]Through 1988, electric utilities only; after 1988, includes independent power producers.

[188] See, e.g., Testimony of Adam Sieminski and Testimony of Amy Myers Jaffee, before the Select Committee on Energy Independence and Global Warming, hearing on "The Future of Oil" (June 11, 2008).
[189] International Energy Agency, World Energy Outlook 2006 at 86 (2006).
[190] Id. at 87
[191] Energy Information Administration, Annual Energy Outlook 2008 at 81 (2008) [hereinafter "EIA AEO 2008"].
[192] Energy Information Administration, Annual Energy Review 2007, Tables 5.11 and 5.13c (June 2008). The industrial sector accounts for approximately 24.4 percent, the residential and commercial sectors approximately 1.6 percent, and the electric power sector approximately 1.4 percent. *Id.* at Tables 5.11, 5.13a, 5.13b, 5.13c, and 5.13d.

Source: Energy Information Administration, Energy Perspectives (2008) (Figure 18), available at http://www.eia.doe.gov/emeu/aer/ep/ep_frame.html.

The United States is increasingly dependent on foreign sources of oil—imposing a massive drain on the U.S. economy. The United States accounts for 25 percent of global oil consumption but accounts for less than 10 percent of global production and has around 2 percent of proven oil reserves. Meanwhile, over the past three decades, we have seen a dramatic increase in the United States' reliance on imported oil to satisfy its growing demand. Net imports have grown from 21 percent in 1970, to 52.9 percent in 2000, and to over 58 percent today.[193] Oil imports cost the United States a staggering $319 billion in 2007, over 45 percent of our total trade deficit—up from less than 24 percent of the trade deficit in 2002.[194] Dr. David L. Greene of the Oak Ridge National Laboratory estimates that the full cost of dependence on foreign oil to the U.S. economy is much higher—$750 billion in 2008, including a loss of potential GDP of $352 billion (about 2 percent of total GDP).[195]

U.S. Crude Oil Consumption, Production, and Net Imports



[1]Petroleum products supplied used as an approximation for consumption.
[2]Crude oil and natural gas plant liquids production.

Source: Energy Information Administration, Energy Perspectives (2008) (Figure 14), available at http://www.eia.doe.gov/emeu/aer/ep/ep_frame.html.

[193] Energy Information Administration, Annual Energy Review 2007, Petroleum Net Imports by Country of Origin, Table 5.7 (June 2008).
[194] For U.S. trade deficit numbers, see Bureau of Economic Analysis, "U.S. International Trade in Goods and Services – Exports, Imports, and Balances," available at http://www.bea.gov/newsreleases/international/trade/trad_time_series.xls. For U.S. oil import expenditures, see U.S. Census Bureau, FT 900: U.S. International Trade in Goods and Services, Exhibit 17 (Imports of Energy-Related Petroleum Products, Including Crude Oil) (July 2008), available at http://www.census.gov/foreign-trade/Press-Release/current_press_release/exh17.pdf, and FT 900: U.S. International Trade in Goods and Services, Exhibit 17 (Imports of Energy-Related Petroleum Products, Including Crude Oil) (July 2003), available at http://www.census.gov/foreign-trade/Press-Release/2003pr/07/exh17.pdf.
[195] David L. Greene, Oak Ridge National Laboratory, "Costs of Oil Dependence Update 2008: Summary" (Aug. 8, 2008).

This growing dependence on foreign oil has dire implications for U.S. national security and economic stability. Dependence on imported oil makes the United States increasingly vulnerable to foreign governments' manipulation of supply and prices, as well as to potential disruptions in global supply. OPEC countries control 76 percent of estimated global oil reserves and account for 38 percent of global production.[196] Moreover, investor-owned companies control only about 6 percent of the world's known oil reserves. By contrast, government-owned and operated companies in oil-producing countries, such as Saudi Aramco in Saudi Arabia or the National Iranian Oil Company in Iran, control most of the rest.[197] Of the top 20 oil producing companies in the world, 14 are national oil companies (NOCs) or newly privatized NOCs.[198] Although Canada and Mexico supply a substantial proportion of U.S. imports, OPEC countries control virtually all of the world's marginal production capacity and therefore have the ability to set the global price for this commodity.

This makes the United States uniquely vulnerable to a supply crisis, which could be created by a range of scenarios. These include a cutoff of oil supplies by a major exporter such as Venezuela, a confrontation with Iran, an Iranian or terrorist threat to the Strait of Hormuz, through which 16-17 million barrels of oil passes each day, terrorist attacks on major oil production facilities or export infrastructure in Nigeria or elsewhere, a broadening of conflict in Iraq, or destruction of oil production or fuel refining infrastructure as a result of a severe storm or natural disaster.[199] This vulnerability was underscored at the Select Committee's November 7, 2007 hearing entitled "Oil Shock: Potential for Crisis," at which former Commander of the U.S. Pacific Command, Admiral Dennis Blair, and former EPA Administrator Carol Browner testified on "Oil Shockwave"—a "war game" exercise focusing on a crippling oil crisis.

Despite increasingly strident calls to open the Outer Continental Shelf (OCS) and the Arctic National Wildlife Refuge to drilling, the facts make clear that we cannot drill our way out of this problem. More drilling may be good for U.S. oil company profits but will have little or no impact on prices consumers pay for oil or gasoline and will not substantially reduce U.S. dependence on foreign oil. As a preliminary matter, it bears emphasis that there is no shortage of opportunities for drilling on federal lands in the United States. Oil and gas companies currently hold leases to nearly 68 million acres of federal lands and offshore areas on which they are not currently producing.[200]

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[196] Energy Information Administration, International Energy Annual 2005, Table G.1 (World Production of Crude Oil, Natural Gas Plant Liquids, and Other Liquids, 1980-2005) (2007), available at http://www.eia.doe.gov/pub/international/iealf/tableg1.xls; BP Statistical Review of World Energy June 2008, Table A1 (Oil – Proved Reserves), available at http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2008/STAGING/local_assets/downloads/spreadsheets/statistical_review_full_report_workbook_2008.xls#'Oil – Proved reserves'!A1.

[197] David Baker, "Big Oil has trouble finding new fields," San Francisco Chronicle, Feb. 1, 2008, available at http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/02/01/BUMDUOD7S.DTL.

[198] Amy Myers Jaffe & Ronald Soligo, The International Oil Companies at 3 (Nov. 2007) (The James A. Baker III Institute for Public Policy), available at http://www.bakerinstitute.org/publications/NOC_IOCs_Jaffe-Soligo.pdf.

[199] See, e.g., Testimony of Amy Myers Jaffe, before the Select Committee on Energy Independence and Global Warming, hearing on "The Future of Oil" (June 11, 2008), at 1-2.

[200] See, e.g., Testimony of Athan Manuel, before the Select Committee on Energy Independence and Global Warming, hearing on the "Future of Oil" (June 11, 2008), at 11.

With regard to the OCS, nearly 83 percent of technically recoverable offshore oil reserves offshore in the United States are located in areas *already* available for leasing and drilling.[201] Of a total of 101 billion barrels of reserves, only 18 billion barrels are in areas that, up until October 1, 2008, were off limits—including 10 billion barrels off the coast of California, where there is a consistent record of bipartisan opposition to drilling.[202] The Department of Energy's Energy Information Administration (EIA) estimates that, even if the entire lower 48 OCS were opened to drilling, this would increase cumulative U.S. oil production by only 1.6 percent by 2030 and would have an "insignificant" impact on prices.[203]

As to the Arctic National Wildlife Refuge, EIA estimates that if the Refuge were opened for drilling, production would likely peak in 2027 at just 0.78 million barrels per day—reducing world oil prices by 78 cents per barrel in EIA's average price and resource case—corresponding to an estimated 4 cent per gallon decrease in the price of gasoline.[204]

Finally, regardless of U.S. oil production trends, there are serious questions about how increasing global demand will be met—and whether it can be met at all. This concern was underscored at the Select Committee's June 2008 hearing on the "The Future of Oil." Estimates of the total petroleum resource currently in the ground – both conventional and unconventional[205]—vary from 14 to 24 trillion barrels.[206] However, actual "proven reserves" that have already been discovered and are expected to be economically producible are much lower—estimated at between 1.1 and 1.4 trillion barrels worldwide. Chevron Corporation has estimated that humanity has consumed 1 trillion barrels of oil during the past 125 years, but that it will take just 30 years to burn through another trillion barrels. The IEA estimates current proven reserves, including non-conventional sources, could last 42 years if they were produced at current rates.[207]

At the same time, generating new oil supply is proving increasingly difficult. The fields that oil companies find are generally in hard-to-reach places like deep water areas in the Gulf of Mexico, where drilling and pumping costs far more than it does on land. Much of these companies' current oil supplies come from old giant fields which are now in decline and

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[201] U.S. Mineral Management Service, Report to Congress: Comprehensive Inventory of U.S. OCS Oil and Natural Gas Resources (Feb. 2006). available at http://www.mms.gov/revaldiv/PDFs/FinalInvRptToCongress050106.pdf. Figures are adjusted to account for the estimated 1.26 billion barrels of oil and 79.96 trillion cubic feet of gas in the Gulf of Mexico that were made accessible following this inventory by the Gulf of Mexico Energy Security Act of 2006.

[202] Energy Information Administration, Impacts of Increased Access to Oil and Natural Gas Resources in the Lower 48 Federal Outer Continental Shelf (2007), available at http://www.eia.doe.gov/oiaf/aeo/otheranalysis/ongr.html.

[203] Id.

[204] Energy Information Administration, Analysis of Crude Oil Production in the Arctic National Wildlife Refuge (May 2008), available at http://www.eia.doe.gov/oiaf/servicerpt/anwr/index.html. See also Testimony of Athan Manuel before the Select Committee on Energy Independence and Global Warming, "The Future of Oil" at 3-4 (June 11, 2008).

[205] Conventional oil is crude oil and natural gas liquids produced from underground reservoirs by means of conventional wells. Non-conventional oil includes oil shales, oil sands, and extra-heavy crude.

[206] Energy Information Administration, Long-term Global Oil Scenarios: Looking Beyond 2030 (Slide presentation by Glen Sweetnam from EIA 2008 Energy Conference, April 7, 2008) (EIA uses 20.6 trillion barrels as its base case.).

[207] International Energy Agency, supra note 189, at 88.

deepwater fields which may have shorter lifespans than traditional fields.[208] Further, a growing share of reserve additions are coming from revised appraisals of existing fields, not the discovery of new fields. Even with advances in technology, the average size of discoveries per exploratory well is around 10 million barrels, which is half the output of wells dug between 1965 and 1979.[209]

OPEC's oil production capacity has not kept up with demand growth and has actually fallen over the past 25 years, from 38 mbd in 1979 to roughly 31 mbd today. Yet, for the world to reach the 2030 oil supply targets offered by IEA and EIA, roughly 60 percent of new supplies would need to come from OPEC. More than half of that volume is projected to come from just three countries whose relations with the United States are, at a minimum, strained and whose own domestic stability is questioned by many: Iraq, Iran, and Saudi Arabia.

In short, the shrinking margin between stagnant supply and soaring demand provides yet another reason that the United States and the world need to begin to look beyond oil to meet our growing energy needs.

2. The Electricity Challenge

The U.S. power sector is facing rapid and sustained growth in demand over the coming decades. EIA projects that electricity demand will grow by 29 percent from 2006 to 2030,[210] as compared with a projected 23 percent growth in the U.S. population.[211] Most of the predicted demand growth is in the commercial and residential sectors, with 49 and 27 percent projected growth, respectively. This increase in demand is fueled by a combination of population growth, population shifts towards warmer regions with higher cooling needs, and increasing reliance on electrically powered appliances and equipment. EIA estimates that this increase in demand, together with the expected retirement of 45 gigawatts of generating capacity, will require the construction of 263 gigawatts of new capacity (or equivalent increases in efficiency above and beyond predicted increases).[212] The largest portion of new capacity will be needed in the southeast (characterized by rapid population growth and high cooling needs).[213]

Rapidly growing demand together with underinvestment in transmission infrastructure is creating concerns about the reliability of the electrical grid. A number of steps have been taken to increase grid reliability in the wake of the 2003 blackouts in the northeast. However, transmission congestion remains a problem and the margin between capacity and demand is growing thinner in many regions of the country—notably the Midwest, Southwest, and

[208] Matthew R. Simmons, Simmons & Company International, The 21st Century Energy Crisis Has Arrived (Presentation to the CFA Society of Atlanta: April 16, 2008).
[209] International Energy Agency, World Energy Outlook 2006 at 90 (2006).
[210] EIA AEO 2008, supra note 191, at 67.
[211] See U.S. Census Bureau, Interim Projections of the Total Population of the United States and States: April 1, 2000 to July 1, 2030, available at http://www.census.gov/population/projections/SummaryTabA1.pdf.
[212] EIA AEO 2008, supra note 191, at 68.
[213] EIA AEO 2008, supra note 191, at 69.

California—creating concerns about the potential for brownouts or blackouts in the next several years.[214]

Retail electricity prices have seen a steady upward march over the last decade—due to rising fuel and infrastructure costs. Prices have increased from an average of 6.81 cents per kilowatt hour in 1999 to 9.14 cents in 2007—a 34 percent rise.[215] Larger and faster upticks in prices are expected in many areas of the country due to rising costs of coal and natural gas, among other factors.

Electricity generation is heavily dependent on water, and growing water scarcity due to climate change will constrain power generation in many areas here in the United States and abroad. Power plants that convert thermal energy into electricity—primarily coal, natural gas, oil, and nuclear power plants—currently produce 90 percent of U.S. electricity and consume massive amounts of the country's fresh water supply for steam generation and cooling. Hydroelectric power, which accounts for another 7 percent of U.S. power generation, is of course highly dependent on water flow. As the Select Committee heard from Dan Keppen of the Family Farm Alliance in a July 10, 2008 hearing entitled "Global Warming Effects on Extreme Weather," water used by electric utilities accounts for 20 percent of all the non-farm water consumed in the United States. This figure could rise to 60 percent by 2030, with fast-growing regions like the Southwest and Southeast hit the hardest. Over the last two years, decreased river flow and increased water temperatures already have led to shut-downs of nuclear power plants in the southeastern United States. These problems will be exacerbated as global warming increases temperatures and water scarcity.

The overall fuel mix for power generation in the United States has remained relatively stable over the past decade. Coal remains the leading fuel source, accounting for 49 percent of generation, followed by natural gas with 21 percent, and nuclear with 19 percent. Hydroelectric power accounts for 6 percent, and non-hydro renewables (wind, solar, and geothermal) provide 2.4 percent.[216]

The construction of new generating capacity, however, suggests a shift towards heavier reliance on natural gas and an explosion in wind power. In 2007, natural gas accounted for 56 percent of all new generating capacity, wind accounted for over 30 percent, and coal accounted for just 9.5 percent—with oil and hydro making up the balance.[217] Shattering all its previous records, the wind energy industry installed 5,244 megawatts in 2007, expanding the nation's total wind power generating capacity by 45 percent in a single calendar year and injecting an investment of over $9 billion into the economy.[218]

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[214] See generally North American Electric Reliability Corporation, 2007 Long-term Reliability Assessment (Oct. 2007).
[215] Energy Information Administration, Average Retail Price of Electricity to Ultimate Customers: Total by End-Use Sector (Aug. 25, 2008), available at: http://www.eia.doe.gov/cneaf/electricity/epm/table5_3.html.
[216] Energy Information Administration, Annual Energy Review 2007, at 224-26 (2008).
[217] Energy Information Administration, Electric Power Annual with data for 2006, at Table 2.4 (Planned Nameplate Capacity Additions from New Generators, by Energy Source, 2007 through 2011) (2007), available at http://www.eia.doe.gov/cneaf/electricity/epa/epat2p4.html.
[218] American Wind Energy Association, AWEA 2007 Market Report (2008), available at http://www.awea.org/projects/pdf/Market_Report_Jan08.pdf.

Meanwhile, there are substantial obstacles to expansion of coal and nuclear generation—two of the mainstays of the current U.S. generation portfolio.

Coal

Coal remains a key fuel for the electric power sector, both for the United States and the rest of the world. Often referred to as the Saudi Arabia of coal, the United States has the largest coal reserves in the world (27 percent of global reserves) and produces over a billion short tons of coal annually. Over 90 percent of U.S. coal consumption is used for electricity generation. It is frequently asserted that U.S. reserves are sufficient to last 250 years at current rates of consumption, though a recent National Research Council report emphasized that this estimate could not be confirmed and some question whether full recovery is feasible.[219] China and India, two of the largest, fastest growing economies in the world, have large reserves and rely on coal for most of their electricity generation (79 percent for China and 68 percent for India).

Coal presents a serious challenge from the perspective of global warming. Because of coal's high carbon content, coal-fired power plants emit roughly twice as much carbon dioxide per unit of electricity as natural gas-fired plants. Existing coal-fired plants account for about a third of U.S. CO_2 emissions. Projected business-as-usual expansion in conventional coal-fired power plants would make achievement of our climate goals impossible. Absent limits on CO_2 emissions, EIA estimates that over half of new capacity added by 2030 will be provided by coal-fired generation. If constructed without carbon controls, these new coal-fired plants alone would increase U.S. greenhouse gas emissions by over 10 percent. Globally, an estimated 1.4 million megawatts of new coal-fired generating capacity is expected to be built by 2030—the lion's share in China and India. If built without carbon controls, these plants alone would increase global greenhouse gas emissions by roughly 30 percent above present levels.

Here in the United States, there has been a major slowdown in construction of new coal-fired power plants. According to one tally, 59 coal-fired power plant projects were cancelled in 2007 alone,[220] and the pace of cancellations has continued in 2008. Of the 36,000 megawatts of new coal-fired generating capacity predicted to be constructed between 2002 and 2007, only around 4,500 megawatts were actually built.[221] This slowdown was due in large part to public and regulatory opposition related coal plants' emissions of CO_2 as well as conventional pollutants, such as mercury. This opposition, together with uncertainty about future climate regulation, is making it increasingly difficult for new coal-fired power plants to secure financing. For example, in February 2008, three of what were then Wall Street's biggest investment banks issued standards requiring utilities seeking financing for coal-fired power plants to demonstrate that the plants will be economically viable even with stringent federal controls on CO_2 emissions.[222]

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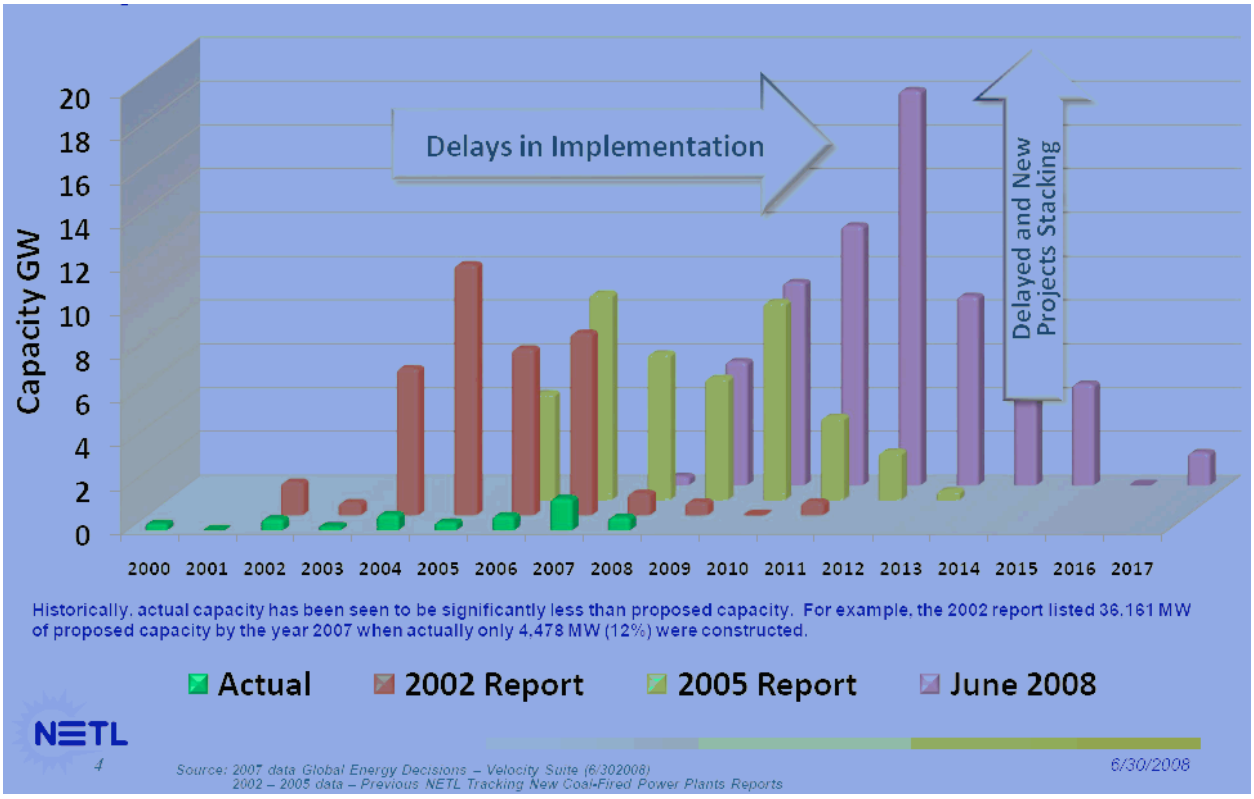
[219] See National Research Council, Coal: Research and Development to Support National Energy Policy at 3 (2007).
[220] See Coal Moratorium Now, Progress Towards a Coal Moratorium 59 Coal Plants Cancelled or Shelved in 2007, available at http://cmnow.org/59plants.pdf.
[221] National Energy Technology Laboratories, Tracking New Coal-Fired Power Plants, June 30, 2008, at 5, available at http://www.netl.doe.gov/coal/refshelf/ncp.pdf.
[222] See, e.g., Jeffrey Ball, "Wall Street Shows Skepticism Over Coal: Banks Push Utilities To Plan for Impact Of Emissions Caps," Wall Street Journal, Feb. 4, 2008, at A6.

Past Announcements vs. Actual Construction of Coal-Fired Power Plants



Source: National Energy Technology Laboratories, Tracking New Coal-Fired Power Plants (June 30, 2008).

Nuclear Power

While some are forecasting a nuclear "renaissance", a massive wave of construction in the next two decades would be necessary just to maintain nuclear power's current share of U.S. electricity generation. For nuclear power to maintain its current 19 percent share of U.S. electricity supply, around 50 new nuclear plants will need to be constructed by 2030. For nuclear power to grow to supply 30 percent of U.S. electricity, more than 100 reactors would need to be built by 2030.

A large and sustained expansion in nuclear generation is unlikely in light of the major hurdles facing the industry. The Nuclear Regulatory Commission expects to receive applications for 34 new nuclear power plants by the end of 2009.[223] Until this year, it had been three decades since a new application had been submitted. The last reactor completed in the United States came online in 1996 after a construction period of 23 years. A pattern of cost overruns and construction delays drove private investors away from nuclear energy in the 1970s.

[223] EERE Network News, NRC Expects Applications for 34 Nuclear Power Plants by 2010 (July 16, 2008), available at http://apps1.eere.energy.gov/news/news_detail.cfm/news_id=11876.

Cost projections for new nuclear power plants have increased dramatically—in many cases surpassing the total value of the electric utility—making it extremely unlikely new plants can be financed without taxpayer-backed loan guarantees. Just a few years ago, the nuclear industry was projecting a new 1,000 megawatt reactor would cost around $2 billion. A 2007 Keystone Center study found costs for the same plant could reach $4 billion. New plants are now expected to cost $6-8 billion each, a figure which approaches or exceeds the total market capitalization of many electric power companies.[224] For the 67 nuclear plants that have come online in the United States since 1976, on average more than 13 years passed between when a new plant application was officially accepted by the Nuclear Regulatory Committee and when the plant began commercial operation.[225]

In light of these costs and risks, it remains in doubt whether private financing will be available for any new nuclear facilities without the assurance of federal government guarantees on the loans. The Congressional Budget Office estimates the risk of default on these loans to be "very high—well above 50 percent."[226] The Department of Energy has received applications for federal loan guarantees from 21 proposed nuclear power plants. But the $122 billion in requested assistance far surpasses the $18.5 billion Congress made available in loan support. The director of the Department of Energy's loan program office has stated that $18.5 billion could probably accommodate only two power plants.[227]

The Nuclear Energy Institute (NEI) has stated that additional financing from French and Japanese government export credit agencies, in exchange for agreements on the sourcing of reactor components, could—in conjunction with the federal loan guarantees—increase the number of nuclear plants receiving loan guarantees to three or four.[228] At no time "in the immediate future" does NEI anticipate private companies will be able to finance new nuclear plants without the aid of federal loan guarantees.[229]

Meanwhile, the United States has not found a solution to the problem of long-term disposal of spent nuclear fuel. Approximately 56,000 metric tons of high-level nuclear waste is stored at 65 operating and 9 decommissioned reactor sites around the country. Without any expansion in the current fleet, spent fuel waste will grow to more than 80,000 metric tons by the end of existing reactor licenses, and would expand to over 120,000 metric tons if all current licenses are renewed.[230] The Yucca Mountain facility has been plagued by delays, cost overruns, serious questions about safety, and political opposition. The Department of Energy projects that

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[224] Nuclear Energy Institute response to follow-up questions submitted by Rep. Markey after the June 19, 2008, hearing on climate change in the Energy and Air Quality Subcommittee of the House Committee on Energy and Commerce. Frank Bowman, President and CEO of the Nuclear Energy Institute, testified during that hearing. Received Oct. 21, 2008.

[225] Id.

[226] Congressional Budget Office, Cost Estimate, S.14, Energy Policy Act of 2003, at 11 (May 7, 2003), available at http://www.cbo.gov/ftpdocs/42xx/doc4206/s14.pdf.

[227] Katherine Ling, "Nuclear Power: 17 apply for DOE loan guarantees, far exceeding available cash," Greenwire, Oct. 2, 2008.

[228] Nuclear Energy Institute, supra note 224.

[229] Id.

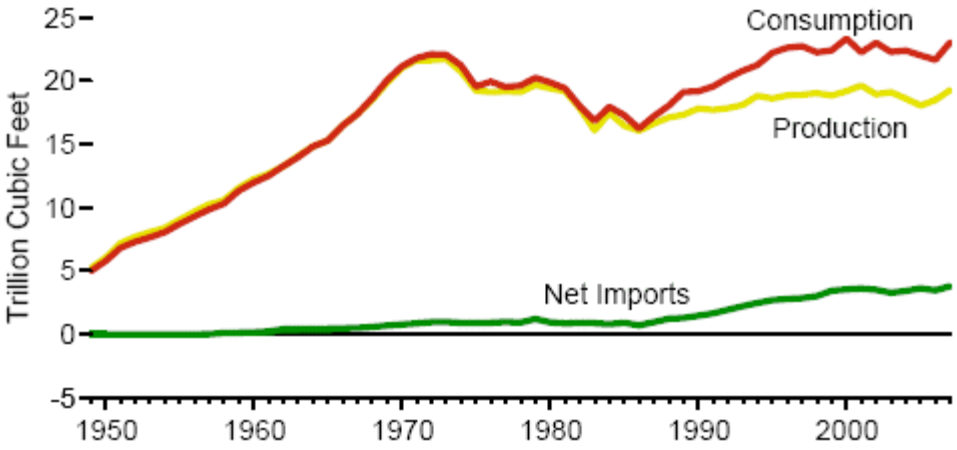
[230] The Keystone Center, Nuclear Power Joint Fact-Finding at 75 (June 2007), available at http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf.

it will open no earlier than 2017, and there are substantial doubts as to whether it will ever do so. Even if it is opened, Yucca Mountain will have a 70,000 metric ton capacity, making it is insufficient to accommodate all the waste from existing facilities. An expansion of 45 to 100 additional reactors would require the construction of another Yucca Mountain-sized facility every 17-24 years for as long as the fleet was in operation. Without resolution of the waste disposal issue, it is difficult to see how a significant expansion of nuclear power can proceed.

3. The Natural Gas Challenge

The United States accounts for over 22 percent of global consumption of natural gas, but has only 3.4 percent of global reserves. However, domestic production satisfies 80 percent of U.S. demand—and over 80 percent of U.S. imports come from Canada. Although there is slightly greater geographic distribution of natural gas reserves around the world than oil, the majority of natural gas reserves are still concentrated in relatively few countries—notably Russia (27.2 percent of global reserves), Iran (15.3 percent), and Qatar (14.6 percent).[231] According to EIA, U.S. annual consumption of natural gas in 2007 was 23 trillion cubic feet or 63 billion cubic feet per day. Of that, the United States imports about 4.6 trillion cubic feet—approximately 20 percent. In 2007, 83 percent of U.S. natural gas imports came from Canada by pipeline. Liquefied natural gas (LNG) imports in 2007 totaled about 770 billion cubic feet—just over 3 percent of U.S. consumption.[232]

U.S. Natural Gas Consumption, Production, and Net Imports



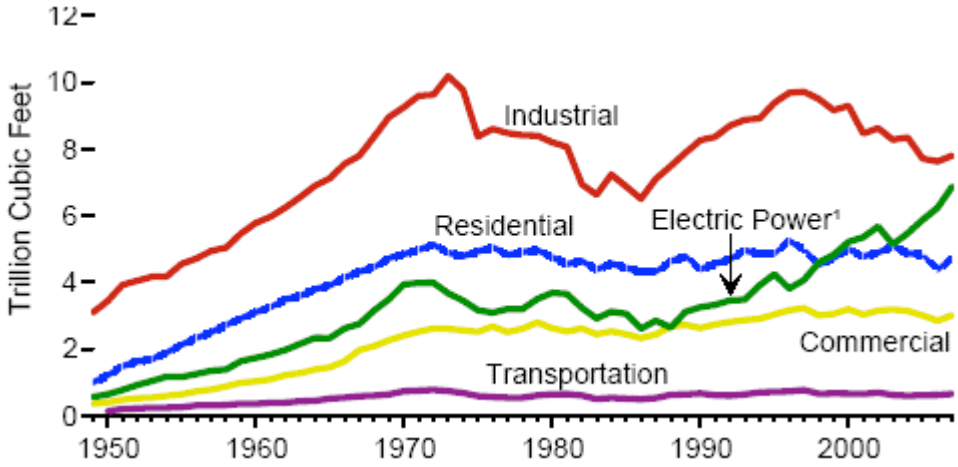
Source: Energy Information Administration, Energy Perspectives (2008) (Figure 34), available at http://www.eia.doe.gov/emeu/aer/ep/ep_frame.html.

Natural gas has become the fuel of choice for new power plants in the United States, because of its low emissions of CO_2 and conventional air pollutants in comparison with coal. In addition, natural gas plays a critical role as a feedstock and fuel for U.S. manufacturing.

[231] Energy Information Administration, International Energy Outlook 2008, at 44 (Table 6) (2008), available at http://www.eia.doe.gov/oiaf/ieo/pdf/nat_gas.pdf.
[232] Energy Information Administration, U.S. Natural Gas Imports by Country, available at http://tonto.eia.doe.gov/dnav/ng/ng_move_impc_s1_a.htm.

The four main consumers of natural gas in the United States are electricity generation (30 percent), and the residential (20 percent), commercial (13 percent), and industrial (29 percent) sectors.[233] Natural gas accounted for 55 percent of new generating capacity built in the United States in 2007. In addition, over half of U.S. homes are heated or cooled with natural gas, and over 70 percent of new homes are designed to use natural gas for space heating.[234] In the commercial sector, the primary uses of natural gas are also space heating and cooling and water heating. Industrial consumption of natural gas is focused primarily in the pulp and paper, metals, chemicals, petroleum refining, stone, clay and glass, plastic, and food processing industries—including as a feedstock for the manufacturing of a wide range of products, such as fertilizer.

U.S. Natural Gas Consumption by Sector



Source: Energy Information Administration, Energy Perspectives (2008) (Figure 37), available at http://www.eia.doe.gov/emeu/aer/ep/ep_frame.html.

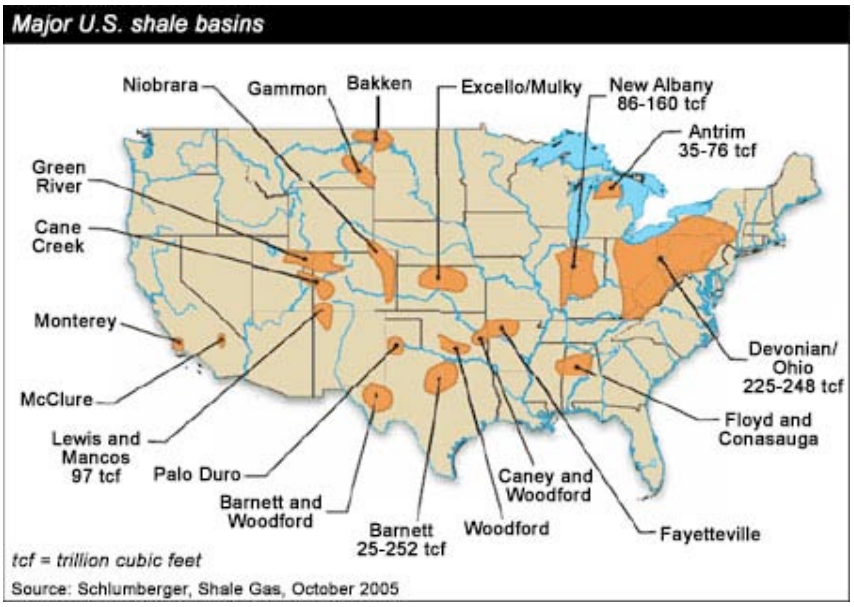
There has been a substantial increase in natural gas prices over the past several years, which has had an adverse effect on U.S. manufacturers that depend on this resource. The average annual Henry Hub spot price in 2007 was $6.97 per million Btu—more than double the average annual price of $3.36 in 2002.[235] Rising natural gas prices have had a serious adverse impact on the U.S. manufacturing sector, particularly in specific sectors like fertilizer production. At the Select Committee's July 30, 2008 hearing entitled "What's Cooking With Gas?: The Role of Natural Gas in Energy Independence and Global Warming Solutions," Rich Wells of The Dow Chemical Company testified that natural gas price increases over the past eight years have "contributed significantly to the US manufacturing sector losing over 3.7 million jobs, the chemical industry losing nearly 120,000 jobs, and the permanent loss of nearly half our fertilizer production capacity."

[233] Energy Information Administration. Natural Gas Consumption by End Use, at http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm.
[234] Natural Gas Supply Association, Natural Gas Overview Residential Uses, available at http://www.naturalgas.org/overview/uses_residential.asp (last accessed on October 26, 2008).
[235] Energy Information Administration, Natural Gas Year-In-Review 2007 (Mar. 2008).

Fortunately, U.S. natural gas production from "unconventional" onshore sources—principally shale resources—is increasing rapidly and has the potential to provide substantial new resources and to relieve pressure on prices. In the past few years, U.S. natural gas production has increased after a decade of essentially flat production. EIA predicts that production will continue to increase for the next few years if demand and prices stay high.[236] This increase has come in large part from the development of unconventional resources, which now are the source of 47 percent of U.S. natural gas production. New drilling technologies, especially horizontal drilling and hydraulic fracturing, have allowed the extraction of natural gas from geologic formations that could not be tapped with traditional techniques. In the western United States, there has been a dramatic increase in production of natural gas associated with coal deposits, so-called coalbed methane.

Shale formations are growing in importance for natural gas production. They are widely distributed, large, and contain huge resources of natural gas, but are just starting their full development. According to the EIA, the production from one Barnett Shale field in Texas alone contributes more than 6 percent of production from the lower 48 States, which is more than from Louisiana, one of the largest producing states.[237] Since 2005, more shale resources have been discovered including the recent announcement by Chesapeake Energy of the Haynesville field located in East Texas and Louisiana. The company says wells drilled on its leases could produce as much as 44 trillion cubic feet of natural gas—nearly twice what the United States consumed last year.[238] Based on their National Oil and Gas Assessment, the U.S. Geological Survey estimates that in "continuous resources," which are typically unconventional formations like shales, there is 328 trillion cubic feet of natural gas[239] or approximately 14 years of resources at current consumption levels.

[236] Energy Information Administration, "Is U.S. natural gas production increasing?" (June 2008), available at http://tonto.eia.doe.gov/energy_in_brief/natural_gas_production.cfm
[237] Id.
[238] Ben Casselman, "Chesapeake, Plains Set to Tap Gas Field," Wall Street Journal, July 3, 2008.
[239] Calculation based on mean vales for the regional assessments from the USGS National Oil and Gas Assessment, available at http://energy.cr.usgs.gov/oilgas/noga/.



Development of these unconventional resources has raised concerns over water quality and availability that may reduce production in some parts of the country. Hydraulic fracturing requires the injection of large amounts of water, which can include dangerous contaminates and threaten underground drinking water supplies.[240] Coalbed methane production releases saline water from the coal seams that can also contain arsenic, lead and other heavy metals[241] and must be dealt with properly to avoid contamination of water supplies or destruction of pasture as has occurred in some areas of Wyoming.[242] In some areas of the country, water supply systems are struggling to meet the demands of increased natural gas production on top of existing drinking and agriculture usage.[243]

Construction of the Alaska Natural Gas Pipeline could bring online a substantial new source of domestic supply. Alaska's North Slope has massive natural gas resources, with potential recoverable reserves estimated at 100 trillion cubic feet.[244] Proposals for a natural gas pipeline to transport this "stranded" resource to markets in the lower 48 States—over 3000 miles via Alberta, Canada to Chicago—have been discussed for over two decades. In 2004, Congress enacted the Alaska Natural Gas Pipeline Act, which, among other things, authorized $18 billion in loan guarantees to support construction of the pipeline. As natural gas prices have risen over the past decade, interest in development of a pipeline has likewise increased. The State of Alaska has established its own framework for promoting the pipeline—awarding a license to build the pipeline to TransCanada Corporation in August 2008 with $500 million in state support. Nevertheless, the ultimate fate of the pipeline—estimated to cost up to $40 billion—

[240] Steve Hargreaves, Natural gas vs. contaminated water, CNNMoney.com, July 29, 2008, at http://money.cnn.com/2008/07/28/news/economy/_shale_drilling/index.htm.
[241] U.S. Geological Survey, Fact Sheet FS-156-00, Water Produced With Coal Bed Methane (Nov. 2000), available at http://pubs.usgs.gov/fs/fs-0156-00/fs-0156-00.pdf.
[242] Hal Clifford, Wyoming's powder key, High Country News, Nov. 5, 2001, available at http://www.hcn.org/issues/214/10823.
[243] Vickie Welborn, "Competition for Water Raises Concerns" Shreveport Times, August 8, 2008
[244] William F. Hederman, Congressional Research Service, "The Alaska Natural Gas Pipeline: Status and Current Policy Issues," No. RL34671, at 9 (Sept. 12, 2008).

remains unclear.[245] If built, the pipeline at full initial capacity could deliver 4.5 billion cubic feet per day of natural gas to the lower 48—equivalent to 7 percent of current domestic consumption.[246]

By contrast, recent proposals to open new areas of the Outer Continental Shelf for gas production are unlikely to lead to substantial new production or to significant downward pressure on prices. According to EIA, total U.S. proven natural gas reserves—resources that have been identified and tested and either have been or will be developed—were 211 trillion cubic feet at the end of 2006. Of the total U.S. proven natural gas reserves, 15 trillion cubic feet or about 7 percent were Outer Continental Shelf (OCS) offshore reserves. EIA estimates that 73 percent of these technically recoverable natural gas resources in the OCS (or all but 2 percent of total proven natural gas reserves) are available for leasing and development.[247] Furthermore, EIA's analysis found that "lower 48 natural gas production is not projected to increase substantially by 2030 as a result of increased access to the OCS."[248]

[245] See, e.g., Serge Kovaleski and Mike McIntire, "Palin's Pipeline Is Years From Being A Reality," New York Times, Sept. 10, 2008.
[246] William F. Hederman, Congressional Research Service, "The Alaska Natural Gas Pipeline: Status and Current Policy Issues," No. RL34671, at 5 (Sept. 12, 2008).
[247] Energy Information Administration, Impacts of Increased Access to Oil and Natural Gas Resources in the Lower 48 Federal Outer Continental Shelf (2007), available at http://www.eia.doe.gov/oiaf/aeo/otheranalysis/ongr.html
[248] Id.

II. ENERGY AND CLIMATE "WIN-WIN" SOLUTIONS

Global climate change and energy security are inextricably intertwined and together present one of the greatest challenges in the history of the United States and the world. To preserve our planetary home for ourselves and future generations, we must move swiftly to slash greenhouse gas emissions in the next couple decades. Ultimately, we must achieve global reductions of at least 50-85 percent by mid-century, requiring U.S. emissions to be cut by at least 80 percent in that time frame. At the same time, to preserve the United States' economic stability and national security, it is imperative that we move quickly to achieve energy independence. That can only be done by revolutionizing our transportation system to wean ourselves of oil, and by ramping up efficiency and clean electricity generation to power our growing economy.

The challenge facing America—and the core mission of the Select Committee—is to identify "win-win" solutions that simultaneously enhance energy security and combat global warming. Climate solutions are by necessity energy solutions: Energy production and consumption generate the vast majority of U.S. and global greenhouse gas emissions, and it is only by transforming our energy system that we will achieve the cuts needed to halt global warming. Fortunately, most of the leading technological solutions to global warming will substantially enhance energy security—including, most notably, boosting energy efficiency in the electric power, transportation, and buildings sectors, expanding renewable electricity generation, developing and deploying carbon capture and sequestration, expanding advanced biofuels production, and moving towards electric-drive vehicles. These are true "win-win" solutions.

The same cannot be said of some of the purported energy security solutions currently on the table. Notably, increasing our reliance on high-carbon fuels, such as coal-to-liquids, tar sands, or tar shale, may increase the domestic energy supply, but could greatly hinder our efforts to reduce greenhouse gas emissions. Increased domestic production of oil and natural gas can provide a "bridge" measure to help alleviate dependence on foreign oil in the medium-term, but its impact will be limited at best and it moves us no closer to solving the climate crisis. To the extent that a narrow focus on drilling distracts us from the larger challenges that are facing us, it will undermine our long-term energy and economic security.

This part lays out a series of recommendations—identifying "win-win" solutions that should be the priorities for enactment by the 111th Congress. The first and most overarching of these is the enactment of economy-wide "cap-and-invest" legislation that will simultaneously cut global warming pollution, protect American consumers, and channel private and public investment towards low-carbon energy technologies. In addition, we identify a series of sector-specific complementary measures—for the electric power sector, the built environment, and the transportation sector—that will support and enhance low-carbon energy technology development and deployment in these sectors.

In addition, in the Section entitled "Support Green Jobs and Clean Tech Investment," the report highlights the prospects for economic growth and green job creation these policies will

bring. As the United States is facing one of the most serious economic crises in history, this blueprint for change provides the key to jumpstart a powerful engine of economic recovery and development.

Finally, in the last two sections, the report identifies a series of measures needed to provide American consumers with short-term relief from high energy prices and to help guide the responsible development of domestic oil and gas resources while the United States brings alternative energy sources online.

A. ENACT ECONOMY-WIDE "CAP-AND-INVEST" LEGISLATION

The number one priority for energy security and climate change in the 111th Congress should be the adoption of economy-wide "cap-and-invest" legislation that will combat climate change while spurring an energy technology revolution. A number of proposals were introduced in the 110th Congress that provide useful precedents and ideas from which the next Congress can draw. These include:

- H.R. 6186, the Investing in Climate Action and Protection Act (iCAP), introduced by Mr. Markey
- The October 2008 climate legislation discussion draft circulated by Mr. Dingell and Mr. Boucher
- S. 3036, Lieberman-Warner Climate Security Act, introduced by Sen. Boxer
- H.R. 6316, the Climate MATTERS Act, introduced by Mr. Doggett
- H.R. 1519, the Safe Climate Act, introduced by Mr. Waxman
- S. 1766, the Low Carbon Economy Act, introduced by Sen. Bingaman and Sen. Specter

Based upon the Select Committee's work during the 110th Congress, balanced and workable climate legislation should adhere to the following design principles:

1. **Science-Based Emission Targets**: Reduce U.S. global warming pollution by at least 20 percent by 2020 and at least 80 percent by 2050, the necessary U.S. contribution to stabilize atmospheric concentrations of heat-trapping gases and avoid dangerous global warming.
2. **Economy-Wide, Market-Based, Cap-and-Trade Approach**: Utilize an economy-wide cap-and-trade system as the principal mechanism for achieving our emissions reduction targets.
3. **Ensure Effectiveness and Fairness Through Auctions:** Auction pollution allowances, instead of giving them free-of-charge to polluters, to avoid windfall profits to polluters, ensure fairness, and reduce social costs.
4. **Consumer Focused**: Return a substantial portion of the auction proceeds to low- and middle-income households to help compensate for any increase in energy costs as a result of climate legislation.
5. **Invest in Efficiency, Technology, and American Workers**: Make substantial investments to spur increases in energy efficiency and the development and deployment of low-carbon technologies, and to help American workers transition to the new low-carbon economy.

6. **Ensure Global Participation**: Include an integrated package of "carrots" and "sticks" to ensure that major-emitting developing countries, like China and India, take comparable action on global warming—and to avoid negative effects on the competitiveness of U.S. industry.
7. **Smart Offsets and Incentives for Supplemental Emission Reductions**: Establish rigorous standards governing the award of offset credits and provide robust financial incentives for supplemental reductions in "uncapped" emissions not eligible to generate offset credits.
8. **Rigorous Market Oversight**: Establish a rigorous framework for market oversight and regulation to ensure transparency, fairness, and stability in the market for emission allowances, offset credits, and the derivatives thereof.
9. **Build Resilience to Climate Change Impacts**: Build resilience to unavoidable impacts of climate change, both in the United States and in vulnerable developing countries. This must include investment in the necessary capacity to provide a robust Earth observation and prediction system.
10. **Integrate Complementary Policies and State and Local Roles**: Integrate cap-and-invest with complementary policies to overcome market barriers and reduce the overall cost of climate legislation, and preserve appropriate roles for State and local action on climate change.

1. Reduce U.S. global warming pollution by at least 20 percent by 2020 and at least 80 percent by 2050, the necessary U.S. contribution to stabilize atmospheric concentrations of heat-trapping gases and avoid dangerous global warming.

It is imperative that any proposal ensure that the United States meets science-based emissions reduction targets to avoid impacts of dangerous global warming. According to the IPCC's Fourth Assessment Report, stabilizing greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous interference with the climate system will require a global effort to reduce anthropogenic greenhouse gas emissions worldwide by at least 50 to 85 percent below 2000 levels by 2050.[249] The IPCC and others estimate that, to play its part, the United States must reduce its total emissions by at least 80 percent from current levels over that timeframe.[250] Establishing stringent near-term reduction targets will be essential to achieving adequate cumulative emission reductions, and to ensuring that long-term reduction targets are achieved in a cost-effective manner. At minimum, U.S. emissions should be reduced by 20 percent by 2020. A comprehensive climate proposal should also provide a mechanism for periodic review, whereby the United States' emissions reduction goals may be strengthened if the latest scientific information dictates that it is necessary.

[249] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change, Summary for Policymakers at 15 (Table SPM.5) (2007).
[250] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change, Summary for Policymakers at 38-39 (Table TS.2) (2007); Amy L. Luers et al. (Union of Concerned Scientists), How to Avoid Dangerous Climate Change: A Target for U.S. Emission Reductions (Sept. 2007), available at http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/a-target-for-us-emissions.html.

2. Utilize an economy-wide, market-based cap-and-trade system as the principal mechanism for achieving emissions reduction targets.

A market-based cap-and-trade system is the most cost-effective mechanism to achieve deep and certain emissions reductions in the United States. Unlike traditional command-and-control regulations like emissions performance standards, a cap-and-trade system allows reductions to be made where the cost is lowest, saving compliance and administrative costs and increasing flexibility. One alternative to a cap-and-trade system is a carbon tax, which can provide an effective mechanism to incentivize economy-wide emission reductions. For example, Rep. Larson has introduced H.R. 3416, the "America's Energy Security Trust Fund Act," an economy-wide carbon tax bill which is discussed in Rep. Larson's additional views, appended to this report. A cap-and-trade system has the advantage of guaranteeing a specified level of emissions reductions over a given timeframe—which is essential given the gravity of the impending climate crisis.

To lower the overall cost of climate legislation, ensure fairness, and avoid perverse incentives, as many sources of emissions as is practicable should be included in the cap-and-trade program. Of course, it is not practicable or cost-effective to include all sources in such a program. Examples of categories that, because of administrative costs and difficulty, should not be under the cap include: (1) sources for which measurement of emissions is exceedingly difficult, and (2) categories that comprise very numerous sources, have very low emissions at each source, and are not susceptible to regulation at an "upstream" choke point (see discussion below). For these reasons, emissions from landfills, wastewater treatment facilities, coal mines, and small farms and agricultural soil management, for example, should be excluded from the cap—though some of these sources are readily susceptible to regulation through performance standards. Select Committee staff research indicates that 87 percent of U.S. emissions can be included in a cap-and-trade system, including virtually all emissions from the industrial, energy, and transportation sectors.

Two additional important choices must be made—the point at which to regulate the "capped" emissions and the emissions threshold that determines whether a source is included or not included in the cap. Each emissions stream may be capped upstream, downstream, or midstream. An "upstream" cap places the point of regulation with the point-of-entry of fossil fuels or fluorinated industrial greenhouse gases (like HFCs, PFCs, SF_6, or NF_3) into commerce in the United States. A "downstream" cap is one in which the point of regulation coincides with the point of emissions of greenhouse gases. A "midstream" cap places the cap somewhere in between. For example, emissions from coal combustion could be regulated upstream at the coal mines or downstream at the electric power or industrial facilities burning the coal. Similarly, emissions from transportation could be regulated upstream at the refineries or (theoretically) downstream at the level of individual car, plane, train, and ship owners. Natural gas offers even more options: upstream at the wellheads, downstream at the electric power, industrial, commercial, or residential users of the gas, or midstream at the natural gas processing plants or natural gas distribution companies. Most current proposals employ some combination of upstream, downstream, and midstream caps.

Many economists favor upstream caps because they reduce the number of points of regulation, and therefore—it is argued—reduce administrative costs.[251] Nevertheless, downstream caps for power plants and large industrial point sources generally are preferable, because these entities directly control the decisions that affect the emissions-intensity of their operations. If emissions thresholds are set correctly, the number of covered sources is manageable. And in the case of electric power plants, these entities also typically already monitor their CO_2 emissions and have experience with other market-based approaches to environmental protection.[252] Downstream caps are not feasible for the transportation sector or for industrial gases, which are characterized by a vast number of dispersed emission sources. Combustion of natural gas in the residential and commercial sectors poses a unique problem. It is not advisable to place an upstream cap on natural gas processing plants, as at least one legislative proposal this Congress has done. Doing so would eliminate coverage of emissions from the use of "pipeline-quality" gas, which is not processed and currently represents at least 25 percent natural gas produced in the United States.[253] Creating this loophole could encourage increased production of pipeline quality gas, further decreasing the cap's coverage.

To maximize emissions coverage while reducing administrative complexities, a mixed approach including upstream and downstream caps is recommended. This approach would include the following:

- Power Plants and Industrial Facilities: A downstream cap on power plants and industrial facilities;
- Transportation and Other Liquid- and Gaseous Coal or Petroleum-Based Fuels: An upstream cap on producers or importers of petroleum- or coal-based liquid or gaseous fuels—capturing most of the emissions attributable to the transportation sector, as well as those attributable to home heating oil and oil-fired electric generating units;
- Fluorinated Gases: An upstream cap is placed on producers or importers of HFCs, PFCs, SF_6, or NF_3;
- Residential and Commercial Natural Gas Use: A midstream cap on natural gas local distribution companies—capturing emissions from residential and commercial use of natural gas; and
- Geological Carbon Sequestration Sites: A downstream cap carbon capture and sequestration sites to capture any leakage of carbon dioxide.

To avoid double-counting of emissions, (1) industrial facilities and electric utilities should not be required to submit allowances for any emissions resulting from the use of petroleum- or coal-based liquid or gaseous fuels; (2) natural gas local distribution companies should not be required to submit allowances for emissions resulting from combustion of any natural gas delivered to industrial facilities and electric utilities subject to the program; and (3) industrial facilities and

[251] Robert N. Stavins, "Addressing climate change with a comprehensive U.S. cap-and-trade system," ENRP Discussion Paper 2008-01, Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Cambridge, MA (Jan. 2008); Robert Repetto, "National Climate Policy: Choosing the Right Architecture", Yale School of Forestry and Environmental Studies (June 2007).

[252] CERA Advisory Service/North American Environmental Startegies (for Edison Electric Institute and National Commission on Energy Policy), "Design Issues for Market-Based Greenhouse Gas Reduction Strategies" (Feb. 2006).

[253] Select Committee Majority staff communication with Department of Energy staff.

power plants should not be required to submit allowances for emissions of HFCs, PFCs, SF_6, or NF_3 that are purchased for use at the facility.

The second choice to be made is what level of emissions from a given source should trigger compliance responsibilities. This choice of emissions threshold affects both the number of facilities with compliance obligations and the aggregate emissions covered under the cap. To maximize emissions coverage while limiting administrative costs, a fair test is that entities that do not emit 10,000 metric tons CO_2-equivalent of greenhouse gases annually should not be required to submit allowances. A 10,000 metric ton CO_2-equivalent threshold would account for 80 percent of emissions from the manufacturing sector (while burdening only 2 percent of facilities with compliance requirements) and virtually 100 percent of emissions from the electric power sector (while burdening 35 percent of facilities) in the United States.[254] This threshold would yield approximately 10,000 regulated entities for an economy-wide program. Other proposals recommend a higher threshold of 25,000 metric tons CO_2-equivalent like the one used in the EU's reporting program. Research by the California Environmental Protection Agency indicates that in California, raising the reporting threshold from 10,000 metric ton CO_2-equivalent to 25,000 metric ton CO_2-equivalent for currently permitted facilities would decrease emissions coverage by only 2 percent, but decrease the number of affected facilities by half.[255] Similar analysis should be performed on a national level, taking into consideration the scope of the national program, before making a final determination.

3. Auction pollution allowances, instead of giving them free-of-charge to polluters, to avoid windfall profits to polluters, ensure fairness, and reduce social costs.

One of the key questions in designing a cap-and-trade system to reduce greenhouse gas emissions is how to allocate tradable allowances. This was the subject of the Select Committee's January 23, 2008 hearing entitled "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade." As a general matter, allowance allocation does not affect the achievement of the program's environmental goal; the emissions cap must be met regardless of how allowances are distributed. However, allowance allocation does significantly affect how costs and benefits are distributed, and it can also affect the system's overall cost. In addition, allocation is relevant to environmental performance insofar as auctioning and revenue recycling (or allocation of allowances for public benefit purposes) can be used to achieve reductions in emissions by sources not covered by the overall emissions cap—for example, by providing financial incentives for agricultural or forestry practices or projects that sequester carbon.

The government has long experience in auctioning public resources, whether radio spectrum or mineral rights. The ability to pollute is another public resource, and Congress, as the steward of that resource, should obtain fair value for it through auctions.

[254] Tristram West and Naomi Pena, Determining Thresholds for Mandatory Reporting of Greenhouse Gas Emissions, 37 Environmental Science and Technology 1059 (2003).
[255] California EPA/Air Resources Board, State Report: Initial Statement of Reasons for Rulemaking, Proposed Regulation for Mandatory Reporting of Greenhouse Gas Emissions at 52 (Oct. 19, 2007).

Furthermore, economic theory and real-world experience indicate that—except in certain contexts such as utilities subject to cost-of-service regulation—free allocation of allowances may lead to windfall profits for polluters.[256] This is so because, even where polluters receive allowances for free, these allowances have substantial value. As a result, a firm's decision to produce a marginal unit of electricity or other product carries with it an opportunity cost—the cost of having to submit allowances to the government equivalent to the emissions generated in producing that marginal unit, rather than selling those allowances on the open market. Many economists conclude that, except in limited circumstances, polluters can be expected to incorporate this cost into the product's price, even though they received the allowances for free. This results in a net transfer of wealth from consumers to polluters. There is growing evidence that, consistent with these predictions, free allocation under Phase I of the EU Emissions Trading System (ETS) led to windfall profits in some sectors.[257]

Auctions avoid this problem and have a number of other potential advantages as well. Auctioning eliminates the need to come up with rules for allocating allowances among incumbent polluters and accommodating new entrants into the market—and avoids "rent seeking" behavior among polluters seeking to secure free allocations. Auctioning can also provide an earlier, stronger, and clearer price signal to reduce emissions. Finally, auctions generate revenues that can be used for a variety of beneficial public purposes. Such purposes could include rebates or tax credits to reduce the program's economic impacts on consumers, reduction of distortionary taxes on labor or capital, transitional support for workers in adversely affected industries, investment in research, development, demonstration, and deployment of technologies such as renewables and carbon capture and sequestration (CCS), efficiency policies, policies that reduce emissions from sectors not subject to the cap, and investment in adaptation to the impacts of climate change.[258]

Existing market-based systems are moving towards full auctioning. The European Commission has proposed that, for Phase II of the EU ETS (2013-2016), the ETS should shift to 100 percent auctions for utilities and greatly increased reliance on auctions for industrial sources.[259] In the United States, most of the states participating in the northeastern Regional Greenhouse Gas Initiative (RGGI) have adopted full or near-full auctioning of allowances.

Auction design is critically important to ensuring market liquidity and stability. To optimize liquidity and stability, auctions should be held on a quarterly basis using forward

[256] Testimony of Dallas Burtraw, Robert Greenstein, and Peter Zapfel before the Select Committee on Energy Independence and Global Warming, hearing on "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade" (Jan. 23, 2008).
[257] Testimony of Peter Zapfel before the Select Committee on Energy Independence and Global Warming, hearing on "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade" (Jan. 23, 2008).
[258] Testimony of Dallas Burtraw, Robert Greenstein, and John Podesta before the Select Committee on Energy Independence and Global Warming, hearing on "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade" (Jan. 23, 2008).
[259] Testimony of Peter Zapfel before the Select Committee on Energy Independence and Global Warming, hearing on "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade" (Jan. 23, 2008); Commission of the European Communities, Proposal to Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gasemission allowance trading system of the Community (Jan. 23, 2008), available at http://ec.europa.eu/environment/climat/emission/pdf/com_2008_16_en.pdf.

auctioning of allowances—up to four years prior to the date of compliance obligations. Providing a regular and frequent supply of allowances to the market, some well in advance of compliance obligation deadlines, will help to reduce volatility, contain costs, increase liquidity, and increase certainty for regulated entities. A broad range of auction formats are possible, but two—the single-round, sealed-bid, uniform price format and what is known as an "ascending clock" multiple round format—have garnered support from economists working in this area.[260] RGGI's initial auction utilized the former, but future RGGI auctions may employ the latter if necessary to address evolving market conditions.[261] Auction design should incorporate mechanisms—such as bidding limits and publication of bid information, among others—to enhance transparency and reduce the potential for collusion or manipulation.[262]

4. Return a substantial portion of the auction proceeds to low- and middle-income households to help compensate for any increase in energy costs as a result of climate legislation.

Auctioning allowances allows the government to transfer the value of the allowances (i.e., auction proceeds) to low- and middle-income households to compensate for any increase in energy costs due to climate legislation. Federal climate legislation can and should avoid burdening low-income households, which spend a greater share of their income on energy costs in comparison with higher-income households. Research by the Center for Budget Policies and Priorities (CBPP) demonstrates that setting aside 14 percent of allowance value would be sufficient to compensate for increased energy costs for the 20 percent of American households with the lowest incomes.[263] The "Climate Change Rebate Act of 2008" (H.R. 7194), introduced by Select Committee member Rep. Hilda Solis, compensates households in the bottom two income quintiles for reductions in purchasing power associated with increased energy costs under climate legislation. However, middle-class households can and should be protected as well. For example, Chairman Markey's iCAP bill (H.R. 6186), which sets aside 55 percent of allowance value for this purpose, compensates virtually all increased energy costs for 66 percent of U.S. households (including all households of four earning under $70,000 per year) and provide benefits to over 80 percent of U.S. households (including all households of four earning up to $110,000 per year).

Refundable tax credits and rebates should each play a role in transferring funds to low- and middle-income households. For those households that file tax returns, refundable tax credits are a simple, efficient way to deliver funds. It is possible to design a tax credit that, like the earned income tax credit (EITC), phases in with earnings and is adjusted for family size, but would be available to households with higher incomes. There is a good case for designing a

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[260] See Charles Holt et al., Auction Design for Selling CO2 Emission Allowances under the Regional Greenhouse Gas Initiative (Oct. 2007), available at http://www.rggi.org/docs/rggi_auction_final.pdf; Peter Crampton, "Comments on the RGGI Market Design" (Nov. 15, 2007), available at http://www.cramton.umd.edu/papers2005-2009/cramton-rggi-market-design-comments.pdf.

[261] Regional Greenhouse Gas Initiative, Design Elements for Regional Allowance Auctions under the Regional Greenhouse Gas Initiative (Mar. 17, 2008), available at http://www.rggi.org/docs/20080317auction_design.pdf.

[262] Holt et al., supra note 260.

[263] Testimony of Robert Greenstein before the Select Committee on Energy Independence and Global Warming, hearing on "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade" (Jan. 23, 2008).

separate tax credit for seniors, whose needs are likely to be smaller since they receive Social Security benefits with automatic cost-of-living-adjustments that account for any increases in consumer prices. Credits for seniors could phase in with the sum of their Social Security benefits, pension income, and veterans' benefits. For lower-income households that do not always file taxes and may need benefits on a more frequent basis, monthly cash rebates can be provided using the Electronic Benefit Transfer system already used for food stamps.[264] H.R. 6186 and H.R. 7194 include each of these elements: a refundable tax credit, a senior tax credit, and a rebate program for low-income households.

Direct compensation has some important advantages over providing consumer-relief funds to utilities or other entities. First, compensating households directly ensures that consumers will still receive the signal of higher energy prices, thus incentivizing greater efficiency and a transition to lower-carbon energy sources, yet will ultimately not suffer financially as a result of climate legislation. In addition, direct consumer relief provides a mechanism to address energy costs other than those related to electricity (such as gasoline).

5. Make substantial investments to spur energy efficiency, develop low-carbon technologies, and help American workers to transition to the new, low-carbon economy.

A significant portion of auction proceeds should be used to spur the development of zero- and low-carbon energy technologies in the United States. These investments will speed the commercialization of new technologies, reduce the overall cost of climate legislation, and grow the U.S. economy by positioning us to be able to sell these technologies around the world.

First, a cap-and-invest program can provide a crucial funding source for programs to increase energy efficiency—particularly in the electric power and transportation sectors. As discussed at greater length below, such programs can deliver major reductions in GHG emissions, greatly enhance our energy security, and substantially reduce the cost of achieving our climate goals. H.R. 6186 proposes an innovative approach to the promotion of efficiency measures, by establishing a pay-for-performance program under which States receive funding from auction proceeds based on their performance in increasing efficiency in the electric power sector and buildings. Competitive grants supporting State and local programs to reduce vehicle miles traveled—thus increasing the efficiency of the transportation sector—are also authorized. These provisions have been incorporated into the Dingell-Boucher discussion draft circulated in October 2008.

Second, cap-and-invest legislation should focus on strategic investments in research, development, demonstration, and deployment of renewable energy technologies and CCS. Congress has authorized a range of important RD&D programs under EISA and other recent legislation, but these programs have not yet received adequate funding. To speed the widespread early deployment of renewable electricity generation—which will help renewable technologies to mature quickly to cost parity with fossil fuel technologies—cap-and-invest legislation should

[264] See Center on Budget Policy and Priorities, Fact Sheet: How a "Climate Rebate" Would Work (June 3, 2008), available at http://www.cbpp.org/6-3-08climate-fact.htm; Testimony of Robert Greenstein; Testimony before the Select Committee on Energy Independence and Global Warming, hearing on "Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade" (Jan. 23, 2008).

provide a long-term funding stream for incentive programs. Incentives can be designed as tax credits (such as the current Production Tax Credit and Investment Tax Credit) or as a package of production payments (perhaps awarded through a reverse auction) for commercial-scale operations and rebates for the purchase and installation of distributed generation technologies such as solar panels. Climate legislation should provide cost-sharing grants to cover incremental costs of implementing CCS technology at coal-fired power plants in order to bring this technology to market before a carbon price signal alone will. Other priorities for technology funding under a climate proposal, many of which are discussed in the sections that follow, include electric transmission and distribution efficiency (including smart-grid technologies), low-carbon renewable fuels, low-emission vehicles, and building efficiency.

Finally, the proposal should include robust programs to assist American workers with the transition to a low-carbon economy. Green jobs training programs, such as those enacted under EISA, should be supported. In addition, a program should be established to provide training, income support, and tax credits for health care insurance for up to two years to any workers affected by the transition to a low-carbon economy. Both S. 3036 and H.R. 6186 provide models for such a program.

6. Include "carrots" and "sticks" to ensure that major-emitting developing countries, like China and India, take comparable action on global warming—and to avoid negative effects on the competitiveness of U.S. industry.

It is imperative that any proposal include provisions to encourage international action to combat climate change. Without international action, dangerous global warming cannot be avoided.

First, a climate proposal should encourage the President to work proactively under the United Nations Framework Convention on Climate Change, and in other appropriate forums, to establish binding agreements committing all major greenhouse gas-emitting nations to contribute equitably to the reduction of global greenhouse gas emissions.

Second, a climate proposal should create "carrots" to encourage our trading partners to take action that is comparable to that of the United States to combat climate change. Carrots could include access to funding for deployment of clean energy technologies in developing countries and assistance for countries that take actions to reduce emissions from deforestation. The ability to sell offset credits into the U.S. carbon market should also be conditioned upon a country taking comparable action. (This restriction could be lifted, however, for countries that are among the least developed of developing nations or countries with very low greenhouse gas emissions.)

Third, a climate proposal must include "sticks" to prevent adverse impacts on U.S. competitiveness. A border adjustment mechanism should be put in place to assign an additional cost to imports from countries that have not taken comparable action to reduce greenhouse gas emissions. Countries that have not taken comparable action should be required to purchase special "international reserve allowances" to accompany their imports and account for the greenhouse gas emissions from the production of those goods. The pool of international reserve

allowances should be separate from the domestic allowance pool, so that the program will not affect domestic emission levels or the price of domestic emission allowances. Proceeds from the sale of international reserve allowances can be used to supplement clean technology transfer and international adaptation programs. Least-developed countries and countries with very low greenhouse gas emissions may be exempted from this requirement. A number of proposals, including S. 1766, S. 3036, H.R. 6186, and the Dingell-Boucher discussion draft have included border measures of this type.

In designing the international reserve allowance program, Congress must be cognizant of World Trade Organization restrictions and design the program carefully to maximize chances of withstanding legal challenges. In addition, a time lag between the beginning of the U.S. cap and trade program and the implementation of an international reserve allowance program will be necessary, as international negotiations may take a number of years. To prevent production shifting abroad and thus resulting in loss of U.S. jobs and an undermining of the environmental objective of the legislation, a proposal should provide assistance to trade-exposed U.S. manufacturing industries during this interim period. This interim program should be designed carefully to encourage early reductions in greenhouse gas emissions and avoid windfall profits to polluters. To do this, allocation of assistance within a sector should be based upon production levels rather than emissions levels.

7. Establish rigorous standards governing the award of offset credits and provide robust financial incentives for supplemental reductions in "uncapped" emissions not eligible to generate offset credits.

Comprehensive climate legislation should contain thoughtful use of both "offsets," which can reduce the overall cost of a cap-and-invest system, and targeted financial incentives that can deliver supplemental reductions in emissions or increases in sequestration.

Offset credits should be awarded for reductions in "uncapped" emissions or increases in biological sequestration that can be clearly demonstrated to be real, verifiable, additional, permanent, and enforceable. EPA should develop standard measurement methodologies for project types eligible for offset credits and put in place rigorous standards for project development and approval. The risk of allowing offsets into the market is that if they are not real, verifiable, additional, permanent, and enforceable, they will compromise the United States' overall emissions cap. For this reason, caution dictates that only a short list of "uncapped" emissions or biological sequestration opportunities be allowed to earn offset credits. These include reductions in emissions from sources difficult to cap, such as oil and gas systems, livestock operations, and abandoned coal mines, and increases in biological carbon sequestration through afforestation and reforestation. As for international offset credits, there has been substantial concern in recent years about the integrity of some categories of credits issued under the Kyoto Protocol's Clean Development Mechanism. It is essential that a rigorous regulatory screening mechanism be established to determine which, if any, international offset credits should be allowed to be used in a U.S. cap-and-invest system. Finally, appropriate quantitative limits should be placed on the use of both domestic and international offset credits, to avoid flooding the market and to ensure that adequate investment is directed towards the transformation of our energy economy.

Because financial incentives are less risky in that they cannot compromise the emissions cap, Congress should consider a proposal providing direct financial support, but not offset credits, for projects where the climate benefits are less certain. These include projects that increase biological sequestration of carbon or reduce greenhouse gas emissions through improved agricultural soil management and forest management practices. Providing financial incentives for U.S. farmers and foresters to achieve greenhouse gas reductions through such projects can deliver substantial climate and other environmental benefits, while channeling income and jobs to rural areas.

On the international level, massive supplemental reductions are possible through the provision of incentives to encourage developing countries to implement national policies to slow deforestation and forest degradation—which account for 20 percent of global greenhouse gas emissions. Incentives can also be used to encourage deployment of clean energy technologies—including American-made technologies—in developing countries, helping to bridge the financial gap between clean and "dirty" technologies in these countries. As explained above, access to such incentives can be made contingent upon these countries taking comparable action to combat climate change, providing important "carrots" to encourage such action.

8. Establish a rigorous market oversight regime to ensure transparency, fairness, and stability in the market for emission allowances, offset credits, and the derivatives thereof.

Economy-wide climate legislation will establish a market in tradable emission allowances and offset credits—and related derivatives, such as futures and options—that is likely to be valued in the hundreds of billions of dollars annually. The recent subprime mortgage meltdown on Wall Street, excessive speculation in the oil and natural gas markets, and manipulation of the electricity markets—among other historical examples—all underscore the critical need for vigorous government oversight of this new carbon market. Avoiding manipulation of the carbon market takes on a special importance for at least two reasons: First, consumers will bear the burden of price volatility in the carbon markets resulting from excessive speculation or market manipulation, in the form of higher energy prices, just as they have in the case of the oil markets. Second, the carbon market is one of the few examples in which the government is effectively requiring private parties to participate in a new market.

The carbon market created under a cap-and-invest system can be divided into three components: (1) auctions of emission allowances, (2) a secondary market involving trading of emission allowances and offset credits, and (3) a market in derivatives, such as futures and options, based on emission allowances and offset credits. Oversight of the auction market should be assigned to the agency charged with conducting auctions (EPA in most legislative proposals), which should be given adequate authority for that purpose. It is possible that, under recent legislation amending the Commodities Exchange Act, the Commodity Futures Trading Commission will have some authority over futures and options contracts based on emission allowances or offset credits—to the extent that such contracts serve a "significant price discovery function."[265] However, there is no existing regulatory authority over the secondary market in

[265] Renee Johnson et al., The 2008 Farm Bill: Major Provisions and Legislative Action, Congressional Research Service Report No. RL34696, at 38 (Oct. 3, 2008).

allowances and offsets themselves, except to the extent that such trading is conducted on already-regulated exchanges.

While further work needs to be done on the design of an appropriate regulatory oversight system for the carbon market, it is apparent that several core principles should govern that system:

- Immediate New Authority: First, robust oversight system needs to be authorized by Congress *concurrently* with the establishment of the carbon market through climate legislation.
- Unitary Regulator: Second, regulation over the secondary market in emission allowances and offset credits, on the one hand, and derivatives based on these instruments, on the other, should not be divided among multiple agencies. These markets operate in an integrated fashion, and it is imperative that a unitary regulator have authority to oversee both the spot market and the futures market.
- Relationship with Energy Markets: Third, because of the close interrelationship between the carbon market and markets in energy commodities like electricity, coal, and natural gas, there is some value to assigning oversight of the carbon markets to an entity, like the Federal Energy Regulatory Commission, that already has oversight responsibilities in the energy markets.
- Maximize Transparency and Oversight: Fourth, one means of maximizing transparency and oversight and enforcement authority over carbon market trading would be to require, to the greatest extent possible, that trading occur on federally regulated exchanges. There may be important benefits to over-the-counter (OTC)—meaning off-exchange—trading in derivatives for legitimate hedging purposes. But if OTC trading is to be permitted, alternative oversight mechanisms such as large-trader reporting requirements, may be appropriate.
- Robust Anti-Manipulation and Enforcement Authority: Fifth, whatever the mechanism for regulatory oversight, the federal regulator should be given robust authority to monitor the market, ensure public reporting of price and other transaction data, and to prevent fraud, manipulation, and excessive speculation—including strong enforcement authorities.

These principles are reflected in Title II of Chairman Markey's iCAP bill (H.R. 6186), the most detailed proposal to date for carbon market oversight, which charges the Federal Energy Regulatory Commission with regulating the carbon market. The iCAP carbon market oversight provisions are incorporated into the Dingell-Boucher discussion draft circulated in October 2008.

9. Build resilience to unavoidable impacts of climate change.

Unfortunately some impacts from climate change are now unavoidable, regardless of the path we choose to take. As discussed above, these impacts will be borne most heavily by vulnerable communities, both here in the United States and abroad.

Climate legislation should include funding to aid communities in the United States and in vulnerable developing countries in adapting to these impacts of climate change. Domestically, climate legislation should include the following elements:

- Regional and National Assessments: Establish a federally-led process to periodically assess the United States' vulnerability to climate change impacts in the near-, medium-, and long term, at a regional and national levels. This process should capitalize on the economies of scale for scientific observation and research at the federal level, while involving researchers, institutions, public officials, and other stakeholders at the State and local level in developing "down-scale" assessments of climate impacts.
- National Climate Service: Establish a National Climate Service to provide research products and decision tools to federal, State, local, and tribal decision-makers, to enable them to assess and appropriately respond to predicted climate change impacts.
- National Adaptation Strategy: Establish an interagency group at the federal level to develop and periodically update, in coordination with federal, State, local, and tribal stakeholders, a national strategy to protect our infrastructure, public health systems, and our natural resources, wildlife, and fisheries from climate change impacts.
- Federal Agency Adaptation Plans: Require federal agencies to develop and implement plans to address climate change impacts within their respective jurisdictions.
- Fund State, Local, and Tribal Adaptation Projects: Provide a mechanism to fund State, local, and tribal government programs and projects to build resilience to climate change impacts.

These policies will require a substantial federal investment in policy-relevant climate monitoring, observational, modeling, and research capacity to provide a robust Earth observation and prediction system. Chairman Markey's iCAP bill (H.R. 6186) provides the most detailed legislative proposal thus far on domestic adaptation programs, and the domestic adaptation provisions of iCAP are incorporated into the Dingell-Boucher discussion as one potential option for use of allowance value.

Internationally, climate legislation should provide aid to the most vulnerable developing nations to increase their resilience to the impacts of climate change. As explained above, lower-income countries in the developing world that are least responsible for climate change are likely to suffer some of the worst impacts and have the least capacity to respond to those impacts. The United States, as one of the wealthiest countries and one of the largest contributors historically and currently to climate change, has a moral obligation to help these countries build their resilience. Moreover, it is in our national security interests to do so—to lessen the impacts discussed above, which can destabilize developing countries and act as threat multipliers that undermine U.S. interests abroad. International adaptation programs should receive robust funding and may be implemented through the U.S. Agency for International Development (USAID), through multilateral mechanisms set up through the United Nations Framework Convention on Climate Change, through other international entities, or some combination of the foregoing.

10. Integrate the cap-and-invest program with complementary policies to overcome market barriers and reduce the overall cost of climate legislation, and permit appropriate continuing state and local action.

An economy-wide cap-and-invest program must be the keystone of the United States' climate and energy security policy. To a greater extent than any other policy option, such a

program will provide an overarching, strategic policy requiring cuts in greenhouse gas emissions and investment in the transition to a prosperous, low-carbon economy.

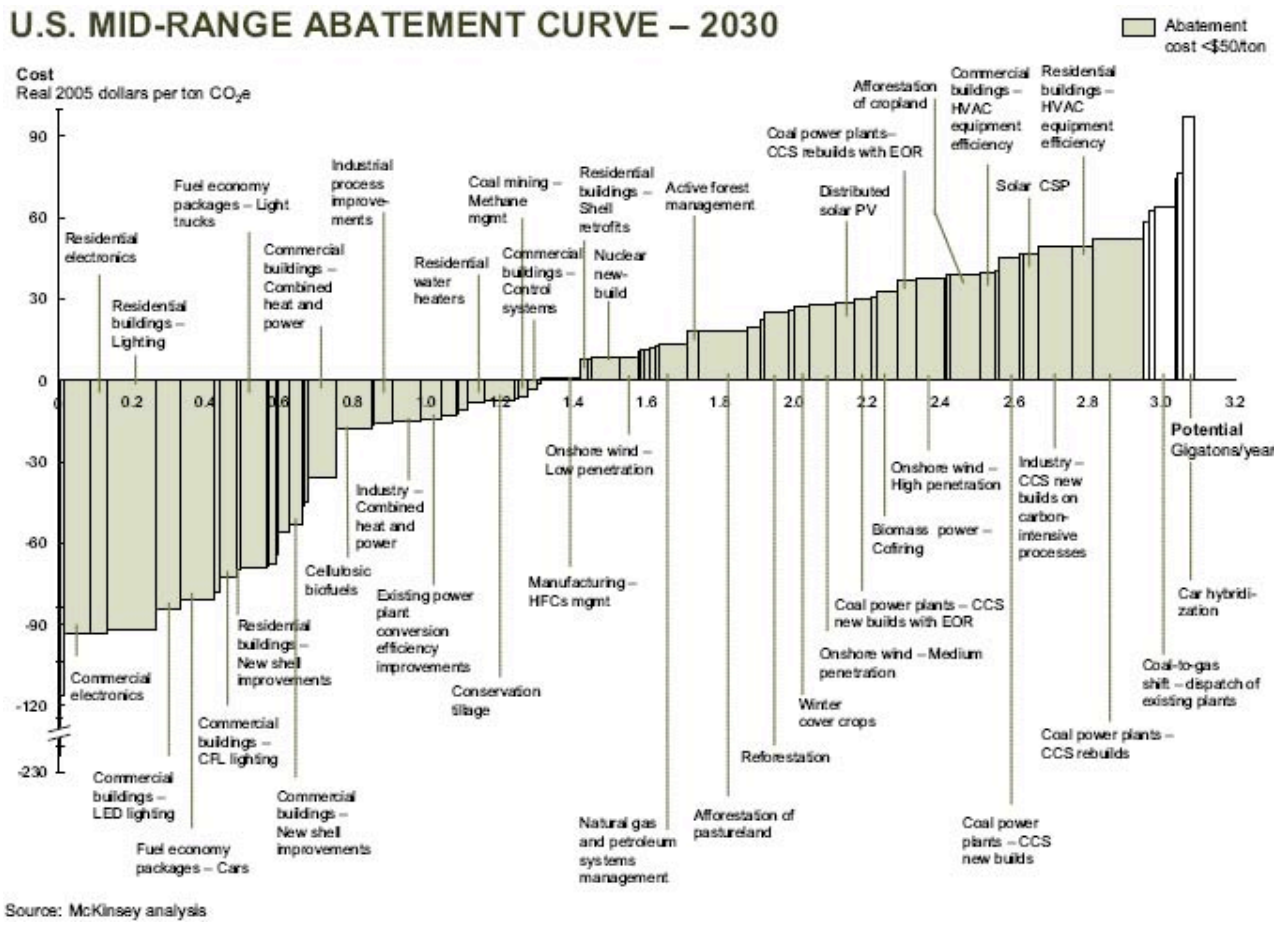
However, further policies external to a cap-and-trade program may be required to achieve emissions reduction targets in a cost-effective manner. Complementary policies will be especially important in the transportation sector, where reducing greenhouse gas emissions requires changes in vehicles, fuels, and consumer behavior, and in the built environment, where reducing direct and indirect greenhouse gas emissions requires changes in buildings, appliances, lighting, heating, cooling, and consumer behavior. A range of such policies is discussed in the following sections.

In addition, while it is imperative that the federal government take the lead on national climate and energy policy, State and local governments should continue to play a critical role in these areas. That is particularly so in areas of traditional state or local preeminence, such as land-use and smart-growth planning to increase the efficiency of our transportation system, efficiency policies in the electricity and natural gas sectors, building efficiency standards, policies to promote deployment of renewable electricity generation such as state renewable electricity standards, and programs to increase resilience to climate change impacts. State and local governments have helped to catalyze federal action on energy and climate issues, and it is important that they be given space to continue to do so.

B. BOOST EFFICIENCY OF THE ELECTRICITY SECTOR AND BUILDINGS

The largest and least expensive way to expand electricity supply and reduce greenhouse gas emissions is by improving energy efficiency. Numerous studies have confirmed the basic notion that the best and cheapest power plant is the one we never have to build—because greater efficiency leads to reduced demand. For example, a December 2007 McKinsey & Company analysis found that the United States could reduce greenhouse gas emissions in 2030 by 3 to 4.5 billion tons of carbon dioxide equivalent using currently available approaches and high-potential emerging technologies at a marginal cost of $50 per ton or less.[266] However, nearly 40 percent of this abatement potential could be achieved at *a net savings*. Investments in these areas would yield positive economic returns over their lifecycle, by reducing total energy costs, and thus substantially offset the overall social cost of a climate program. The vast majority of these profitable abatement options exist in the area of energy efficiency.[267]

Estimated Cost and Magnitude of Greenhouse Gas Emission Abatement Options



[266] For reference, total U.S. greenhouse gas emissions for 2006 were approximately 7.1 billion tons carbon dioxide equivalent.

[267] McKinsey & Company, Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? (Dec. 2007), available at: http://www.mckinsey.com/clientservice/ccsi/pdf/US_ghg_final_report.pdf

Source: McKinsey & Company, Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost? (December 2007).

Studies show that, in the electricity sector, efficiency measures can deliver nearly a 25 percent reduction in demand over then next 20 years—providing a highly cost-effective means of meeting rising demand. A 2004 survey by the American Council for an Energy Efficiency Economy (ACEEE) of 11 different studies showed that the median achievable potential for electricity efficiency gains was 24 percent over the next 20 years (an average of 1.2 percent per year).[268] Remarkably, that is nearly equivalent to EIA's prediction for electricity demand growth between now and 2030—though that prediction already incorporates some expected efficiency gains. The same study found that a 9 percent reduction of natural gas consumption is achievable through efficiency measures in the next 15 to 20 years.[269]

In addition to being the cleanest way of meeting that demand, efficiency is also the cheapest. Even without including carbon prices, efficiency measures can increase available resources at a cost of roughly $0.03/kWh, as compared with nearly $0.07/kWh for coal- or gas-fired generation. A May 2006 study found that, for the ten northeastern states participating in RGGI, 20-30 percent of the reference forecast for electricity demand could be achieved through cost-effective improvements in energy efficiency.[270]

Several studies have shown that investment in complementary efficiency programs can substantially reduce the overall cost of climate legislation. A 2006 ACEEE analysis of RGGI showed that, by doubling current efficiency investments in the region, wholesale power market prices could be kept flat through 2020 and then would rise by less than 0.5 percent through 2024.[271] A doubling of energy efficiency investment would also reduce carbon allowance prices by about one-third below baseline allowance prices in 2024, and would increase regional economic growth by 0.6 percent in 2021 relative to the base case. Recent modeling by Resources for the Future predicts that use of 100 percent of RGGI auction proceeds in efficiency measures reduces allowance prices by 25-30 percent as compared with use of only 25 percent for efficiency. Based on similar analyses, most RGGI states have opted to auction virtually all allowances and to invest most of the auction proceeds in State-led efficiency programs.

Because of a host of market barriers, the carbon price provided by a cap-and-trade program—standing alone—will not lead to optimal adoption of efficiency measures. For example, the buildings and appliances sectors are characterized by split incentives—where buyers or users would achieve lifecycle cost savings from more efficient homes or appliances, but builders and manufacturers have a disincentive to improve efficiency because it would increase sticker prices. Consumers generally do not have adequate information to distinguish between different homes or products on the basis of efficiency. In addition, consumers may apply irrationally high discount rates in making purchasing decisions—requiring that a more

[268] Steven Nadel et al., "The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies," Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings (2004).
[269] Id.
[270] William Prindle et al., Energy Efficiency's Role in a Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative, ACEEE Report Number E064 (May 2006).
[271] Id.

efficient home or product "pay back" the increased cost within a very short time frame, even though the consumer would be financially better off in the medium- to long-term with the more efficient home or product. In the power sector, electric utilities often are the actor best positioned to increase demand-side efficiency, but have a disincentive to do so because revenues are based on the volume of electricity sold. Because a cap-and-trade program does not address these and other market barriers, on its own such a program is not likely to achieve the full cost-saving benefits of efficiency measures. The result is that, absent coherent policies, achievement of the environmental objectives of the cap-and-trade system will be more expensive than is necessary.

To ensure optimal deployment of efficiency measures, and achieve the cost savings that they provide, complementary policies are necessary. These policies can include both regulatory drivers and financial incentives.

Buildings and Appliances

Improving energy efficiency in buildings and appliances is the area of greatest emission abatement and energy- and cost-saving potential. Efficiency improvements in this category include lighting retrofits, higher performance for appliances, improvements in heating, ventilation and air conditioning systems, as well as better building envelopes and building control systems. Over the next 30 years, the built environment in the United States is expected to increase by an amount roughly equal to 70 percent of today's existing building stock—providing a crucial opportunity for energy savings and emission reductions.[272]

Buildings, not transportation, are the largest single source of greenhouse gas emissions. Buildings contribute up to 48 percent of U.S. greenhouse gas emissions.[273] In 2007 over three-quarters of the electricity generated by U.S. power plants was used in commercial, residential, and industrial buildings,[274] and roughly one-third of the natural gas consumed was used for residential and commercial use.[275] Most of this energy consumption, and resulting emissions, stem from the energy used to operate lighting, heating, and cooling in buildings, and could be considerably decreased. The IPCC found that by 2030, 29 percent of global projected baseline emissions could be cost-effectively reduced in the residential and commercial building sectors.[276]

Federal, State, and local governments can lead by example. For several years, State and local governments have incorporated green building guidelines in municipal, residential, and

[272] Marilyn A. Brown, Toward a Climate Friendly Built Environment at 3-4 (Pew Center on Global Climate Change, June 2005).
[273] American Institute of Architects, Architects and Climate Change, available at http://www.aia.org/SiteObjects/files/architectsandclimatechange.pdf.
[274] Energy Information Administration, Annual Energy Review 2007, Table 2.1a (Energy Consumption by Sector, Selected Years, 1949-2007). Approximately 40 percent of energy consumed in 2007 was used in residential and commercial buildings alone.
[275] Energy Information Administration, Natural Gas Consumption by End Use 2007, available at http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm.
[276] Intergovernmental Panel on Climate Change, Fourth Assessment Report, Climate Change 2007: Mitigation of Climate Change at 389 (2007).

commercial buildings. At the Select Committee's May 14, 2008 hearing entitled "Building Green, Saving Green: Constructing Sustainable and Energy-Efficient Buildings," San Francisco Mayor Gavin Newsom testified about the success San Francisco enjoyed as one of the first cities to require the United States Green Building Council's Leadership in Energy and Environmental Design's (LEED) standard certification for all new municipal construction and major renovation projects. The city offers expedited building permits for energy-efficient building projects, saving contractors time and money as they build more efficiently. Other cities have adopted some form of LEED or Green Globes certification for large or new municipal buildings. At the federal level, EISA included rigorous energy efficiency performance standards for new federal buildings and major retrofits costing over $2.5 million, including a 55 percent reduction in fossil fuel-generated energy consumption by 2010 (relative to a 2003 baseline) and a 100 percent reduction by 2030. Among other measures, EISA also established an Office of Federal High-Performance Green Buildings within the General Services Administration, charged with promoting green building standards in federal building construction and management.

Building codes are critically important in driving energy efficiency. Building and energy codes prescribe the minimum standards for a building to be declared structurally sound and habitable. Though these codes were originally implemented to protect the safety of inhabitants, they can also improve energy and water efficiency. Once these codes are adopted by law, they become building standards. The International Code Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) have developed commonly adopted building and energy codes formed with the consensus of various building sector professionals. As States and localities adopt more recent building codes they improve the baseline energy efficiency of buildings. The House on September 16, 2008 passed H.R. 6899, The Comprehensive American Energy Security and Consumer Protection Act, which included provisions to encourage adoption of updated codes. Specifically, these provisions require DOE and States to update energy codes for new buildings by 30 percent by 2010 and 50 percent by 2020 and for States to adopt the federal model codes or efficiency-equivalent codes. Incentive funding is offered for adopting the code and training officials to implement the codes. These building codes could avoid 1.5 billion metric tons of CO_2 per year by 2030 and reduce the need to build more than 30 new large coal-fired power plants over the coming decades. The Senate did not act on this legislation.

Improving building energy efficiency is profitable and creates jobs. The IPCC has stated that appliance standards and building energy codes could reduce energy use profitably by 2030 through existing technology and government support.[277] The Weatherization Assistance Program (WAP) is one example of such government support. The program leverages government and other community resources to improve the energy efficiency of low-income family homes. For every $1 invested in WAP, the program returns $1.53 in energy savings. Each WAP family saves an average of $358 per year, [278] and the program supports 8,000 local

[277] Intergovernmental Panel on Climate Change, Fourth Assessment Report, Climate Change 2007: Mitigation of Climate Change at 389 (2007).
[278] U.S. Department of Energy, Weatherization Assistance Program Fact Sheet (June 2006), available at http://www1.eere.energy.gov/office_eere/pdfs/wap_fs.pdf.

jobs nationally.[279] Energy efficient buildings are profitable to owners *and* builders. The cost of a green building can fall within an initial "non-green" budget, or with minimal cost difference, and this cost is offset by avoided utility expenses.[280] As consumers become aware of the cost benefits of efficient buildings, developers are seeing an increased demand and premiums for energy efficient buildings.[281]

Electric Power Sector Efficiency

Within the electric power sector, one key policy option for incentivizing efficiency is restructuring the way utilities are motivated to make profits. As noted above, the only incentive in most markets currently is for utilities to drive demand and produce the greatest quantity of electricity as cheaply as possible to meet that demand. In some States, however, the direct link between electricity generation and profits has been broken. In these "decoupled" markets, utilities submit their revenue requirements and estimated sales to regulators. The State's public utility commission sets the rates by regularly applying adjustments to ensure that utilities collect no more and no less than is necessary to run the business and provide a fair return to investors. Decoupling ensures that utilities maintain their expected earnings even as energy efficiency programs reduce sales. It bears mention that many State public utility commissions adopted a somewhat similar "incentive regulation" scheme in the telecommunications sector a decade or more ago, with great benefit to telephone utilities and consumers alike. Five States have adopted decoupling for some or all of their electricity markets, and at least nine others are considering doing so. Approximately 13 States have adopted decoupling for natural gas.

Demand-side management (DSM)—referring to an array of programs and mechanisms to reduce or manage electricity demand—can greatly increase efficiency. In many states, utilities or state government entities manage DSM programs that provide technical assistance and incentives to energy consumers to deploy more efficient lighting, appliances, building shells, and other technologies. DSM programs are also used to shift demand in response to supply conditions, for example, having electricity customers reduce their consumption at critical times or in response to market prices. Reducing summer peak demand—those times when utilities face the greatest strain on their electricity generation, transmission, and distribution systems—is important in reducing overall electricity consumption but also for reducing the need to run costly peak generating units, which typically run on natural gas. Energy efficiency initiatives, along with expanded demand response programs, have the potential to reduce summer peak demand significantly. A February 2008 study by ACEEE found that the state of Maryland could use DSM to reduce summer peak demand by 32 percent below baseline levels in 2015 and 47 percent in 2025.[282]

Another policy option for increasing energy efficiency is an energy efficiency resource standard (EERS)—a market-based mechanism that encourages more efficient generation,

[279] U.S. Department of Energy, Weatherization Assistance Program website, http://apps1.eere.energy.gov/weatherization/improving.cfm (last visited Oct. 20, 2008).
[280] Lisa Fay Matthiessen & Peter Morris, Costing Green: A Comprehensive Cost Database and Budgeting Methodology at 25 (July 2004), available at http://www.usgbc.org/Docs/Resources/Cost_of_Green_Full.pdf.
[281] McGraw-Hill, Green Building Smart Market Report 2006 at 4 (2006).
[282] Maggie Eldridge et al., Energy Efficiency: the First Fuel for a Clean Energy Future: Resources for Meeting Maryland's Electricity Needs, ACEEE (Feb. 2008).

transmission, and use of electricity. An EERS establishes electric and/or gas energy savings targets for utilities, often with flexibility to achieve the target through a market-based trading system. Currently, 15 States have some type of EERS in place or in development.[283] State public utility commissions typically oversee these programs and are responsible for verifying energy saving improvements. As part of the original energy bill (H.R. 3221) that passed the House last July, the 15 percent renewable electricity standard (RES) allowed 4 percent to be achieved through energy efficiency. This 4 percent requirement was effectively an EERS. Stand-alone EERS policies have long been proposed at the federal level.

Combined heat and power (CHP) could greatly improve efficiency by capturing the vast resource of "waste heat" produced by industrial, commercial, and residential facilities. CHP, also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source, such as natural gas, biomass, biogas, coal, waste heat, or oil. CHP technology can be used by industrial facilities and commercial and large residential buildings to increase energy efficiency and reliability, as well as reduce air pollution and greenhouse gas emissions.[284] A study commissioned by the Department of Energy assessing the market potential for CHP applications estimates that, in the industrial sector alone, smaller CHP technologies (known as distributed generation) could provide 33,000 megawatts of power generating capacity using currently available technologies—over 3 percent of current U.S. capacity.[285] EISA included a number of programs to spur installation of CHP systems, such as the Waste Energy Recovery Incentive Grant Program and the Energy-Intensive Industries Program, established under Section 451 of the Act. But these programs have not yet received funding and additional assistance may be necessary to meet the potential for these technologies. Further assistance for these projects could be provided in the form of direct financial grants, tax incentives, low-interest loans, or utility and environmental policies that increase the financial prospects for a project.[286]

Fuel cells are another important tool for advanced energy storage, increased energy efficiency, reduced emissions, and an opportunity for increasing domestic energy supply and energy security. Fuel cells are highly reliable and flexible in installation and operation, and energy, when stored as hydrogen in the form of a gas or a liquid, will never dissipate until it is used, making it a good application for emergency generators and other critical energy applications. When using hydrogen from a renewable source, fuel cells offer a multi-purpose renewable energy source. They have the potential to replace the internal combustion engine in vehicles and provide power for stationary and portable power applications. Many portable devices can be powered by fuel cells, such as laptop computers and cell phones. They can also be used for stationary applications, such as providing electricity to power homes and businesses. Fuel cells can be used in transportation applications, such as powering automobiles, buses, and other vehicles. Moreover, they offer a cleaner and more efficient alternative to traditional

[283] American Council for an Energy Efficient Economy, Energy Resource Standards Around the World (Sept. 2007), available at http://www.aceee.org/energy/state/6pgEERS.pdf.
[284] Environmental Protection Agency, Combined Heat and Power Partnership: Basic Information, at http://www.epa.gov/chp/index.html (last visited Oct. 20, 2008).
[285] Resource Dynamics Corporation, Cooling, Heating, and Power for Industry: A Market Assessment at 2, prepared for U.S. Department of Energy and Oak Ridge National Laboratory (Aug. 2003), available at http://www.eere.energy.gov/de/pdfs/chp_industry_market_assessment_0803.pdf.
[286] Environmental Protection Agency, Combined Heat and Power Partnership: Funding Resources, at http://www.epa.gov/chp/funding/index.html (lasted visited Oct. 20, 2008).

combustion-based engines and power plants. Currently, most internal combustion engines operate with around 25 percent efficiency and power plants achieve about 35 percent efficiency; however, a stationary fuel cell when used in a combined heat and power system can have an efficiency level of greater than 85 percent.[287]

Modernization of the electricity transmission and distribution system—particularly through "smart grid" investments—promises substantial benefits in increased system efficiency, reliability, and flexibility, and reduced peak loads and electricity prices. Smart grid technologies essentially involve the use of digital communications and information technology for a variety of grid functions, including monitoring, measuring, and responding to electricity demand and congestion; sensing and locating system disruptions or security threats and deploying automated protective responses; implementing "smart" meters in homes and businesses that allow consumers to receive time-of-use pricing information and to communicate consumer preferences to the grid; and implementing "smart" appliances that can be programmed to respond to communications from the grid regarding pricing or load. Collectively, these technologies can substantially increase the efficiency of the grid and can reduce peak load demand, both of which reduce the need for construction of new generation.[288] In addition, an array of other grid modernization technologies—such as the deployment of high-efficiency superconductor power distribution cables—can further enhance grid efficiency and reliability.[289]

The 110th Congress has taken some significant steps forward on smart grid development. Title XIII of EISA established a Smart Grid Advisory Committee to advise the Secretary of Energy on grid modernization issues and requires the Secretary to report to Congress biennially on the state of grid modernization efforts, including recommendations for Congressional action. In addition, EISA requires DOE to establish a program of regional demonstration projects for smart grid technologies, as well as a Smart Grid Investment Matching Grant Program to reimburse 20 percent of qualifying smart grid investments. Finally, Section 306 of the Energy Improvement and Extension Act of 2008 (enacted as part of H.R. 1424, the economic rescue legislation enacted in October 2008), provides for accelerated depreciation (for purposes of the tax code) of investments in smart meters and other smart grid technologies.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Cap and Invest:** Congress should make funding for performance-based incentives for State and local efficiency programs, including adoption and implementation of building efficiency programs, a centerpiece of cap-and-invest legislation. As noted above, Chairman Markey's iCAP bill (H.R. 6186) provides a model for the incorporation of such

[287] See, e.g., Connecticut Hydrogen Fuel Cell Coalition, Hydrogen Fuel Cell Benefits, at http://www.chfcc.org/Resources/benefits.asp.
[288] See, e.g., testimony before the House Committee on Energy and Commerce, hearing on "Facilitating the Transition to a Smart Electric Grid," May 3, 2007.
[289] See Testimony of Greg Yurek before the Select Committee on Energy Independence and Global Warming, hearing on "Renewing America's Future: Energy Visions of Tomorrow, Today," July 31, 2008.

incentives into climate legislation, and these provisions have been incorporated into the discussion draft introduced by Chairmen Dingell and Boucher in October 2008.

- **National Model Building Efficiency Standards for New Buildings:** Congress should enact the national building efficiency standards that were included in H.R. 6449, the "Comprehensive American Energy Security and Consumer Protection Act"—which would require States to adopt and enforce building codes requiring a 30 percent improvement in new building energy efficiency by 2010 and a 50 percent improvement by 2020.

- **Efficiency Labeling Programs for Existing and New Buildings:** Congress should support measures to provide consumers with transparent information on the energy efficiency of existing and new buildings. For example, Chairmen Dingell and Boucher's climate legislation discussion draft outlines an Energy Performance Labeling Requirement for buildings, grouped according to use and labeled based on their energy efficiency and performance. This requirement builds on the existing Energy Star qualified new homes label by additionally considering the efficiency of existing buildings.

- **Energy Efficiency Tax Credits:** Congress should make the Energy Policy Act of 2005 tax credits for qualified energy efficiency improvements permanent. These credits allow homeowners to recoup some of the costs of making approved energy efficient improvements to their primary home or business.

- **New Efficiency Standards for Federal Buildings:** The federal government should adopt the recently adopted International Energy Conservation Code of 2008 for new federal buildings, even those that fall under exceptions outlined in EISA. The new IECC code will achieve an approximate 15 percent increase in energy efficiency compared to the 2005 IECC energy code.

- **Appliance Efficiency Standards:** Congress should enact legislation requiring the Department of Energy to establish new efficiency standards for appliances and equipment not yet covered by current legislation, such as flat-screen televisions, computers, and data servers. The Department of Energy should move forward aggressively with promulgation of new appliance efficiency standards pursuant to its existing authority under the Energy Policy and Conservation Act, and Congress should provide close oversight of this process.

- **National Energy Efficiency Resource Standard:** Congress should enact a market-based federal energy efficiency resource standard requiring electric utilities to achieve gradually increasing annual improvements in efficiency—either in tandem with a national Renewable Electricity Standard, or independently thereof.

- **Combined Heat and Power:** Congress should fully fund the Energy-Intensive Industries Program established under Section 451 of EISA.

- **Fuel Cells:** Congress should study the potential role of the federal government in promoting hydrogen fuel cell development and deployment in service of increased energy efficiency, for example through large-scale federal procurement programs.

- **Smart Grid Development and Deployment:** Congress should fully fund the smart grid research, development, and demonstration program under Section 1304 of EISA and the Smart Grid Investment Matching Grant Program established under Section 1306 of EISA. Congress should prioritize consideration and potential adoption of the grid modernization recommendations of the Secretary of Energy and the Smart Grid Task Force submitted pursuant to Section 1303 of EISA. Finally, Congress should consider establishing a dedicated funding source to promote smart grid and transmission investments, either through a set-aside under cap-and-invest legislation or through a national "wires charge".

C. DRAMATICALLY EXPAND RENEWABLE ELECTRICITY GENERATION

Renewable sources can become a major contributor to the U.S. electricity supply within the foreseeable future. Renewables currently generate 8.4 percent of the country's electricity, with non-hydro renewables responsible for just 2.5 percent.[290] Reaching 20 percent of total generation by 2020 is an ambitious—but achievable—target for renewables based on the current state of the technologies and the available renewable resources. Reaching this target would require around 200,000 megawatts of new renewable generation, depending significantly on how large a role electricity plays in fuelling the transportation sector and the extent to which energy efficiency can reduce demand growth.

Adoption of a national renewable electricity standard (RES) requiring that 20 percent of electricity generated in the United States come from renewable sources by 2020 should be a centerpiece of our national energy strategy. A key driver of renewable energy growth in the United States has been state-level RES's. Twenty-six States along with Washington, DC, now have RES's, and more than 46 percent of nationwide electrical load is covered under these mandatory policies. The types and quantities of renewable electricity required under these programs vary widely among the states, but it has become clear that States with RES's are deploying more renewable electricity generation than States with them. While only 11 States have had these programs in place for at least four years, more than half of the non-hydro renewable electricity generating capacity added in the United States over the last decade has occurred in States with RES programs. Current mandatory State RES policies will require the addition of more than 60,000 megawatts of new renewable electricity capacity by 2025. At the same time, RES policies are having little or no impact on consumer electricity rates and in many markets the renewable electricity is priced competitively with fossil fuel-based generation.[291] During the 110th Congress, the House twice passed a national RES of 15 percent by 2020—with the option to meet up to 4 percent with efficiency—but the Bush Administration threatened to veto the measure and the Senate was unable to pass it.

Tax incentives—including the Production Tax Credit (PTC) and the Investment Tax Credit (ITC)—will also play a key role in deploying renewable electricity generation. These two policies have been a major driver of renewable energy development over the past several years by giving individuals, businesses, and utilities incentives to invest in renewable energy generation. These tax credit programs help renewables to be deployed at sufficient scale to begin to move down the cost curve and become more competitive with traditional fossil fuel-based generation. Moreover, they provide a policy "bridge" that is helping the renewable energy industry survive in an environment where the benefits of low- and zero-carbon emissions are not properly valued by the market. Unfortunately, between 1999 and 2004, the PTC has expired on three separate occasions which has led to a boom-bust cycle of development, especially in the wind industry.

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[290] Energy Information Administration, Annual Energy Review 2007, Table 8.2b Electricity Net Generation: Electric Power Sector, Selected Years, 1949-2007 (2007).

[291] Ryan Wiser & Galen Barbose, Renewables Portfolio Standards in the United States: A Status Report with Data Through 2007, Lawrence Berkeley National Laboratory (April 2008), available at http://eetd.lbl.gov/ea/EMS/reports/lbnl-154e-revised.pdf.

In conjunction with the economic rescue package enacted into law in October 2008 (H.R. 1424), the 110th Congress extended the ITC for eight years and the PTC for two years for electricity derived from biomass, geothermal, hydropower, landfill gas and solid waste, and one year for electricity derived from wind. For the first time, renewable energy projects harnessing river and ocean currents, waves, tides, and thermal energy conversion are also eligible for the PTC. However, because of the current financial crisis, there are concerns as to whether project developers will be able to take full advantage of the tax credits in 2009. Moreover, a longer-term extension of the production tax credit is crucial to provide investors with the certainty needed to move forward with sustained investments in renewable electricity generation and in the underlying technologies.

Feed-in tariffs provide another potential option for encouraging expansion of renewable electricity generation. Over 40 countries, States, and provinces around the world use so-called feed-in tariff policies to promote deployment of renewable electricity generation. Feed-in tariffs—often called renewable energy payments (REP) policies in the United States—require utilities to purchase electricity from renewable electricity generators on a priority basis through long-term (5-25 year), fixed-rate power-purchase agreements. The rates are generally set by the government on a cost basis to provide for a reasonable rate of return on investment, with cost recovery guaranteed through system benefits charges to electricity customers. As opposed to RES policies that set deployment levels (e.g., 20 percent by 2020) and allow the market to determine the price for renewable energy, feed-in tariff policies provide broad support for a diverse range of renewable energy technologies by setting different rates for different technologies. Germany's Renewable Energy Sources Act of 2000 has been successful in using feed-in tariff policies to spur record rates of investment and job growth in the renewable energy sector. There is now a growing interest in adopting feed-in tariff policies in the United States with several States now considering such policies, including Michigan, Illinois, Minnesota, Rhode Island, Hawaii, Washington, and California.

Transmission has quickly become recognized as one of the most prominent barriers to the wide-scale deployment of renewable electricity. Building the generation where renewable resources are strongest and most abundant will require the construction of transmission lines to move the power out of rural areas where it is generated to population centers where it can be used. In addition to expanded transmission access, smart-grid technologies—discussed above—can help to reliably integrate renewable electric power generation while enabling electric vehicles to store electricity and provide enhanced demand response capabilities. Where possible, States are taking important steps to address this barrier. For example, the Western Governors' Association is working with the Department of Energy to identify "renewable energy zones" and conceptual transmission plans for delivering renewable energy from these zones to load centers. However, federal leadership will be critical in helping to ensure that adequate new transmission is built, establishing streamlined procedures and standards for interconnection, and encouraging deployment of smart-grid technologies to enable full utilization of renewable resources.

The federal government has an important role to play in eliminating regulatory barriers to the expansion of renewable electricity generation. Despite the success of State-level initiatives to promote renewables, the balkanized structure for electricity regulation and the

inconsistency of federal and State incentive programs have created a relatively unstable investment climate for the domestic renewable electricity market, limiting financing opportunities for individual projects and domestic manufacturing capacity. The federal government has a key role to play in helping to rationalize these programs and regulatory regimes to encourage expanded renewable electricity generation.

While in no way a comprehensive list, the renewable resources outlined below are most likely to contribute significantly to the U.S. and global electricity supply over the next two to three decades.

Wind

More than 20,000 megawatts of new wind capacity was installed worldwide in 2007, more than a quarter of which was installed in the United States. Germany is the global leader in installed wind capacity, with the United States now second. Wind generating capacity has been growing at more than a 30 percent annual rate in the United States since 2000. In 2007 wind power accounted for 35 percent of all new generating capacity in the United States.

Department of Energy research suggests generating 20 percent of electricity from wind in the United States is an ambitious yet feasible scenario if certain challenges are overcome.[292] With policy support, the United States is protected to have more than 60,000 megawatts of wind installed by 2012 and by 2016 it could reach 112,000 megawatts, surpassing nuclear capacity in the United States. To meet this goal, wind turbine production capacity would have to ramp up to 16,000 new megawatts per year by around 2018—up from current production capacity of approximately 7,000 megawatts per year.

As wind technology continues to improve, prices are falling and capacity factors are increasing. The cost of wind energy over the past 20 years has dropped from 40 cents per kWh to 4 to 6 cents per kWh at good sites. While most new wind turbines in the United States produce 1.5 to 2 megawatts of power, superconducting materials may enable the construction of 10 megawatt turbines in the near future.[293] Increases in the capacity factor of the turbines—or the percentage of time in which they are producing at their full capacity—have grown 11 percent over the past two years and will continue to increase as the technology improves.

Solar

With more energy in the form of solar radiation striking the Earth's surface in an hour than humanity uses in an entire year, the available solar resource is enormous. Capturing this energy and converting it into electricity is primarily done through photovoltaic cells that convert sunlight into direct electrical current and concentrating solar power, which concentrates the sun's energy using huge mirrors or lenses and then uses this heat to run a conventional turbine.

[292] U.S. Department of Energy, 20% Wind Energy By 2030: Increasing Wind Energy's Contribution to the U.S. Electricity Supply (July 2008), available at http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf.
[293] Testimony of Greg Yurek before the Select Committee on Energy Independence and Global Warming, on "Renewing America's Future: Energy Visions of Tomorrow, Today" (July 31, 2008).

Solar photovoltaics (PV) have experienced explosive growth over the last several years—but, unfortunately, the United States is falling behind in this lucrative emerging market. World capacity grew 62 percent in 2007 alone[294] and installed capacity has grown from 1,200 megawatts in 2000 to 9,200 megawatts in 2007.[295] Solar PV installations in the United States grew by over 80 percent in 2007.[296] Nevertheless, the United States fell to the fourth largest PV market in the world, behind Germany, Japan, and Spain. Technology advances and increases in the scale of production in the solar industry have exceeded those of any other renewable energy sector as prices for PV modules have fallen to around $4 per watt from almost $100 per watt in 1975. Solar PV prices have declined an average of 4 percent per year over the past 15 years.[297] The Department of Energy's Solar America Initiative seeks to make solar PV cost-competitive with conventional forms of electricity by 2015. With huge investments in new production of polysilicon (the critical input for most PV cells) ready to come online in 2009, the materials shortage that plagued the industry for the last few years will likely be alleviated. Production costs—and PV module prices—are expected to continue falling.

Over the next two decades, solar PV will become a major source of power—both here in the United States and globally. Solar PV is projected to grow from a $20 billion industry in 2007 to a $74 billion industry within a decade. A study from the National Renewable Energy Laboratory found that installed capacity in the United States could climb to 10,000 megawatts by 2015, 26,000 megawatts by 2020, and ultimately more than 100,000 megawatts by 2030 with the passage of the critical 8-year extension of the investment tax credits included in the financial rescue package enacted in October, 2008.[298] Globally, research from the European Photovoltaic Industry Association and Greenpeace suggests that by 2030, global PV capacity could reach 1,864,000 megawatts and satisfy the electricity needs of 14 percent of the world's population.[299]

Concentrating solar power (CSP) systems will deliver large-scale, centralized electricity generation from solar energy. CSP systems are generally utility-scale projects with many acres of mirrors and lenses that can produce dozens to hundreds of megawatts of electrical power. The National Renewable Energy Laboratory has identified the potential for nearly 7,000,000 megawatts of solar thermal power generation in the southwestern United States, roughly seven times current U.S. electric generating capacity. More than 4,000 megawatts of solar thermal projects are currently in development nationwide, and Environment America has projected

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[294] Solarbuzz, Marketbuzz 2008: Annual World Solar Photovoltaic industry Report (2008), available at http://www.solarbuzz.com/Marketbuzz2008-intro.htm.

[295] European Photovoltaic Industry Association and Greenpeace, Solar Generation V – 2008 Solar electricity for over one billion people and two million jobs by 2020 (2008), available at http://www.greenpeace.org/raw/content/international/press/reports/solar-generation-v-2008.pdf.

[296] Jonathan Dorn, Earth Policy Institute, Solar Cell Production Jumps 50 Percent in 2007 (Dec. 27, 2007), at http://www.earth-policy.org/Indicators/Solar/2007.htm.

[297] Solarbuzz. Fast Solar Energy Facts: Global Performance, at http://www.solarbuzz.com/FastFactsIndustry.htm (last visited Oct. 20, 2008).

[298] Robert Margolis, National Renewable Energy Laboratory, Quantifying the Benefits of Extending the Solar ITC (Feb. 2008)

[299] European Photovoltaic Industry Association and Greenpeace, Solar Generation V – 2008: Solar electricity for over one billion people and two million jobs by 2020 (2008), available at http://www.greenpeace.org/raw/content/international/press/reports/solar-generation-v-2008.pdf.

80,000 megawatts could be built by 2030 with investment tax credit support.[300] The cost of energy from solar thermal power plants is estimated to be approximately 14 to 16 cents/kWh.[301]

Geothermal

The United States has about 35 percent of the world's installed capacity of geothermal energy, with about 2,500 megawatts connected to the grid across six States. While several new facilities are in construction around the country, the amount of electricity produced from geothermal energy has essentially been flat for the past two decades. New facilities are estimated to be able to produce base load electricity for 5 to 7 cents/kWh.[302]

The United States has massive, untapped geothermal energy resources. Scientists with the U.S. Geological Survey (USGS) recently found that the electric generation potential from currently identified geothermal systems distributed over 13 U.S. states is more than 9,000 megawatts. Their estimated power production potential from yet to be discovered geothermal resources is more than 30,000 megawatts. An additional 500,000 megawatts may be available by harnessing geothermal reservoirs characterized by high temperature, but low permeability, rock formations.[303]

An MIT study estimated that recovering a small fraction of the available resource using conventional geothermal as well as enhanced (or engineered) geothermal systems, could feasibly yield 100,000 megawatts of electrical power in the United States by 2050.[304] And a study sponsored by the Western Governors Association found 5,600 megawatts of new geothermal capacity could be added through 2015 and 13,000 megawatts within the next 20 years in their 13-State region.[305]

Biomass

Biomass currently supplies more electricity in the United States than wind, solar, and geothermal power combined, and the potential for additional generation from this energy source is vast. Biomass available for electricity generation includes residues from forests, primary mills, and agriculture, as well as dedicated energy crops and urban wood wastes. Biomass can be used as the sole fuel source for power plants, or it can be used in conventional

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[300] Solar Energy Industries Association, U.S. Solar Industry: 2007 Year in Review (2007), available at http://seia.org/galleries/pdf/Year_in_Review_2007_sm.pdf.

[301] Bernadette del Chiaro et al., Environment America Research and Policy Center, On the Rise: Solar Thermal Power and the Fight Against Global Warming (Spring 2008), available at http://www.environmentcalifornia.org/uploads/EX/qu/EXqur2dJBZQbJESwUtulZA/On-The-Rise.pdf.

[302] California Energy Commission, Comparative Cost of California Central Station Electricity Generation Technologies, Final Staff Report (June 2003), available at http://www.energy.ca.gov/reports/2003-06-06_100-03-001F.PDF.

[303] U.S. Geological Survey, Fact Sheet: Assessment of Moderate- and High-Temperature Geothermal Resources of the United States (2008), available at http://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf.

[304] Massachusetts Institute of Technology. The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems on the United States in the 21st Century at 1-3 (2006), available at http://www1.eere.energy.gov/geothermal/pdfs/future_geo_energy.pdf.

[305] Martin Vorum & Jefferson Tester, "Potential Carbon Emissions Reductions from Geothermal Energy by 2030," in Tackling Climate Change in the U.S. at 153 (2007).

power plants to substitute for a portion of the traditional fuel, typically coal, in a process called co-firing. While most co-firing plants use biomass for between 1 and 8 percent of heat input,[306] biomass can effectively substitute for up to 20 percent of the coal used in the boiler.[307] In addition to reducing lifecycle greenhouse gas emissions, co-firing biomass also lowers fuel costs, avoids landfilling, and reduces emissions of sulfur oxide and nitrogen oxide.

An EIA analysis of the impacts of a 15 percent national renewable electricity requirement found that electricity production from biomass could grow by a factor of eight between 2005 and 2030.[308] Most of this generation would come in the southeastern United States, where nearly a third of the country's biomass feedstock potential exists.[309] The EIA found that the Southeast region could meet nearly its entire 15 percent renewable requirement through 2020 with indigenous biomass resources.[310] In a September 20, 2007 Select Committee hearing on renewable electricity standards, venture capitalist Nancy Floyd, founder and managing director of Nth Power, agreed that a biopower industry could be jumpstarted in the South that would drive private investment and spur the regional economy. Using biomass for electricity would help the region create thousands of blue collar jobs, increase global export opportunities, and keep billions of dollars in the Southeast that would have otherwise left to import coal and other fuels from other States and countries.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Cap-and-Invest:** Enact a mandatory, economy-wide cap-and-invest system to provide a stable, long-term price signal for carbon and to correct the massive market failure currently putting renewable electricity generation at a competitive disadvantage with high-carbon electricity sources. Use allowance auction proceeds to fund early deployment of renewable electricity generation, either through extension of the production tax credit and investment tax credit or through an analogous rebate or grant program.

- **National Renewable Electricity Standard:** Enact a Renewable Electricity Standard (RES) to require utilities to meet a gradually increasing percentage of their generation with renewable sources. This technology-neutral approach allows utilities to meet the standard using the most cost effective renewable option in the area in which they operate.

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[306] Zia Haq, Energy Information Administration, Biomass for Electricity Generation, available at http://www.eia.doe.gov/oiaf/analysispaper/biomass/.
[307] Federal Energy Management Program (FEMP), Biomass Cofiring in Coal-fired Boilers, DOE/EE-0288. (2004), available at http://www1.eere.energy.gov/femp/pdfs/fta_biomass_cofiring.pdf.
[308] Energy Information Administration, Impacts of a 15-Percent Renewable Portfolio Standard at 9 (Table 2: Summary Results) (June 2007), available at http://www.eia.doe.gov/oiaf/servicerpt/prps/pdf/sroiaf(2007)03.pdf. .
[309] Marie Walsh et al., Oak Ridge National Laboratory, Biomass Feedstock Availability in the United States: 1999 State Level Analysis (Jan. 2000), available at http://bioenergy.ornl.gov/resourcedata/index.html.
[310] Energy Information Administration, Regional Generation Impacts of a 15-Percent Renewable Portfolio Standard (RPS) (Supplement to Report #: SR-OIAF/2007-03) (June 2007), available at http://www.eia.doe.gov/oiaf/servicerpt/prps/pdf/regional_generation.pdf .

- **Double Federal RD&D Spending:** Double federal investment in research, development, and demonstration to accelerate the pace of innovation and technology development and reassure private investors that this area is important to the public and worth their investment.

- **5-8 Year Extension of the Production Tax Credit:** Provide a five- to eight-year extension of the production tax credit for renewable electricity generation, to provide the investment certainty needed for manufacturers and developers of renewable energy systems—especially in the wind industry—to expand.

- **Develop a National Green Transmission Policy:** The Department of Energy and the Federal Energy Regulatory Commission, in collaboration with States, federal land management agencies, and industry and non-governmental stakeholders, should conduct a national assessment of transmission infrastructure needs to support an expansion of renewable electricity generation and should develop a comprehensive national policy to enable the construction of green transmission.

D. DRIVE THE DEVELOPMENT OF CARBON CAPTURE AND SEQUESTRATION

Carbon capture and sequestration (CCS) technologies will be crucial to reconciling our continued reliance on coal with the urgent need to reduce greenhouse gas emissions. This was the clear message of the Select Committee's September 6, 2007 hearing on "The Future of Coal," at which Governor Dave Freudenthal of Wyoming testified together with several leading industry and non-governmental experts. As foreshadowed above, this is both a domestic and a global issue because the United States has vast coal reserves and currently relies on coal for nearly 50 percent of its electricity generation, while China and India also have large reserves and are even more dependent on coal for power generation.

CCS involves physical capture of CO_2 at power plants and other major point sources and compression and injection of CO_2 into deep geological reservoirs (or some other means of permanent sequestration, such as integration into concrete). There are three principal technology options for capturing CO_2 emissions at coal-fired power plants: (1) pre-combustion capture using integrated combined cycle (IGCC) technology; (2) pre-combustion capture using oxy-fuel combustion; and (3) post-combustion capture using solvents or membranes. Research indicates that it is possible to capture greater than 85 percent of the emissions stream generated by a power plant or other major industrial source, though implementation of currently available capture technology does impose a significant energy penalty.[311]

If captured CO_2 is to be injected, it is compressed into a dense fluid (supercritical) state for transport via pipeline to an injection site. Three types of geologic formations are well-suited to long-term storage of injected CO_2: depleted oil and gas fields, saline formations, and deep coal seams. Surveys indicate that both global and U.S. storage capacity is potentially vast. Even the IPCC's low-end estimate of 1680 gigatons of global capacity is equivalent to over 70 years of emissions from all global fossil fuel combustion at current levels, while the high-end capacity estimate would be over six times greater.[312] The Department of Energy projects that U.S. domestic geologic formations "have at least enough capacity to store several centuries' worth of point source emissions" from the United States.[313] There appears to be a good correlation between emissions sources and geological basins suitable for long-term storage, and preliminary assessments suggest that risks to human health and the environment from large-scale injection of CO_2 are limited.[314]

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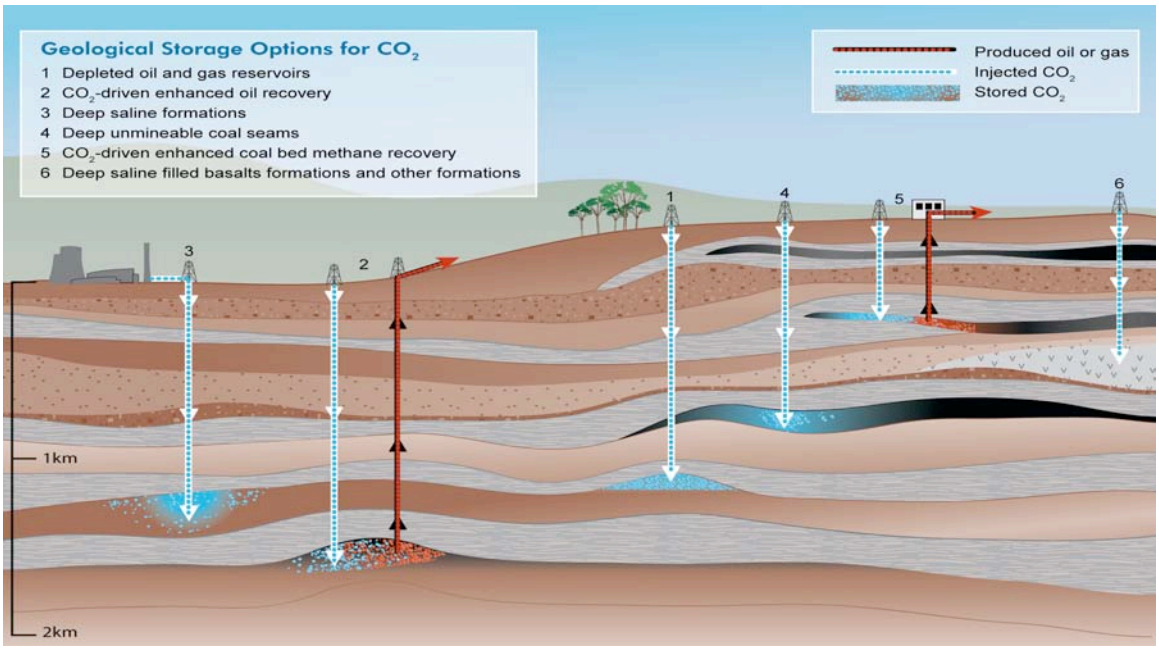
[311] For discussion of capture technologies, see, e.g., Massachusetts Institute of Technology, The Future of Coal at 17-40 (2007) [hereinafter "MIT Future of Coal"]; Intergovernmental Panel on Climate Change, Special Report: Carbon Dioxide Capture and Storage, Summary for Policymakers at 5-12 (2005) [hereinafter "IPCC CCS Report"].
[312] IPCC CCS Report, supra note 311, at 197.
[313] U.S. Department of Energy, Carbon Sequestration: Technology Roadmap and Program Plan 2005, at 4 (2005) available at http://fossil.energy.gov/programs/sequestration/publications/programplans/2005/sequestration_roadmap_2005.pdf.
[314] IPCC CCS Report, supra note 311, at 8; MIT Future of Coal, supra note 311, at 50.



Source: Intergovernmental Panel on Climate Change, Special Report: Carbon Dioxide Capture and Storage, Summary for Policymakers (2005).

Although most of the technologies on which CCS is based are already proven, they have not yet been integrated or implemented at commercial scale. Underground injection of naturally produced CO_2 has been used since the early 1970s as part of enhanced oil recovery (EOR) projects, and there are several major commercial projects worldwide that inject captured CO_2 for underground storage, as well as a growing number of pilot-scale projects. However, successful commercial development of CCS requires that we move quickly to implement commercial-scale demonstration projects integrating capture and storage technologies.

Because of the costs of implementing CCS technologies, they will not be deployed on a commercial scale without the establishment of appropriate regulatory drivers. For example, projected construction costs for IGCC plants using CCS are 32-47 percent greater than for conventional IGCC plants while supercritical pulverized coal plants using CCS have capital costs 60-73 percent greater than conventional supercritical pulverized coal plants.[315] Absent regulatory limits on CO_2 emissions, implementation of CCS is expected to increase the overall cost of electricity by 25 to 85 percent in comparison with an uncontrolled plant—at least for first-generation projects.[316] State utility regulation in most cases would prevent utilities from recovering this cost differential, making utilities highly unlikely to invest in CCS in the absence of regulatory requirements to do so.

[315] Testimony of Robert Sussman before the Select Committee on Energy Independence and Global Warming, hearing on "The Future of Coal," Sept. 6, 2007 (using studies conducted by the Massachusetts Institute of Technology, the Department of Natural Resources and the Public Service Commission of Wisconsin, and the U.S. Environmental Protection Agency).
[316] Id.

In addition, substantial legal and regulatory obstacles must be resolved before widespread commercial deployment of CCS will be possible. EPA has recently promulgated a proposed rule governing regulation, under the Safe Drinking Water Act, of geological injection of CO_2 for sequestration.[317] However, as a recent Government Accountability Office report requested by the Select Committee emphasized, the proposed rule leaves unclear a host of regulatory issues—including how releases of CO_2 to the atmosphere will be addressed, and how geological injection of CO_2 will be treated under other environmental statutes such as CERCLA and RCRA.[318] In addition, there are substantial unanswered questions regarding who has ownership over injected CO_2 and who will be liable for any damage resulting from leakage of injected CO_2.[319] Some of these issues—particularly with regard to property rules—will likely be answered at the State level. The liability issue in particular may require the enactment of a federal legal framework governing these issues in future.

Even enactment of economy-wide climate legislation, standing alone, likely would not result in widespread commercial deployment of CCS within the next two decades, because the price of carbon will not be high enough to justify CCS before that time. Multiple analyses have concluded that the price per ton of CO_2 necessary to make implementation of CCS economically rational is on the order of $25-50 or more.[320] Under the climate proposals currently under consideration, these carbon price thresholds may not be reached until far into the future, making commercial deployment of CCS unlikely in the next two decades without additional policy drivers.

Complementary policies—including performance standards for new coal-fired power plants and financial incentives for early adopters of CCS technology for coal-fired power plants—will be necessary to ensure rapid development and deployment of CCS. Adoption of national performance standards requiring implementation of CCS technologies, by a date certain, on all new coal-fired power plants would provide the private sector with a strong signal and powerful incentives to move forward rapidly with development and deployment of such technologies. H.R. 6186 includes such performance standards, as does the Dingell-Boucher climate legislation discussion draft circulated in October 2008—the latter with later implementation deadlines than the former. Simultaneously, the federal government can provide support in the form of funding for early movers, under a cap-and-invest program, for the incremental costs of implementing CCS. Most proposed climate legislation has included such incentives in one form or another.

Congress has taken some important preliminary steps to promote development of CCS-related technologies. Most importantly, Sections 702 and 703 of EISA require the Department

[317] Environmental Protection Agency, Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells; Proposed Rule, 73 Fed. Reg. 43,492 (July 25, 2008).
[318] Government Accountability Office, Climate Change: Federal Actions Will Greatly Affect the Viability of Carbon Capture and Storage As a Key Mitigation Option, No. GAO-08-1080 (Sept. 2008).
[319] Id.
[320] Testimony Robert Sussman before the Select Committee on Energy Independence and Global Warming hearing on "The Future of Coal," Sept. 6, 2007 (Using studies conducted by the Massachusetts Institute of Technology, the Department of Natural Resources and the Public Service Commission of Wisconsin, and the U.S. Environmental Protection Agency).

of Energy to undertake 3-5 large-scale capture projects and 7 large-scale geological storage projects and authorizes nearly $2 billion over four years for that purpose. EISA Sections 711 and 714 require the Department of Interior to conclude a comprehensive assessment of geological storage opportunities in the United States and to make recommendations to Congress regarding a framework for geological sequestration on federal lands. In addition, as part of the "Energy Improvement and Extension Act of 2008" (enacted as part of H.R. 1424, the October 2008 economic rescue legislation), Congress provided tax credits for CCS projects: $20 per metric ton of CO_2 captured and disposed of in secure geological storage and $10 per ton captured and used for qualified enhanced oil or natural gas recovery projects.

Despite these steps forward, the CCS demonstration program remains underfunded, and concerted action is necessary to speed the development and commercial deployment of CCS. The Department of Energy's current technology roadmap does not predict widespread commercial availability of CCS until 2020—by which time substantial new convention coal-fired generation capacity may already have been constructed in the U.S. and globally without CCS capability built in. The next Administration and Congress must make CCS demonstration and an urgent priority, so that the United States can both implement this technology domestically and export it to the remainder of the world.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Fund CCS Demonstration Projects and R&D Activities:** Congress should fully fund the CCS demonstration program authorized by EISA and the Administration should move expeditiously to implement that program. In addition, Congress should dramatically increase federal spending on CCS research and development activities authorized under the Energy Policy Act of 2005.

- **Performance Standards for New Coal-Fired Power Plants:** Congress should enact legislation, either in tandem with economy-wide cap-and-invest legislation or (if necessary) independently of it, mandating that all new coal-fired power plants implement CCS within a reasonable period after commencing operation.

- **Fund CCS Deployment Through Cap-and-Invest:** Congress should include funding for CCS demonstration projects and deployment incentives in comprehensive cap-and-invest climate legislation.

- **Establish an Interagency CCS Task Force:** The next Administration should promptly establish an interagency task force to address – in a proactive and coordinated fashion – the legal and regulatory obstacles to commercial deployment of CCS. This effort should include:
    - Completing a detailed national assessment of geological storage opportunities

- Completing EPA's underground injection regulations under existing legal authority, and providing recommendations to Congress regarding any additional regulatory authority needed to address CO_2 injection activities.
- Making comprehensive recommendations to Congress regarding the appropriate legal framework needed to address financial responsibility and other issues associated with CCS.

E. TRANSFORM THE U.S. TRANSPORTATION SYSTEM THROUGH FUEL EFFICIENCY, ELECTRIC-DRIVE VEHICLES, LOW-CARBON FUELS, AND TRANSPORTATION CHOICES

The U.S. transportation sector produces roughly a third of total U.S. greenhouse gas emissions, accounts for nearly 70 percent of total U.S. oil consumption, and is 95 percent dependent upon petroleum. To reduce both oil consumption and emissions in the transportation sector will require the United States to address three interrelated issues—the efficiency of our vehicles, the fuels that power them, and how much we drive them.

1. Vehicles—Increase Fuel Economy and Transition to Electric Drive

Implementing higher fuel economy standards is one of the single most important means to increase the United States' energy independence. After Congress first increased fuel economy standards for automobiles from 13 miles per gallon (mpg) to 27.5 mpg starting in 1975, imported oil as a percentage of total U.S. consumption fell from 47 percent in 1977 to 27 percent in 1985. However, after Congress in the mid-1990s blocked both the Clinton Administration's authority to increase fuel economy standards and Chairman Markey's repeated legislative efforts to do so, U.S. dependence on imported oil skyrocketed to 60 percent by 2005.

The 110th Congress scored a major achievement on this front by mandating that fuel economy standards increase by at least 40 percent by 2020. With the passage of EISA, Congress for the first time since 1975 mandated an increase in fuel economy standards for the nation's fleet of cars and light trucks to achieve the maximum feasible standard for each model year beginning in 2011 such that the average of the fleet achieves at least 35 mpg by 2020. This will save at least 2.5 million barrels of oil per day by 2030—more than all the oil currently imported from the Persian Gulf. In addition, it will reduce U.S. greenhouse gas emissions by more than 500 million metric tons of carbon dioxide equivalent per year by 2030 and will save consumers almost $22 billion annually by 2020 in gasoline that they will not have to buy, even after paying for the new fuel efficient technologies.

In addition, Congress has provided substantial support for research, development, demonstration, and deployment of technologies to improve vehicle efficiency. In addition to setting new CAFE standards, EISA authorized a number of research, development, demonstration, and deployment programs for plug-in hybrid, advanced vehicle battery, and other advanced vehicle technologies. EISA also authorized $25 billion in loans to support retooling of U.S. auto manufacturing facilities to produce more fuel efficient vehicles—a program that was fully funded under H.R. 2638, the Continuing Resolution enacted September 30, 2008.

The future of transportation lies in the transition from internal combustion engines to electric vehicles. As the Select Committee learned during its July 2007 and June 2008 hearings focusing on efficient vehicles, the development of plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles hold great potential to enhance America's energy independence and reduce greenhouse gas emissions. Electric motors are three to four times more efficient at turning their fuel into useful work than either gasoline or diesel engines. They also consume no energy while idling and utilize regenerative braking to recharge the vehicle's battery. The oil refining and

delivery process is also extremely inefficient and energy-intensive compared to back-end processes required to get electricity to its point of use.

General Motors, Chrysler, Toyota, and Nissan have all announced plans to produce all-electric vehicles or PHEVs for the U.S. market, with the Chevrolet Volt expected to be the first vehicle from the major manufacturers to hit the market in 2010. Plug-in models like the Volt are expected to have an all-electric range of around 40 miles. Since 75 percent of Americans drive less than 40 miles per day, these vehicles would allow most drivers to eliminate gasoline from their daily commutes altogether. An alternative, more transformative approach is currently being developed by California-based Project Better Place and Nissan in Denmark and Israel. Under this approach, a company maintains ownership of batteries—thereby substantially lowering the upfront cost of the vehicles—and car owners would substitute out or recharge batteries at stations around the country when the vehicle needs a fresh charge. If fully implemented, this approach would extend vehicle range indefinitely and thus makes electric vehicles more readily available to greater segments of the driving population. However, it requires government support to help build the infrastructure needed for drivers to switch batteries.

The electric grid is an important and readily available piece of infrastructure that could power the transport sector in the United States. The electric infrastructure is currently designed to meet the highest expected demand for power, which only occurs for a few hundred hours a year. During the night more than 50 percent of generating capacity lies idle. By utilizing this idle generating capacity, the Department of Energy's Pacific Northwest National Laboratory found that up to 84 percent of U.S. cars, pickup trucks, and sport utility vehicles can be transitioned to electricity without building a single new power plant. Since only 1.6 percent of U.S. electricity comes from burning oil, an 84 percent level of electric vehicle penetration is estimated to eliminate the consumption of 6.5 million barrels of oil equivalent per day, more than all the oil currently imported from OPEC countries. With the cost of gasoline at $3.50 per gallon and the national average cost of electricity of 9.5 cents per kilowatt hour, an electric vehicle runs on an equivalent of around 84 cents per gallon.

PHEVs slash greenhouse gas emissions, even with our current electricity fuel mix. As highlighted by Austin Texas Mayor Will Wynn in testimony before the Select Committee on July 12, 2007, a battery-powered electric vehicle generates only 40 percent of the greenhouse gases produced by an equivalent gasoline vehicle, despite nearly half of U.S. electricity coming from carbon-intensive coal combustion. Greenhouse gas benefits will improve in the future as renewable electricity generation ramps up.

The 110th Congress has taken important steps towards the promotion of electric vehicles and domestic production of efficient vehicles. The tax credits passed in the economic rescue package (H.R. 1424) would range from $2,500 to $15,000, depending on the vehicle's size and battery capacity, and would be used against the purchase of a new plug-in vehicle until the total number of qualified vehicles sold in the United States reached 250,000. In addition, Congress appropriated $25 billion in loans to assist the auto industry retool existing manufacturing plants to build more fuel efficient vehicles, pursuant to Section 136 of EISA.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Ensure Rigorous Implementation of CAFE Standards:** Congress should encourage or require NHTSA to adopt realistic estimates of future gasoline prices in analyzing the economic feasibility of EISA's fuel economy standards, and should closely oversee NHTSA's development and implementation of those standards (for more on this, see the NHTSA oversight section below).

- **Grant the California Waiver Request:** EPA should grant the Clean Air Act waiver sought by California to impose more stringent tailpipe standards on its automotive fleet (standards which more than a dozen additional States also wish to adopt). This waiver was denied in December 2007 by the Bush Administration.

- **Expand Tax Credits for Efficient Vehicles and for PHEV Conversions:** Congress should continue to aggressively promote the development and deployment of plug-in hybrid and all-electric vehicles. In addition to the just-enacted tax incentives for the purchase or plug-in hybrid vehicles, Congress should support additional tax incentives for conversion of existing cars and trucks to electric vehicles and should consider tax credits for trading in less fuel efficient vehicles in order to purchase fuel efficient ones.

- **Expand Federal RD&D:** Congress should support a robust program of research, development, and demonstration of advanced automotive technologies – particularly advanced battery technologies that will support the transition to electric vehicles.

- **Fund Loan Guarantees for Advanced Battery Development:** Congress should fully fund Section 135 of EISA which authorizes loan guarantees for the development of advanced batteries for plug-in-hybrid and all-electric vehicles.

- **Oversee Loan Guarantee for Auto Plant Retooling:** Congress should aggressively oversee the implementation of the EISA Sec. 136 loan guarantee program for advanced technology vehicles.

- **Establish State Electric Vehicle Grant Program:** Congress should create a "State Electric Vehicle Grant Program," similar to other federal energy efficiency programs, to enable State and local governments to apply for grants to procure plug-in-hybrid or all-electric vehicle fleets as well as install any needed charging and/or battery swapping infrastructure.

2. Fuels—Promote Advanced Biofuels and Restrict High-Carbon Fuels

Biofuels

Biofuels—and particularly advanced biofuels—can dramatically reduce our reliance on imported oil while at the same time cutting greenhouse gas emissions. Ethanol biofuels convert the starches and sugar in plant-based materials into ethanol, typically using either an

enzymatic or a gasification process. Current ethanol production uses corn, beets, cereals, or sugar cane for feedstock. Almost all U.S. ethanol is produced from corn starch. Cellulosic ethanol, by contrast, is produced from the non-edible parts of plants; it can be produced from algae waste biomass, switchgrass and other plants that require lower energy or water inputs compared to conventional feedstock. Cellulosic ethanol faces some remaining technical and economic hurdles, but offers great promise because it does not compete with food production for feedstock (as corn-based ethanol does) and has lower lifecycle greenhouse gas emissions. Biodiesel, made of fats from animal or vegetable oils, is virtually indistinguishable from traditional petroleum-based diesel.

Because they can be domestically produced, biofuels have become an integral element of efforts to reduce oil imports. Biofuels accounted for only four percent of total U.S. fuel consumption as of 2006, but EIA projects that they will account for nearly 16 percent of consumption by 2030.[321] A 2005 report prepared for the Department of Energy found that the United States could produce sufficient biomass to produce biofuels to displace 30 percent of current fuel consumption by 2030.[322]

Depending on the biofuel source, lifecycle greenhouse gas emissions from biofuels can be 12 to 71 percent lower than the greenhouse gas emissions from conventional petroleum-based fuel.[323] Some researchers and stakeholders have expressed concerns about so-called "dirty" biofuels, which have hidden lifecycle greenhouse gas emissions or other adverse environmental impacts attributable, for example, to clearing of tropical forests to produce palm oil for biofuels.[324] These concerns can be addressed through lifecycle emissions standards and sustainability standards, which are incorporated into the current U.S. renewable fuel standard (discussed below) and can be included in a future low-carbon fuel standard (also discussed below).

U.S. biofuels development and production are surging, thanks to federal incentives and mandates. After the 1979 oil embargo, a tax credit for blending ethanol with gasoline was introduced, and biofuels tax credits continue today. The May 2008 Farm Bill adjusted the tax credit for blending ethanol into gasoline down to $0.45 per gallon for corn ethanol and up to $1.01 per gallon for cellulosic ethanol. The tax credit for blending biodiesel is $1.00 per gallon.

The Energy Policy Act of 2005 created a Renewable Fuels Standard (RFS) under Section 211(o) of the Clean Air Act, establishing a national mandate to blend in an increasing volume of biofuels on an annual schedule, culminating in 7.5 billion gallons of ethanol by 2012. In 2007, EISA expanded and restructured the RFS—requiring the U.S. fuel supply to include 36 billion gallons of biofuels by 2022, with subsidiary mandates for production of non-corn-based

[321] EIA AEO 2008, supra note 191, at 81.
[322] See generally Robert D. Perlack et al., Oak Ridge National Laboratory Technical Report, Biomass as Feedstock for A Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply (2005), available at http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf.
[323] Environmental Protection Agency, Fact Sheet: Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuel Use, Doc. No. EPA420-F-07-035 (April 2007), available at http://www.epa.gov/OMS/renewablefuels/420f07035.pdf.
[324] Worldwatch Institute, Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture. German Ministry of Food, Agriculture and Consumer Protection at 196-201 (2007).

"advanced biofuels," biomass-based diesel, and cellulosic biofuels. Lifecycle greenhouse gas emissions of advanced biofuels and biomass-based diesel must be 50 percent below the average emissions of the U.S. fuel supply in 2005, and a 60 percent reduction is required for cellulosic biofuels. In addition, 35 states have some form of RFS or financial incentives for biofuel production. Ethanol is currently blended into about 46 percent of U.S. gasoline, the majority as a 10 percent blend in gasoline (E10). Every automobile in the United States can run on E10. Flex-fuel vehicles, which are more widely available in Brazil and other parts of the world than in the United States, can operate on fuel blends of up to 85 percent ethanol (E85). New engine designs and technology are being developed to capitalize on ethanol's higher octane and reduce its fuel economy penalty.

U.S. production of fuel ethanol jumped from 175 million gallons in 1980 to an estimated 6.5 billion gallons in 2007.[325] Biodiesel has also enjoyed phenomenal growth in the last few years, growing from U.S. sales of 2 million gallons in 2000 to 250 million gallons in 2006.[326] The National Biodiesel Board reported in January 2008 that the existing production capacity for biodiesel stands at 2.24 billion gallons per year, with another 1.23 billion gallons of annual capacity planned for development by the end of 2008. [327]

Biofuels lack a strong infrastructure for fuel transportation. Biofuels are largely transported via railway, tanker truck, and barge. The increasing supply and demand of ethanol may require new infrastructure to supply biofuels. Biodiesel can travel through the existing diesel fuel pipeline and storage systems, but ethanol faces challenges. Ethanol picks up excess water and petroleum sludge in existing gasoline pipelines, which can compromise ethanol fuel integrity. Furthermore, existing pipelines require additional maintenance to prevent corrosion of pipe joints. Ethanol storage tanks differ from conventional fuel tanks, though a conventional fuel tank can be converted for ethanol for approximately $1,000.[328] These differences may partially explain the low number of ethanol fuel stations. Currently, over 1,800 locations in the United States have E85 pumps, but these are primarily located in the Midwest.[329] Nationwide, there are 700 major commercial fleets using biodiesel and 1100 retail filling stations.[330] To help improve the availability of biofuels, EISA included provisions that prohibited corporate bans on installing E85 pumps and mandated an ethanol pipeline feasibility study and grants to assist with the conversion of infrastructure and storage for renewable fuels.

Although the United States is the largest producer of biofuels, other countries are developing and promoting them vigorously. The global biofuels market will expand from $20.5 billion in 2006 to $80.9 billion in 2016, driven by increasing government mandates and

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[325] Renewable Fuels Association, Changing the Climate: Ethanol Industry Outlook 2008 at 2 (2008).
[326] Miguel Carriquiry, U.S. Biodiesel Production: Recent Developments and Prospects, 13(2) Iowa Ag Review 8 (Spring 2007), available at http://www.card.iastate.edu/iowa_ag_review/spring_07/IAR.pdf.
[327] National Biodiesel Board, U.S. Biodiesel Production Capacity (Jan. 25, 2008), available at http://www.biodiesel.org/pdf_files/fuelfactsheets/Production_Capacity.pdf.
[328] Worldwatch Institute, Biofuels for Transport: Global Potential and Implications for Sustainable Energy and Agriculture at 241 (2007).
[329] See National Ethanol Vehicle Coalition, E85 Refueling Locations by State, at http://www.e85refueling.com/states.php?PHPSESSID=9924807cbc680ae06ce6c66004859b75.
[330] National Biodiesel Board, National Trucking Company's Biodiesel Study Shows Positive Results (Mar. 21, 2007), available at http://www.biodiesel.org/news/07clicktrhrus/20070321_decker.shtm.

continuing high oil prices.[331] The United States is a large contributor to this effort, leading the world in fuel ethanol production. Brazil is the second-largest producer by a slim margin (41.1 percent of the market compared to the 47.9 percent U.S. share) and relies on ethanol from domestic sugarcane (a non-food crop) for 40 percent of their auto fuel supply.[332] Brazil's biofuels industry is discussed at greater length in the section below on the Select Committee's Congressional delegation to Brazil in February 2008. Germany, Sweden, France and Spain are the largest European Union ethanol producers, primarily using beets and cereals as feedstock.[333] Biodiesel production is led by Germany, followed by the United States, France and Italy.

Concerns about the impact of biofuels production on U.S. food prices are likely overstated, but provide another reason to move towards greater reliance on cellulosic biofuels. Currently, most biofuels in the United States and Europe are made from food crops. Natural disasters, high commodity prices, and other factors have caused concern that biofuel feedstocks are becoming too valuable to sell as food supplies to poor communities. However, less than a third of U.S. retail food contains corn as a major ingredient and rising prices for corn-related products raises overall U.S. retail food prices less than 1 percentage point per year above the normal rate of inflation.[334] Although the United States is not severely impacted by higher ethanol feedstock costs, low-income developing nations may face a greater challenge.

Greater development of cellulosic biofuels allays concerns that biofuels may raise food prices. Developing cellulosic fuels from non-food sources such as switchgrass, corn stover, and bamboo weakens the link between food and fuel. Furthermore, advances in biofuel technology could help developing nations meet their own energy needs while bolstering agricultural communities abroad. This would require investment in agricultural communities and developing cellulosic biofuel infrastructure, something that is already occurring in the United States and abroad. Dr. Susan Lechine, Founder and Chief Scientist of SunEthanol, spoke of cellulosic ethanol development before the Select Committee hearing entitled "The Gas is Greener: The Future of Biofuels" on October 24, 2007. She noted that cost-effective cellulosic ethanol production is achievable in the near term, that it requires significant resources for research and development, and that it will have enormous positive impacts on the environment and the economy, especially for rural economies. At the Select Committee's July 31, 2008 hearing entitled "Renewing America's Future: Energy Visions of Tomorrow, Today," Dr. Aristides Patrinos, President of Synthetic Genomics Inc., discussed his work with Dr. Craig Venter to design and synthesize microbial cells with far superior capabilities in converting biomass feedstocks into fuels. Utilizing cutting-edge genomic technology, this company is pursuing a wide range of next generation fuels that, if feasible, will be superior to traditional biofuels (ethanol and biodiesel), more adapted to the existing infra-structure and compete successfully with gasoline and other fossil fuels.

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[331] Joel Makower et al., Clean Edge Research, Clean-Energy Trends 2007 at 3 (2007), available at http://www.cleanedge.com/reports/Trends2007.pdf.
[332] Worldwatch Institute, supra note 324, at 6.
[333] Id. at 7, 26.
[334] Ephraim Leibtag, Corn Prices Near Record High, But What About Food Costs?, 6 Amber Waves 11 (Feb. 2008), available at http://www.ers.usda.gov/AmberWaves/February08/PDF/CornPrices.pdf.

Natural Gas

Natural gas provides some benefits as a transportation fuel, but there are concerns that substantially expanding transportation demand for natural gas will raise prices—to the detriment of industrial and other consumers. Transportation currently accounts for less than 1 percent of U.S. natural gas consumption, and is used primarily to replace diesel in urban bus, truck, and auto fleets. According to EIA, the United States has only about 119,000 natural gas vehicles on the road, which displace the equivalent of about 200 million gallons of gasoline annually.[335] Currently, Honda makes the only natural gas passenger vehicle available for purchase in the United States—with sales of 500 to 1000 vehicles annually. They have also designed a home-fueling station so car owners can fill up their vehicles in their own garages. At current natural gas prices, home refueling with natural gas costs the equivalent of $1.00 to $1.50 per gallon of conventional gasoline.[336] Some analyses have concluded that lifecycle greenhouse gas emissions from natural gas vehicles are lower than for plug-in hybrids, depending on the fuel source for the electricity used to power them.[337] The United States imports only about 20 percent of the natural gas it consumes (almost exclusively from Canada), as compared with nearly 60 percent for oil.

Based on these factors, some stakeholders, such as oil billionaire T. Boone Pickens, have urged Congress to promote expanded reliance on natural gas as a transportation fuel. At the same time, however, industrial consumers of natural gas have emphasized the adverse impacts of already high natural gas prices on U.S. industry and competitiveness—and have cautioned against creating another source of demand that could drive prices yet higher.[338]

High-Carbon Fuels

"High-carbon" transportation fuels—such as those derived from tar sands, oil shale, or coal—present unacceptably high costs in the form of greenhouse gas emissions and production-related environmental impacts. While some look to these fuels as potential substitutes for imported oil, increased reliance on them will undermine our security in the long-term by greatly exacerbating the climate challenge.

Tar sands are a mixture of clay, sand, water, and bitumen, a heavy black viscous oil that can be mined and processed to extract the oil-rich bitumen, which is then refined into oil. The bitumen in tar sands cannot be pumped from the ground in its natural state. Instead, the tar sand deposits are mined using strip mining or open pit techniques, or the oil is extracted by

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[335] Energy Information Administration, Alternatives to Traditional Transportation Fuels 2006 (Part II - User and Fuel Data), Tables VI (Estimated Number of Alternative Fueled Vehicles in Use in the United States, by Fuel Type, 2003 – 2006) and C1 (Estimated Consumption of Vehicle Fuels in the United States, by Fuel Type, 2003 – 2006) (May 2008), available at http://www.eia.doe.gov/cneaf/alternate/page/atftables/afvtransfuel_II.html.

[336] Testimony of John German (American Honda Motor Company), before the Select Committee on Energy Independence and Global Warming, hearing on "What's Cooking with Gas: The Role of Natural Gas in Energy Independence and Global Warming Solutions," July 30, 2008.

[337] Id. at Appendix A.

[338] Testimony of Rich Wells (Dow Chemical Company), before the Select Committee on Energy Independence and Global Warming, hearing on "What's Cooking with Gas: The Role of Natural Gas in Energy Independence and Global Warming Solutions," July 30, 2008.

taking huge amounts of water, using energy to convert it to steam, injecting the steam underground to "cook" the sands, and then pumping the melted bitumen to the surface.[339] Around 80 percent of the world's known tar sand resources are in Alberta, Canada,[340] and tar sands currently are used to produce 40 percent of Canada's oil supply.[341]

The process of retrieving and processing tar sands is extremely energy-, land-, and water-intensive. Between two and four tons of tar sand-laden earth, along with three barrels of water, are required to produce just one barrel of oil. In Alberta's Beaver Basin, 9 percent of total surface water is consumed by the region's tar sand operation.[342] Most of this waste water ends up in toxic tailings ponds that now cover over 50 square miles of what was once boreal forest in Alberta.[343] The great amounts of energy needed for extraction and processing mean that oil sands produce three to four times the pre-combustion emissions compared to conventional petroleum oil extraction and refining.[344] Total lifecycle greenhouse gas emissions are nearly three times those of conventional petroleum.[345] The mining and processing of tar sands are Canada's fastest growing source of greenhouse gas emissions, currently accounting for 4 percent of the country's total emissions (without including the actual combustion of the fuel).[346]

Oil shale production technology remains unproven and presents very serious environmental risks. By far the largest deposits of oil shale in the world are found in the United States in the Green River Formation, which covers portions of Colorado, Utah, and Wyoming. There is an estimated 800 billion barrels of recoverable oil from oil shale in the area, more than 70 percent of which is on federally owned and managed lands.[347] At present, fundamental uncertainty remains about the technology that could ultimately be used for large-scale extraction, as well as the larger cost and environmental implications.[348] Even optimistic estimates predict it will take 20 years for tar shales to produce 1 million barrels of oil per day and 30 years to produce 3 million barrels of oil per day.[349] Moreover, oil shale's low energy content combined with its complex, expensive, and energy intensive extraction and refining requirements make it a problematic energy option. Large-scale tar shale processing is estimated to produce five times

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[339] Bureau of Land Management, Oil Shale & Tar Sands Programmatic Environmental Impact Statement Information Center website, at http://ostseis.anl.gov/guide/tarsands/index.cfm (last visited Oct. 21, 2008) [hereinafter "BLM Oil Shale & Tar Sands EIS"].
[340] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change at 268 (2007).
[341] BLM Oil Shale & Tar Sands EIS, supra note 339.
[342] Alberta Department of Energy, Fact Sheet: Oil Sands Consultation: Multistakeholder Committee Interim Report at Page 12 (Nov. 30, 2006), available at http://www.oilsandsconsultations.gov.ab.ca/docs/InterimReport_Appendix_FactSheet.pdf.
[343] Rob Gillies, Environmentalists weigh costs of Alberta oil sands, International Herald Tribune, Aug. 25, 2008, available at http://www.iht.com/bin/printfriendly.php?id=15617946.
[344] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change at 268 (2007).
[345] Ann Bordetsky et al., Natural Resources Defense Council, Driving it Home: Choosing the Right Path for Fueling North America's Transportation Future at 7 (June 2007).
[346] Canadian Association of Petroleum Producers, Canada's oil sands: Greenhouse Gas Emissions, at http://www.canadasoilsands.ca/en/issues/greenhouse_gas_emissions.aspx.
[347] BLM Oil Shale & Tar Sands EIS, supra note 339.
[348] Michael Toman et al. Unconventional Fossil-Based Fuels: Economic and Environmental Trade-Offs at xiii (Oct. 2008) (RAND study sponsored by the National Commission on Energy Policy), available at: http://www.rand.org/pubs/technical_reports/2008/RAND_TR580.pdf
[349] James Bartis et. al., Oil Shale Development in the United States at 23 (2005), available at http://www.rand.org/pubs/monographs/2005/RAND_MG414.pdf.

the pre-combustion emissions of conventional petroleum, making it even more energy intensive than tar sands.[350] If coal plants were used to power tar shale development in the Green River Formation, there would be an 80 percent annual increase in CO_2 emissions in Colorado, Utah and Wyoming.[351]

Coal-to-liquid fuels are similarly problematic from a climate and environment perspective. Coal-to-liquid (CTL) fuels are produced using the Fischer-Tropsch process to gasify coal and then convert it to liquid fuel. The production process for CTL generates twice as much CO_2 emissions per gallon than as conventional petroleum-derived fuel.[352] CCS technologies have not yet been fully developed and sequestration of emissions from coal-fired power plants should be given priority in use of limited geological and other resources. But even with CCS, lifecycle greenhouse gas emissions from CTL are likely to be higher than those from comparable petroleum-based fuels.[353] Like tar sands and tar shale, CTL production requires massive quantities of water—5 to 7.3 gallons for each gallon of CTL.[354] Moreover, to produce enough CTL to substitute even 10 percent of the current U.S. fuel supply would require a 36 percent increase in current coal production[355]—which, because of unsustainable mining practices like mountaintop removal, would result in severe negative environmental impacts.

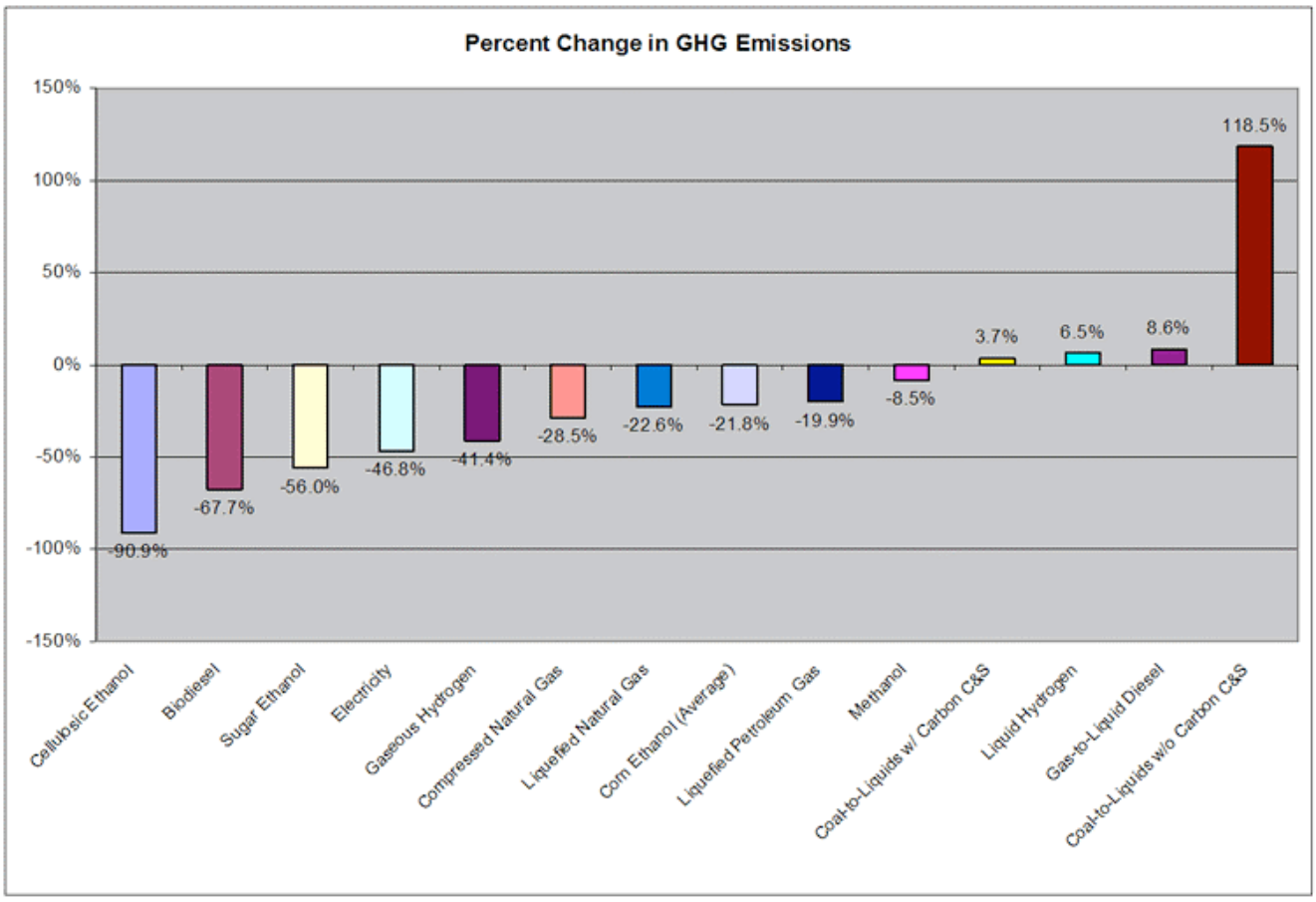
Low-Carbon Fuel Standard

A low carbon fuel standard (LCFS), which requires that the average lifecycle greenhouse gas emissions of fuels be gradually reduced from some baseline over time, provides an important mechanism for reducing fuel-related emissions. A LCFS provides an important policy mechanism for pushing low-carbon technology development and emission reductions in the transportation sector. A LCFS has certain advantages over a renewable fuel standard, because it focuses on the goal of emission reductions without regard to specific fuel type. As such, it advantages comparatively "clean" biofuels and also promotes electricity as a vehicle fuel. A LCFS can be adopted in complement with vehicle fuel economy or emission standards, as the State of California has done. California's LCFS requires a 10 percent reduction in lifecycle GHG emissions by 2020.[356] But even if a cap-and-invest system is adopted that covers transportation fuels, a LCFS serves at least two important purposes. First, it captures "upstream" emissions associated with fuel production, including overseas production, which might not otherwise be accounted for in a cap-and-invest system. Second, it helps to push the development of new fuel technologies more rapidly than the price signal of a cap-and-invest system alone would do—helping to bring advanced biofuels and electric vehicles to market more

[350] Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change at 268 (2007).
[351] The Wilderness Society, Oil Shale Fact Sheet, at http://www.wilderness.org/Library/Documents/upload/Oil_Shale_Tar_Sands_FS_global_warming.pdf.
[352] Toman et al. supra note 348, at 44.
[353] Id.
[354] National Energy Technology Laboratory, Emerging Issues for Fossil Energy and Water: Investigation of Water Issues Related to Coal Mining, Coal to Liquids, Oil Shale and Carbon Capture and Sequestration. At 20 (June 2006), available at http://www.netl.doe.gov/technologies/oil-gas/publications/AP/IssuesforFEandWater.pdf.
[355] Toman et al., supra note 348, at 39.
[356] For analysis of the California LCFS, see, e.g., Alex Farrell et al., A Low-Carbon Fuel Standard for California, Part 2: Policy Analysis (Aug. 1, 2007), available at http://www.energy.ca.gov/low_carbon_fuel_standard/UC_LCFS_study_Part_2-FINAL.pdf.

quickly. Third and relatedly, to the extent that a LCFS promotes development of *domestic* clean fuel sources, it can contribute to reducing oil imports at the same time that it helps reduce transportation sector emissions.

Lifecycle Greenhouse Gas Emissions of Fuels Relative to Conventional Gasoline



Source: Environmental Protection Agency, Fact Sheet EPA420-F-07-035, Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuels Use (April 2007), available at http://www.epa.gov/oms/renewablefuels/420f07035.htm.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Establish a National Low-Carbon Fuel Standard:** Congress should enact a low carbon fuel standard (LCFS) that would set a mandatory schedule for reducing the lifecycle greenhouse gas emissions attributable to the U.S. fuel supply. This LCFS should be harmonized with the existing RFS through 2022 and should effectively replace the RFS from 2023 and thereafter.

- **Expand Federal RD&D:** Congress should increase funding for biofuel research, development, and demonstration programs established under Title II, Subtitle B of EISA, and should support research and development of genomics-driven technologies that produce fuels from renewable feedstocks and from CO_2.

- **Renewable Fuel Infrastructure Grants:** Congress should support expanded storage and dispensing infrastructure for biofuels through the Renewable Fuel Infrastructure Grant program under Section 244 of EISA.

- **Renewable Fuel Infrastructure Tax Credits:** Congress should consider extending the Alternative Fuel Vehicle Refueling Property Credit, under which fueling stations can claim a 30 percent credit for the cost of installing clean-fuel vehicle refueling equipment. H.R. 1424 extended the credit until December 31, 2010, but Congress should consider expanding the credit to 2015 or increasing the percentage of the credit to 50 percent.

3. Reduce Vehicle Miles Traveled While Improving Quality of Life

The United States cannot meet its oil- and greenhouse gas reduction goals through vehicle efficiency improvements and low-carbon fuels alone. We must also reduce how much we drive in a way that preserves mobility and improves quality of life. The amount we drive is typically measured in "vehicle miles traveled" or VMT. Per capita VMT in the United States is dramatically higher than in other advanced industrial countries—5,700 miles a year compared with 2,368 in Japan and 3,961 in Germany as of 1997.[357] VMT in the United States is not only high in comparison with other countries; it is also growing at a dramatic rate. In 2000, VMT reached 2.8 trillion vehicle-miles, almost four times VMT in 1960.[358] It is projected that VMT will increase another 60 percent by 2030, in step with the growing U.S. population.[359] If left unchecked, this projected VMT growth will substantially reduce the oil consumption and greenhouse gas reduction benefits of EISA—while at the same time contributing to increases in conventional air pollution, auto fatalities, and increased traffic congestion.

VMT is expected to continue to rise both because the U.S. population is expected to increase by a third of its present size by 2050 and because housing size is steadily increasing, creating greater space between destinations as a result.[360] Since 1977, the size of the average U.S. home has increased over 46 percent (from 1,720 to 2,521 square feet)[361] while the average

[357] Federal Highway Administration, Our Nation's Highways – 2000, Office of Highway Policy Information. Publication No. FHWA-PL-01-1012 (2000), at http://www.fhwa.dot.gov/ohim/onh00/bar4.htm.
[358] Federal Highway Administration, Our Nation's Highways – 2000, at 24 (2000), available at http://www.fhwa.dot.gov/ohim/onh00/our_ntns_hwys.pdf.
[359] U.S. Department of Transportation, Transportation Vision 2030 at 5 (Jan. 2008), available at http://www.rita.dot.gov/publications/transportation_vision_2030/pdf/entire.pdf.
[360] For the 2050 estimate see Jeffrey Passel and D'Vera Cohn, Pew Research Center, Immigration to Play Lead Role in Future U.S. Growth: U.S. Population Projections 2005-2050 (Feb. 11, 2008), available at http://pewresearch.org/pubs/729/united-states-population-projections. For the July 2008 estimated U.S. population, see Central Intelligence Agency, The World Factbook: United States (last visited Oct. 20, 2008), available at https://www.cia.gov/library/publications/the-world-factbook/print/us.html.
[361] U.S. Census Bureau, Highlights of Annual 2007 Characteristics of New Housing, at http://www.census.gov/const/www/highanncharac2007.html.

household size in the United States dropped from 3.67 members in 1940 to 2.62 in 2002.[362] Houses built in 1950 had 290 square feet per family member; houses built in 2003 provided three times more space—893 square feet—per person.[363] As these larger houses and housing developments are built, sprawl increases and open spaces begin to shrink. It is estimated that up to 5.8 million acres of farmland and open space will be converted to commercial or residential uses by 2025.[364]

A broad array of policies can help communities to "grow smarter," while reducing VMT. Increasing mass transit and creating more pedestrian and bicycle-friendly infrastructure can encourage people to travel without using a car. Planning roads and pathways to create shorter, direct links to destinations can limit car distances. Such planning is often referred to as "smart growth" or "green communities." Communities that use smart growth principles offer environmental and financial benefits. By reducing time spent in cars, global warming pollutants are lessened. Smart growth planning also lowers the costs of road maintenance, highway expansion, and infrastructure needed to deliver utilities. These lower infrastructure costs allow states and localities to redirect budget funds to other fiscal priorities or lower taxes.

Although most of these policies are implemented at the local, State, or regional level, federal policy can play a substantial role in supporting them. Federal funding for transportation and housing and urban development have important impacts on transportation infrastructure and driving patterns and can support smart growth. Brownfield revitalization funding can transform unused, contaminated industrial urban land into viable communities without undue strain on existing infrastructure.

Reducing VMT saves consumers and taxpayers money. The high cost of infrastructure associated with spreading development can strain government budgets. Personal budgets are also impacted by sprawl. Access to transit can reduce the need of a car in a two-worker household, resulting in roughly $6,000 yearly savings and a 30 percent reduction in transportation-related carbon emissions.[365] In 2007, Americans took 10.3 billion trips using public transportation, a 32 percent increase since 1995.[366] Many believe that this increase is due to rising gas prices.[367]

Americans support expanding smart growth planning and mass transit. A 2007 Smart Growth America poll conducted in conjunction with the National Association of Realtors

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[362] U.S. Census Bureau, Table HH-6, Average Population Per Household and Family: 1940 to Present, Internet release date September 15, 2004, at http://www.census.gov/population/socdemo/hh-fam/tabHH-6.pdf.
[363] Alex Wilson and Jessica Boehland, Small is Beautiful: U.S. House Size, Resource Size, and the Environment, 9 Journal of Industrial Ecology 277 (2005).
[364] Predicting Urban Sprawl in Top 20 U.S. Coastal Cities, The Helm (Fall 2000), available at http://www.iisgcp.org/news/helm/fall2000.pdf.
[365] American Public Transit Association, 2008 Public Transportation Fact Book at 10 (June 2008), available at http://www.apta.com/research/stats/factbook/documents08/2008_fact_book_final_part_1.pdf .
[366] Id. at 7.
[367] Id. at 13; see also KFH Group, Inc. for the American Public Transportation Association, How Transit Agencies are Addressing the Impact of Fuel Price and Ridership Increases at 3 (Sept. 22, 2008), available at http://www.apta.com/research/info/online/documents/impact_of_fuel_price.pdf

revealed broad public support for pedestrian friendly communities that employed a mix of residential and commercial uses. At the Select Committee's June 18, 2008 hearing entitled "Planning Communities for a Changing Climate," Smart Growth America director David Goldberg cited a 2007 Growth and Transportation Survey that revealed three quarters of Americans believe that being smarter about development and improving public transportation are better long-term solutions for reducing traffic congestion than building new roads. Half of those surveyed think improving public transit would be the best way to reduce congestion.

Both urban and rural areas can benefit from smart growth. Two witnesses at the Select Committee's "Planning Communities for a Changing Climate" hearing provided very different examples of how to implement smart growth strategies through economic development. Dr. Sultan Al-Jaber discussed the development of Masdar City, a carbon neutral, zero-waste city being built in Abu Dhabi for 50,000 people. Masdar will utilize public transportation and 100 percent renewable energy to develop and market commercially viable products to reduce energy, waste, and water consumption. Steve Hewitt, City Administrator of Greensburg, Kansas, testified about his small rural town's decision to reduce their carbon footprint. After a tornado destroyed 95 percent of Greensburg, the community decided to rebuild their main-street based town using the principles of smart growth community planning and building efficiency standards. By focusing on "greener" development, they expect to create a sustainable local industry and a stronger economic base.

The 110th Congress has taken some initial steps to promote mass transit and smart growth. It passed H.R. 6052, "The Saving Energy Through Public Transportation Act of 2008," which offers grants to assist with the costs of transit fare, facilities, and operations for public transit, including intercity bus services. It also supports commuter alternative programs. In addition, the House passed H.R. 6899, "The Comprehensive American Energy and Security Consumer Protection Act," which provides incentives to lenders and financial institutions to provide lower interest loans to consumers who live in mixed use, dense areas by accounting for money saved by living in less car-dependent areas. The Senate did not take up this bill.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Cap and Invest:** Congress should provide funding, on a competitive basis, through cap-and-invest legislation for State and local efforts to reduce VMT—for example through mass transit and smart growth planning and policies. For example, H.R. 6186 and the Dingell-Boucher climate legislation discussion draft provide for such funding.

- **Prioritize Smart Growth in Transportation Reauthorization:** Encouraging smart growth and expanding mass transit should be a central focus on the transportation reauthorization process in the 111th Congress. The next transportation reauthorization bill should encourage transit-oriented development and discourage actions to convert open spaces without regional or statewide land use plans.

- **Provide Smart Growth Support to State and Local Governments:** Congress should enact H.R. 6495, the "Transportation and Housing Choices for Gas Price Relief Act of 2008," sponsored by Select Committee member Rep. Earl Blumenauer. This legislation provides grants to state and local governments and rural and metropolitan planning organizations for the purpose of reducing VMT, technology upgrades to make public transportation systems more efficient, and establishes a location efficient mortgage goal for Fannie Mae and Freddie Mac of 15 percent by 2019.

- **Support "Complete Streets":** Congress should enact the "complete streets" principles in H.R.5951, the "Safe and Complete Streets Act of 2008." This bill requires all federally-funded transportation projects to accommodate complete streets principles to ensure that pedestrians, the disabled and cyclists, among others, are accommodated.

4. Move Towards a Lower-Carbon Aviation Sector

Aviation is an increasingly significant factor in transportation greenhouse gas emissions worldwide. Aviation emissions generate 12 percent of U.S. transportation CO_2 emissions and 3 percent of total U.S. CO_2 emissions.[368] Experts predict an increase in aviation and its impact on the environment. The Federal Aviation Administration (FAA) estimates that U.S. aviation demand will double or triple by 2025[369] and worldwide aviation emissions are expected to increase 3 to 5 percent per year.[370] Emissions from international aviation rose 48 percent from 1990-2000.[371]

Aviation emissions have a unique impact on the environment. Airplanes emit CO_2, nitrous oxide, particulate matter, and water vapor. The release of aviation emissions in high levels of the atmosphere change the properties of clouds and contrails and can change ozone levels. Inflight emissions particles freeze, forming new clouds which could impact weather patterns.[372] While the effects of CO_2 on the atmosphere are well known, the combined effect of CO_2 and other gases at high altitudes are not as well understood and could double or quadruple the warming effect of CO_2 alone.[373]

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[368] Energy Information Administration, U.S. Carbon Dioxide Emissions from Energy Use in the Transportation Sector, 1990-1998. http://www.eia.doe.gov/oiaf/1605/archive/gg99rpt/tbl8.html; Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005, Table A-108 at p. A-128 and Table ES-2 at p. ES-6 (April 15, 2007).

[369] Federal Air Administration, Next Generation Air Transportation System Integrated Plan at 8 (Dec. 2004), available at http://www.jpdo.gov/library/ngats_v1_1204r.pdf.

[370] Intergovernmental Panel on Climate Change, Aviation and the Global Atmosphere, Summary for Policymakers, How are Aviation Emissions Projected to Grow in the Future? (1999), available at http://www.grida.no/publications/other/ipcc_sr/.

[371] United National Framework on Climate Change, Executive Summary of the Compilation and Synthesis Report on Third National Communications from Annex I Parties at 6 (May 16, 2003), available at http://unfccc.int/resource/docs/2003/sbi/07.pdf.

[372] Intergovernmental Panel on Climate Change, Aviation and the Global Atmosphere: A Special Report of IPCC Working Groups I and III in Collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer, Section 3.3, 3.4, 6.1.2 (1999).

[373] Royal Commission on Environmental Pollution, The Environmental Effects of Civil Aircraft in Flight at 11-15 (Mar. 22, 2007), available at http://www.rcep.org.uk/aviation/av04-s2.pdf.

Aviation emissions are under greater scrutiny than ever before. Foreign countries, States, and members of Congress are taking note of aviation's role in global warming. The European Union has recently included aviation in its Emissions Trading Scheme. Six States and the District of Columbia, in conjunction with five environmental groups, have petitioned the EPA to regulate aircraft greenhouse gas emissions under the Clean Air Act.

Decreasing aviation emissions requires a three-fold emphasis on improving aircraft technology, increasing operational efficiency, and developing low-carbon fuels. The aviation industry and governments around the world will need to support more efficient technology and operations as well as lower-carbon fuel for airplanes. Technology has been developed to improve fuel use and associated emissions. On existing planes, lighter equipment and winglets can be attached to improve air drag. At the April 2, 2008 Select Committee hearing entitled "From the Wright Brothers to the Right Solutions: Curbing Soaring Aviation Emissions," witness Jim May, President and CEO of the Air Transport Association, testified that new engines and planes would greatly improve fuel efficiency. He additionally noted the high cost of fuel has strained the ability of airlines to purchase new equipment.

Changes in aviation operations proposed in the FAA NextGen program can streamline flights to reduce emissions. Incorporating continuous descent approaches, improved plane location technology, and decreasing the vertical distance between planes can streamline flights and prevent fuel-burning holding patterns, take-offs, and landings. Dan Elwell, Assistant Administrator for Aviation Policy, Planning, and Environment for the FAA testified at the Select Committee hearing about the importance of employing these operations as well as others.

There are several jet fuels being developed that may reduce the need for oil-based jet fuel and emit fewer global warming pollutants when burned. Virgin Airlines had a successful commercial test flight using a mix of conventional jet fuel and biofuel in February 2008, and other airlines have announced similar intentions. The Virgin flight used jet fuel developed from sustainable coconut and babassu oil, but companies are also developing a jet fuel from algae, which would use less water and natural resources than other plant-based biofuels. EISA Section 202 (amending Section 211(o) of the Clean Air Act) provided an incentive for jet biofuel production by giving jet biofuel producers "additional renewable fuel" credits, which can be used to help satisfy refiners' obligations under the Renewable Fuel Standard (RFS). However, jet fuels are not directly subject to the RFS mandate.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **FAA Reauthorization:** As part of the FAA reauthorization bill, Congress should enact the policies included in Title V of H.R. 2881 and S. 1300, which include the CLEEN—Continuous, Low Energy, Emissions, and Noise program—to develop lower energy, decreased emissions and noise technology for aircraft, and the NextGen program that outlines operations systems to eliminate unnecessary emissions.

- **Support Low-Carbon Aviation Fuels:** Congress should include aviations fuels in the low-carbon fuel standard described above and should expand support for the development of first and second generation jet biofuel, by enacting a gradually increasing mandate for the production of jet biofuel and by offering tax incentives for such production.

- **Reform NextGen:** The FAA should reform the NextGen program to place a stronger emphasis on reduction of aviation-related greenhouse gas emissions.

- **Clean Air Act Petition for Rulemaking:** In response to the State and local governments' petition for rulemaking, EPA should promptly issue a determination as to whether aircraft greenhouse gas emissions should be regulated pursuant to the Clean Air Act.

F. SUPPORT GREEN JOBS AND CLEAN TECH GROWTH

The win-win energy and climate solutions set forth above present an unprecedented opportunity for an innovation-driven economic revival in which clean energy solutions—built by American workers—are marketed around the world. In an April 2008 Select Committee hearing entitled "Green Capital: Seeding Innovation and the Future Economy," representatives from some of the country's leading venture capital firms testified that unabated climate change is one of the greatest risks facing humanity and that mitigating it constitutes one of the greatest investment and job creation opportunities in history. The business opportunity presented by clean energy technologies was echoed time and again at Select Committee hearings throughout the past 18 months. Recent investment and growth in the clean energy sector echoes this outlook. Solar, wind, biofuels, geothermal, hybrid- and all-electric vehicles, advanced batteries, green buildings, and other clean-energy technologies provided bright spots in an otherwise sluggish economy in 2007. As the U.S. economy struggled with plummeting housing prices, rising foreclosure rates, record oil prices, and creeping unemployment, the clean energy sector continued to demonstrate robust growth, attract large private sector investment, and create many new jobs.

Declining costs, coupled with State renewable electricity standards and federal tax incentives, have led to a dramatic expansion in renewable electricity generation. Renewable technologies experienced a record-breaking year in the United States in 2007. A world-leading 5,244 megawatts of new wind capacity was installed in the United States, enough to power 1.5 million homes. This amounts to 35 percent of the new electricity generating capacity installed nationwide.[374] Public policies that put these technologies on an even playing field with their fossil fuel counterparts will further drive down their costs and accelerate deployment.

As mature industries increasingly move overseas to access cheaper labor, technology and innovation-driven sectors will become the key to sustaining economic growth and creating good jobs. The $26 billion invested by venture capitalists across all sectors in 2006 represented 0.2 percent of U.S. GDP, but the $2.3 trillion in revenues these firms generated made up 18 percent of U.S. GDP. The U.S. semiconductor industry—the focus of U.S. venture capital through the 1980s and early 1990s—now employs 240,000 people in high-wage manufacturing jobs and had sales totaling $102 billion in the global market in 2000, around half of total worldwide sales. In 1999, this sector was the largest value-added industry in manufacturing in the United States, larger than the iron, steel, and motor vehicle industries combined.[375] The recent infusion of significant venture capital into clean energy indicates the sector's potential for similar growth and job creation over the coming decade.

The clean tech sector is booming. U.S.-based venture capital investments in the clean energy sector rose to nearly $3 billion in 2007, a 70 percent increase over 2006. The clean

[374] American Wind Energy Association, supra note 218.
[375] Testimony of Bill Unger (Environmental Entrepreneurs), Testimony before the Select Committee on Energy Independence and Global Warming hearing on "Blowing in the Wind: Renewable Energy as the Answer to an Economy Adrift," March 6, 2008.

energy sector now receives around 10 percent of all U.S. venture capital investments.[376] Worldwide revenue of solar photovoltaics (PV), wind, biofuels, and fuel cells grew 40 percent in 2007, up from $55 billion in 2006 to $77.3 billion in 2007.[377] New global investments in energy technologies—including venture capital, project finance, public markets, and research and development—have expanded by 60 percent from $92.6 billion in 2006 to $148.4 billion in 2007.[378] Most investment in clean energy innovation is occurring outside the established energy industries. The five major independent oil companies, for example, invested less than one hundredth of one percent of 2007 revenues in research and development. Companies in innovation-oriented sectors like the biotech, information technology, and semiconductors routinely invest 15 to 18 percent of revenues in R&D.

The renewable energy and efficiency technology sector has already become a major engine of job creation and numerous studies confirm that adoption of supportive public policies will yield substantial job growth. Research commissioned by the American Solar Energy Society found that in 2006 the energy efficiency industry had revenues of $933 billion and created 8 million jobs, 50 percent of these in manufacturing. Aggressive investment in energy efficiency would result in the creation of 32 million new jobs and nearly $4 trillion in revenues by 2030.[379] Analyses of state-level efficiency programs similarly have found that such programs have substantial benefits in terms of job creation and economic growth.[380] For example, a recent study showed that California's energy efficiency programs resulted in a net increase of nearly 1.5 million jobs from 1977 to 2007.[381] Moreover, State efficiency programs have been shown to produce savings at a rate of two dollars or more for every dollar invested.[382]

Investments in renewable energy create, on average, three to five times as many jobs as similar investments in fossil-fuel energy systems.[383] Analysis by the Union of Concerned Scientists finds that if utilities were to generate an average of 20 percent of their electricity from renewable sources, 185,000 new jobs would be created by 2020.[384] A report by Navigant

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[376] Joel Makower, et al., Clean Energy Trends 2008 (Mar. 2008), available at http://www.cleanedge.com/reports/pdf/Trends2008.pdf.
[377] Id.
[378] Chris Greenwood, New Energy Finance, slide presentation on Global Trends in Clean Energy Development at 6 (2008), available at http://www.eia.org.au/files/78V73UGICR/Greenwood.pdf.
[379] Roger H. Bezdek, Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century (2007), available at http://www.ases.org/ASES-JobsReport-Final.pdf.
[380] See Maggie Eldridge et al., Energy Efficiency: the First Fuel for a Clean Energy Future: Resources for Meeting Maryland's Electricity Needs, ACEEE (Feb. 2008); California Public Utilities Commission and California Energy Commission, Energy Efficiency – California's Highest Priority Resource (Aug. 2006), available at ftp://ftp.cpuc.ca.gov/Egy_Efficiency/CalCleanEng-English-Aug2006.pdf.
[381] Felicity Barringer, Green Policies in California Generated Jobs, Study Finds, New York Times, Oct. 20, 2008, available at http://www.nytimes.com/2008/10/20/business/20green.html.
[382] See, e.g., California Public Utilities Commission and California Energy Commission, Energy Efficiency – California's Highest Priority Resource (Aug. 2006), available at ftp://ftp.cpuc.ca.gov/Egy_Efficiency/CalCleanEng-English-Aug2006.pdf.
[383] Testimony of Daniel Kammen before the Select Committee on Energy Independence and Global Warming, hearing on "Investing in the Future: R&D needs to meet America's Energy and Climate Challenges," Sept. 10, 2008; see also Daniel Kammen et al., Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate? (2004), available at http://socrates.berkeley.edu/~rael/papers.html#econdev.
[384] Union of Concerned Scientists, Cashing in on Clean Energy, July 2007 Update, available at http://ucsusa.org/assets/documents/clean_energy/cashing-in-national.pdf.

Consulting concluded that expiration of the tax credits for renewable electricity generation would have resulted in the loss of 116,000 job opportunities and $19 billion in private investment in the U.S. in 2009.[385]

Biofuels production has substantial benefits for domestic economic growth and job creation, particularly in rural areas. In the United States, the ethanol industry is estimated to employ between 147,000 and 200,000 people from farming to biofuels plant construction and operation.[386] The Department of Energy has noted conservative projections of 10,000 to 20,000 additional jobs for every billion gallons of ethanol production.[387] In Brazil, it is estimated that support for biofuels production has saved almost $50 billion in imported oil and created as many as one million rural jobs.[388]

Investment in efficiency and clean energy technology can be an engine of economic stimulus and job creation for the flagging U.S. economy. This was the focus of the Select Committee's September 18, 2008 hearing entitled "The Green Road to Economic Recovery." For example, the Center for American Progress and the University of Massachusetts-Amherst's Political Economy Research Institute found that $100 billion targeted investment in five energy efficiency and renewable energy production strategies could generate 2 million new jobs, roughly 800,000 of which would be in the construction sector.[389] Such an approach would outperform an economic stimulus approach focused on increasing household spending, such as through rebate checks, by creating 300,000 more jobs.

Over the 12 months ending August 31, 2008, the number of unemployed persons increased by 2.2 million and the unemployment rate increased to 6.1 percent, the highest level in more than five years. Manufacturing and construction were the hardest hit sectors.[390] Putting American workers back to work on retrofitting buildings to improve energy efficiency, expanding mass transit and freight rail, constructing a "smart" electrical grid, building and installing wind and solar energy systems, as well as developing next-generation biofuels will ensure the clean energy technology revolution brings working Americans along with it. The extension of the Production Tax Credit and Investment Tax Credit for renewable electricity sources, the FY 2009 expansion of funding for the Weatherization Assistance Program (which funds building efficiency retrofits for low-income households), and the recently funded $25 billion loan program for domestic auto industry to retool facilities to produce more high-tech, fuel efficient vehicles represent some strong first steps in this direction.

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[385] Navigant Consulting, Economic Impacts of the Tax Credit Expiration, Final Report prepared for the American Wind Energy Association (AWEA) and the Solar Energy Research and Education Foundation (SEREF) (Feb. 13, 2008), available at http://www.awea.org/newsroom/pdf/Tax_Credit_Impact.pdf.
[386] Worldwatch Institute, supra note 224, at 124.
[387] U.S. Department of Energy Office of Science Genomics: GTL, Cellulosic Ethanol: Benefits and Challenges at http://genomicsgtl.energy.gov/biofuels/benefits.shtml (last visited Oct. 20, 2008).
[388] Worldwatch Institute, supra note 224, at 11.
[389] Robert Pollin et al., Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy, Center for American Progress and Political Economy Research Institute (Sept. 2008), available at http://www.americanprogress.org/issues/2008/09/pdf/green_recovery.pdf.
[390] U.S. Bureau of Labor Statistics, The Employment Situation: September 2008, at http://www.bls.gov/news.release/empsit.nr0.htm.

The shift to the green economy can be a broad-based economic program that benefits not only the holders of capital but also the low- and moderate-income Americans who are suffering disproportionately in today's economy. Green jobs expert Van Jones testified at the Select Committee's May 22, 2007 hearing entitled "Economic Impacts of Global Warming: Green Jobs," that jobs in the renewables and efficiency industries can provide pathways out of poverty for at risk youth and underserved communities, as well as for rural communities. At that same hearing, witnesses called for investments in training of workers for these jobs, including targeted training in underserved communities. Congress recognized this opportunity by including H.R. 2847, introduced by Rep. Hilda Solis, in EISA (Section 1002). This provision authorizes $125 million annually for a new jobs training program for the renewable energy and energy efficiency industries.

If we are to make America a global leader in clean technology, we will need to dramatically increase federal RD&D funding. Federal funding for energy research and development has fallen to $3-4 billion a year, one third the levels of the late 1970s, in constant dollars. As President Susan Hockfield from the Massachusetts Institute of Technology described in testimony before the Select Committee on September 10, 2008, "In 1980, 10 percent of federal research dollars went to energy. Today, when we really need energy answers, it is an embarrassing two percent."[391] This trend must be reversed if America is to remain competitive in the global marketplace.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Green Jobs Training:** In addition to enacting the policies outlined above, fully fund the green jobs training program established under Section 1002 of EISA.

- **Federal RD&D Funding:** Congress should double federal research, development, and demonstration funding for clean energy technologies in order to help ensure the United States' role as a leader in the clean tech sector.

- **Encourage Private Financing of Clean Tech and Efficiency:** Congress should study the potential for alternative financing mechanisms, such as a federal clean energy bank, that will further encourage the entry of private capital into the clean tech and efficiency sectors.

[391] Testimony of Susan Hockfield before the Select Committee on Energy Independence and Global Warming, hearing on "Investing in the Future: R&D Needs to Meet America's Energy and Climate Challenges," Sept. 10, 2008.

G. PROTECT AMERICAN CONSUMERS FROM HIGH ENERGY PRICES

Increasing Funding for LIHEAP

This winter, Americans throughout the nation are likely to face major challenges heating their homes. The Low Income Home Energy Assistance Program (LIHEAP) was established to help reduce the impact of home energy expenses on the nation's most vulnerable populations by providing assistance to help with their heating and cooling bills and weatherizing their homes. American families facing escalating home heating costs this winter are already coping with rising gasoline and food prices. At current prices, the average consumer at the top end of the lowest quintile income bracket is spending nearly 11 percent of their pretax income on gasoline.[392] Incredibly, many families will spend even more money heating their homes than they have spent this year paying record prices at the pump. Families receiving LIHEAP assistance will spend, on average, roughly 15 percent of their income on home energy bills.[393]

Around 8 million American households in the United States use heating oil to warm their homes. Of the 8.1 million households in the United States that use heating oil to heat their homes, 6.2 million households, or roughly 78 percent, are located in the Northeast region of the country.[394] The New England region, in particular, relies heavily upon heating oil, with more than half of homes—roughly 53 percent—dependent upon this fuel source for heating. According to EIA, an average household using heating oil should expect to pay $2,524 in heating costs this winter, an increase of 30 percent over last year.

More than 51 percent of households nationwide heat their homes with natural gas. These 58 million U.S. households should expect to pay around $1,017 to heat their home this winter, an increase of 19 percent over last year. Roughly 30 percent of homes, or nearly 39 million American households, use electricity for heat. These households will likely face heating costs of $944 this winter, a 10 percent increase over last year. Finally, the 6.5 million American households using propane to heat their homes should expect to pay $1,890 this winter, an increase of 13 percent over last year.

While the number of households receiving LIHEAP assistance has been increasing in recent years, the 5.3 million households served in Fiscal Year 2007 still represents only a small fraction—15 percent—of all households eligible for assistance.[395] Despite skyrocketing home heating prices and the importance of LIHEAP to millions of families, the Bush Administration's budget request proposed to cut total LIHEAP funding by 22 percent this year, to $570 million.

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[392] For figures on the average income of households in the lowest income quintile, see U.S. Census Bureau, Income, Poverty, and Health Insurance Coverage in the United States: 2006, at 38 (Table A-3: Selected Measures of Household Income Dispersion: 1967 to 2006) (2007), available at http://www.census.gov/prod/2007pubs/p60-233.pdf.

[393] National Energy Assistance Directors' Association, Issue Brief: The Low Income Energy Assistance Program. Providing Heating and Cooling Assistance to Low Income Families at 2 (Nov. 26, 2007).

[394] Energy Information Administration, Residential Heating Oil Prices, What Consumers Should Know (2008), available at: http://www.eia.doe.gov/bookshelf/brochures/heatingoil/index.html.

[395] Libby Perl, The Low-Income Home Energy Assistance Program (LIHEAP): Program and Funding, Congressional Research Service Report No. RL31865, at 14 (Table 3) (Sept. 18, 2008).

The Select Committee held a hearing on rising home energy costs and the future of LIHEAP funding on September 25, 2008, at which Massachusetts Governor Deval Patrick and other witnesses described the desperate need for an increase in LIHEAP funding. On September 30, 2008, President Bush signed into law H.R. 2638, a continuing resolution which included $5.1 billion in funding for LIHEAP and also expanded the eligibility requirements to allow states to provide assistance to people making up to 75 percent of state median income.

Increasing Funding for the Weatherization Assistance Program

The Weatherization Assistance Program enables low-income families to permanently reduce their energy bills by making their homes more energy efficient. According to the Department of Energy, weatherization reduces heating bills by 32 percent by making homes more efficient, and according to the National Association for State Community Services Programs, homes weatherized in 2008 will save an average of more than $413. Analyses of State-level home efficiency programs have been found to produce savings at a rate of two dollars or more for every dollar invested.[396]

Weatherization not only permanently reduces families' energy bills by making their homes more efficient, it also spurs economic growth and job creation. Every one million dollars invested in weatherization creates between 40 and 45 jobs.[397] The Department of Energy's own estimates of the impact on job growth are even higher, projecting that 52 jobs are created for every $1 million invested. Nationwide, weatherization supports 8,000 jobs in low-income communities.[398]

On February 4, 2008, the day the President's budget for Fiscal Year 2009 was released, the Department of Energy website called the Weatherization Assistance program "this country's longest running, and perhaps most successful energy efficiency program." Nevertheless, the President's budget proposal released that day would have completely eliminated this program. In the September 2008 Continuing Resolution, Congress responded by increasing the funding for the Weatherization Assistance Program by $250 million to a total of $478 million—about twice the historical funding level.

Managing the Strategic Petroleum Reserve

Even as oil and gas prices have skyrocketed over the past year, the Bush Administration was contributing to high prices and wasting taxpayer dollars by continuing to fill the Strategic Petroleum Reserve (SPR) during a time of record oil prices. On April 4, 2008, the Department of Energy announced that it would solicit bids for an additional 13 million barrels of oil for the SPR through the Royalty-in-Kind program. The Department also announced that it would increase the rate at which the SPR was being filled from 70,000 barrels per day to

[396] Roger H. Bezdek, Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century (2007), available at http://www.ases.org/ASES-JobsReport-Final.pdf.
[397] Northeast Midwest Coalition, "2008 LIHEAP Fact Sheet."
[398] U.S. Department of Energy, Weatherization Assistance Program website, at http://apps1.eere.energy.gov/weatherization/improving.cfm (last visited Oct. 20, 2008).

76,000 barrels per day beginning in August 2008 and continuing through December 2008.[399] With oil prices above $100 at the time, filling the SPR at the rate of 76,000 barrels per day could have cost the federal government more than $2.5 billion per year.

To call attention to the adverse impacts that continuing to fill the SPR during a time of record oil prices was having on consumers and the treasury, the Select Committee held a hearing entitled "Pumping up Prices: the Strategic Petroleum Reserve and Record Gas Prices" on April 24, 2008. Dr. Frank Rusco, Acting Director, Natural Resources and the Environment at the Government Accountability Office (GAO) testified before the Committee that "[t]aking barrels of oil off the market to put in the Reserve puts upward pressure on prices."[400] Dr. Rusco also noted GAO's recommendations that the Administration should "put fewer barrels into the Reserve when prices are higher and more when prices are lower. One way to do this is to buy a constant dollar amount of oil each month rather than buying a constant number of barrels."[401]

Members of Congress in both the House and Senate had called on the Bush Administration to temporarily halt the fill of the SPR in order to ease upward pressure on oil prices and save taxpayer dollars. Ninety-four Democratic House Members, led by Chairman Markey and the entire Democratic Leadership, called on the President to suspend the fill of the SPR in a letter on May 7, 2008. However, the Bush Administration signaled its intention to continue filling the reserve and go forward with the solicitation of 13 million barrels of additional oil to increase the fill rate for the remainder of the year.

As a result, Congress passed H.R. 6022, the "Strategic Petroleum Reserve Fill Suspension and Consumer Protection Act of 2008"—which President Bush signed into law on May 19, 2008. Chairman Markey was an original cosponsor of this legislation to temporarily suspend the acquisition of oil to fill the SPR during the remainder of calendar year 2008 unless the price of oil dropped below $75 per barrel for the most recent 90-day period.

Deploying oil from the SPR has a proven record of driving down oil prices when it has been used in the past and could have helped prick the speculative bubble in the summer of 2008. Oil has been released or swapped from the reserve in significant quantities on a number of occasions.[402] In 1991, when President George H.W. Bush deployed oil from the reserve, oil prices fell 33.4 percent in a single day. In 2000, President Clinton loaned SPR oil to the market and prices again immediately dropped by 18.7 percent. And in 2005, when President Bush himself released oil following Hurricane Katrina, prices fell 9.1 percent.[403]

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[399] Department of Energy, Press Release**, "**SPR to Continue Royalty-in-Kind Fill Program" (April 4, 2008), available at http://www.doe.gov/news/6142.htm.

[400] Hearing of the Select Committee on Energy Independence and Global Warming, "Pumping up Prices: the Strategic Petroleum Reserve and Record Gas Prices," April 24, 2008, Transcript at 32.

[401] Id.

[402] Department of Energy, Office of Fossil Energy, Petroleum Reserves, at http://fossil.energy.gov/programs/reserves/index.html#Strategic%20Petroleum%20Reserve (last visited Oct. 20, 2008).

[403] See Energy Information Administration, Cushing, OK WTI Spot Price FOB, at http://tonto.eia.doe.gov/dnav/pet/hist/rwtcd.htm.

However, the Bush Administration refused to take this action when oil prices were spiking during the summer of 2008. At a hearing of the Select Committee on May 22, 2008, Chairman Markey pressed for Secretary of Energy Samuel Bodman to commit to releasing oil from the SPR to help consumers. As a result of the Administration's refusal to take action that could have immediately lowered prices, Chairman Markey drafted legislation with Rep. Nick Lampson to require a swap of 10 percent of the light oil currently in the reserve for heavier crudes. H.R. 6578, the "Consumer Energy Supply Act of 2008," would deploy 70 million barrels of light crude onto the market within six months of the bill's enactment. The legislation would then direct the Secretary of Energy to subsequently purchase an equivalent volume of heavy oil within five years in such a way as to maximize the financial return to the federal government.

Dr. Rusco of GAO described the effects of exchanging light for heavy oil in the reserve at the April 24, 2008 Select Committee hearing: "DOE has not, but should, put heavier grades of oil in the Reserve, because, a) many U.S. refineries run most efficiently using heavier oil than what is currently in the Reserve, and b) heavier oils are cheaper than light oils. [S]wapping some of the light oil in the SPR for heavier oils . . . would have a dampening effect on the price of these light oils by putting them on the market now rather than taking them off."[404]

Mr. Kyle Simpson, a former Department of Energy official, agreed at a later Select Committee hearing, noting: "History shows that strategically releasing oil from the SPR is good public policy and can have an immediately beneficial impact on crude oil and petroleum product prices." Mr. Simpson continued that the release of SPR oil "has had and should continue to have the effect of quelling speculation and calming markets, resulting in immediate crude oil and product price reductions."[405]

On July 8, 2008, Speaker Pelosi called on President Bush to swap out 10 percent of the SPR in order to help consumers facing record prices. The text of H.R. 6578 was included in the Comprehensive American Energy Security and Consumer Protection Act, H.R. 6899, which passed the House with strong bipartisan support on September 16, 2008 by a vote of 236-189. The Senate did not take action on the bill.

Cracking Down on Speculation

Over the summer, there was mounting evidence that skyrocketing oil prices were at least in part attributable to excessive market speculation. Indeed, during an April 1, 2008 Select Committee hearing, J. Stephen Simon, ExxonMobil's number two executive worldwide, testified that based on market fundamentals of supply and demand, "the price [of oil] should be somewhere around $50-55 a barrel" and it was a weakening dollar, geopolitical instability, and speculation that was driving prices to their level above $100 per barrel at the time.[406] The House

[404] Hearing of the Select Committee on Energy Independence and Global Warming, "Pumping up Prices: the Strategic Petroleum Reserve and Record Gas Prices," April 24, 2004, Transcript at 32-33.
[405] Testimony of C. Kyle Simpson before the Select Committee on Energy Independence and Global Warming, hearing on "Immediate Relief from High Oil Prices: Deploying the Strategic Petroleum Reserve," July 23, 2008, at 2, 6.
[406] Select Committee on Energy Independence and Global Warming, hearing on "Drilling for Answer: Oil Company Profits, Runaway Prices, and the Pursuit of Alternatives," April 1, 2008, Transcript at 81.

considered multiple pieces of legislation in the 110th Congress to curb speculation in the oil markets. In May, Congress passed the farm bill over President Bush's veto that included language to help close the so-called "Enron Loophole" by bringing energy commodity trades under greater federal oversight. On September 18, 2008, the House passed H.R. 6604, the "Commodity Markets Transparency and Accountability Act of 2008." This legislation would have closed the so-called "London Loophole," which allowed traders to avoid regulation by offshoring their trades. It also would have increased transparency by requiring greater information be made public on trading activities in energy markets and subjecting index and swap dealers to strict reporting and record keeping requirements. In addition, it required the Commodity Futures Trading Commission to set position limits for energy futures markets.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Fully Fund LIHEAP and the Weatherization Assistance Program:** Congress should continue to fully fund LIHEAP and the Weatherization Assistance Program.

- **Manage the Strategic Petroleum Reserve to Protect Taxpayers and Consumers:** The Department of Energy should cut back on or stop filling the SPR when oil prices are high, and swap heavier, less expensive oil for light oil currently in the SPR, as recommended by the Government Accountability Office. In addition, the Department should manage the SPR to protect consumers against extreme gasoline price spikes.

- **Crack Down on Excessive Speculation:** Congress should pass legislation to permanently close remaining loopholes in energy market oversight that allow excessive speculation to occur, and should expand the Commodity Futures Trading Commission staff to enable more rigorous enforcement of existing regulation.

H. RESPONSIBLY MANAGE DOMESTIC OIL AND GAS PRODUCTION

As explained above, expanding domestic oil and gas production is unlikely to have a significant impact on oil, natural gas, or gasoline prices or to substantially reduce U.S. dependence on foreign oil. It is therefore imperative that the United States move aggressively to develop alternative energy sources, as recommended above. However, as these alternative sources are expanded, oil and gas will of course continue to play an important role, and the United States should pursue responsible development of domestic resources.

Until this year, offshore oil and gas production off the East and West Coasts of the United States was largely prohibited by overlapping Executive and Congressional moratoria. Since FY 1982, Congress has included a moratorium on such drilling in annual appropriations bills. In 1990, President George H.W. Bush issued an executive order preventing OCS drilling in these areas, and President Clinton subsequently extended the executive moratorium through 2012. On July 14, 2008, President Bush issued a Presidential Directive rescinding the executive ban. On September 30, 2008, the 27 year-old Congressional moratorium on drilling in federal waters off the East and West Coast expired.

As a result, if the next Administration and the 111th Congress allow the status quo to continue, oil and gas drilling can occur as close as three miles to the shoreline—the limit of federal authority. Drilling that close to our nation's beaches would disrupt the tourism and commercial fishing industries and leave fragile environmental areas such as the Georges Bank off the coast of New England exposed to drilling. Northeast fishery landings are valued at approximately $800 million annually and Georges Bank is the key to the region's fishery. New Bedford, Massachusetts is by far the most productive fishing port in the United States, in terms of value of catch, and commercial fishing brought $350 million into Massachusetts in 2007. Allowing oil and gas drilling in Georges Bank could have severe adverse effects on this ecosystem and our nation's most important fishery.

Under Speaker Pelosi's leadership, the House has already gone on record in favor of a compromise offshore drilling plan—the "Comprehensive American Energy Security and Consumer Protection Act" (H.R. 6899)—which passed the House in a strong, bipartisan vote on September 16, 2008. This plan would allow for increased OCS production while at the same time protecting the areas within 100 miles of the coast. It would also have expanded support for renewable energy and increased efficiency. At Chairman Markey's urging, the bill protected sensitive marine areas such as Georges Bank and National Marine Sanctuaries from drilling.

In addition to OCS drilling, there are a number of other issues relating to domestic oil and gas production that demand attention. A strong majority of the 110th Congress supported the Drill Responsibly in Leased Lands Act of 2008, of which Chairman Markey was a lead sponsor, to require oil companies to diligently develop the 68 million acres of nonproducing leases they already hold. In addition, a series of Gulf of Mexico leases issued in 1998 and 1999 erroneously omitted price caps for royalty relief. Legislation drafted by Chairman Markey to fix the faulty leases has passed the House in the last two Congresses. Taxpayers stand to lose between $10 and

60 billion if legislation is not passed to correct this problem.[407] Finally, as explained above, construction of the Alaska Natural Gas Pipeline could could deliver 4.5 billion cubic feet per day of natural gas to the lower 48 States—equivalent to 7 percent of current domestic consumption.[408]

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **OCS Drilling Legislation:** Congress must work with the next President to pass comprehensive legislation dealing with offshore drilling to ensure that the nation's beaches and marine resources, as well as affected States' rights, are protected.

- **"Use It or Lose It":** Congress should enact legislation requiring oil and gas companies to diligently develop the leases they currently hold.

- **Fix 1998-1999 Gulf of Mexico Leases:** Congress should enact legislation correcting the faulty 1998-1999 Gulf of Mexico leases to protect American taxpayers from a $10 to $60 billion loss.

- **Encourage Construction of the Alaska Natural Gas Pipeline:** Congress should work with the new Administration to encourage development of the Alaska Natural Gas Pipeline.

[407] Government Accountability Office, Oil and Gas Royalties, Royalty Relief Will Likely Cost the Federal Government Billions but Final Costs Have Yet to Be Determined, Report No. GAO-07-369T, at 3 (Jan. 18, 2007), available at http://www.gao.gov/new.items/d07369t.pdf.
[408] William F. Hederman, The Alaska Natural Gas Pipeline: Status and Current Policy Issues, Congressional Research Service Report No. RL34671, at 5 (Sept. 12, 2008).

III. OVERSIGHT OF THE BUSH ADMINISTRATION

The Select Committee has pursued aggressive oversight of the Bush Administration's actions relating to climate change and energy security—including review of EPA, the National Highway Traffic Safety Administration, the Department of Energy, the Department of the Interior, and other agencies. In the course of many of these activities, the Committee has uncovered a deeply troubling pattern of delay, obfuscation, and political interference. The next Administration will have a great deal of work to do to correct these problems.

A. EPA'S RESPONSE TO *MASSACHUSETTS V. EPA*

The April 2007 Supreme Court decision in *Massachusetts v. EPA*, 549 U.S. 497 (2007), held—contrary to EPA's position under the Bush Administration—that greenhouse gases are "air pollutants" subject to regulation under the Clean Air Act. The decision required EPA to determine whether greenhouse gas emissions from motor vehicles and fuels cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare (a so-called "endangerment finding"), and if so, to issue regulations addressing such emissions.

On May 14, 2007, President Bush directed EPA, along with other agencies, to prepare proposed rules in response to *Massachusetts v. EPA* by the end of 2007 and to finalize such rules by the end of 2008,[409] a timeline reiterated by EPA Administrator Stephen Johnson at a June 8, 2007 hearing of the Select Committee. This resulted in an extensive interagency process led by EPA to assess whether greenhouse gas emissions from motor vehicles endangered public health or welfare and to develop, in close collaboration with the National Highway Traffic Safety Administration, proposed regulations to reduce such emissions.

In January 2008, Chairman Markey sent a letter to Administrator Johnson requesting that he appear before the Select Committee, and also that he provide a copy of the draft regulations to reduce greenhouse gas emissions that had reportedly been prepared but never formally proposed. Later that month, he reiterated his request in a telephone conversation with the Administrator and also asked that a copy of the draft endangerment finding be provided. Although Administrator Johnson personally agreed to these requests, EPA ultimately refused to provide these documents, stating that to do so would be confusing to the public, would result in the release of "pre-decisional" materials, and would have a "chilling" effect on future EPA deliberations.

Because EPA provided no legally valid reason for withholding documents from Congress, the Select Committee, on April 3, 2008, issued a subpoena, on a bipartisan basis, for the documents. After negotiations with the White House and EPA, Select Committee staff viewed the requested documents on June 20, 2008. In the first half of 2008, Select Committee staff also began an extensive series of on- and off-the-record conversations with current and former EPA officials related to the Agency's response to the *Massachusetts v. EPA* decision—

[409] See President Bush Discusses CAFE and Alternative Fuel Standards (May 14, 2007), at http://www.whitehouse.gov/news/releases/2007/05/20070514-4.html.

including its April 2008 decision to abandon a regulatory response in favor of a non-regulatory Advanced Notice of Proposed Rulemaking (ANPR) that defers action to the next President.[410]

The culmination of these oversight activities was the July 18, 2008 publication of a Select Committee staff report entitled "Investigation of the Bush Administration's Response to *Massachusetts v. EPA*: How Big Oil Persuaded the Bush Administration to Abandon Proposed Regulations for Global Warming Pollution." The main conclusions of the report are as follows:

- There was widespread agreement within the Bush Administration that greenhouse gas emissions from motor vehicles endanger public welfare and should be regulated. EPA additionally concluded that greenhouse gas emissions from stationary sources such as power plants and refineries should *also* be regulated using Clean Air Act authority.

- Numerous heads of Cabinet agencies and White House offices endorsed (i) EPA's finding that greenhouse gas emissions endanger public welfare, and (ii) EPA's proposals that both vehicle and stationary source greenhouse gas emissions should be regulated under the Clean Air Act.

- In keeping with a prior approval from the White House, EPA in December 2007 transmitted to the White House Office of Management (OMB) and budget a draft "endangerment finding" for motor vehicles and fuels. However, OMB subsequently refused to acknowledge receipt of the finding and unsuccessfully pressured EPA to withdraw it.

- Oil industry lobbyists argued against regulatory action with the support of the Office of Vice President Cheney. Doing the oil industry's bidding, the Bush administration then reversed course—deciding to issue a non-regulatory ANPR in lieu of regulations.

By mid-April 2008, President Bush announced in a speech that "the Clean Air Act, the Endangered Species Act, and the National Environmental Policy Act were never meant to regulate global climate change," and went on to assert that Congress, not the Executive Branch, was responsible for deciding how to address greenhouse gas emissions. Appended to the EPA's text of the ANPR released on July 11, 2008 were letters from a number of Cabinet secretaries and heads of White House offices—all of whom had previously supported regulation of both vehicles and stationary sources under the Clean Air Act—embracing the President's and the oil industry's views that the Clean Air Act was a flawed instrument unsuited for regulation of greenhouse gases. The issuance of the ANPR assured that the Bush Administration would take no meaningful action to reduce greenhouse gas emissions despite the Supreme Court's decision in *Massachusetts v. EPA*.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

[410] See, for example, Juliet Eilperin and R. Jeffrey Smith, "EPA Won't Act on Emissions This Year," Washington Post, July 11, 2008, at A1.

- **Endangerment Finding:** EPA should promptly issue a formal "endangerment finding" recognizing that greenhouse gas emissions from motor vehicles and combustion of fuels for onroad and nonroad vehicles and engines—and other appropriate source categories—may reasonably be anticipated to endanger public health and welfare and should be regulated by EPA under the Clean Air Act.

- **Clean Air Act Regulations:** EPA should promptly develop and issue regulations to reduce greenhouse gas emissions from both mobile and stationary sources using Clean Air Act authority, and submit to Congress any recommendations for legislation needed to clarify such authority. Congress should provide aggressive oversight of EPA's implementation of its legal obligations under the Clean Air Act.

B. NHTSA'S IMPLEMENTATION OF FUEL ECONOMY STANDARDS

EISA directed the Department of Transportation, through the National Highway Traffic Safety Administration (NHTSA), to raise fuel economy standards for both cars and light trucks to a fleet wide average of *at least* thirty-five miles per gallon (mpg) in 2020 starting with model year 2011 vehicles. In each model year, NHTSA is additionally directed to require the maximum feasible fuel economy increase.

In setting the maximum feasible increase, NHTSA uses a computer model that compares the costs of incorporating fuel efficient technologies into the projected automotive fleet (using model information provided by automakers) with the benefits of incorporating them (including direct benefits such as the gasoline costs that consumers would not have to spend, and indirect benefits such as the monetized cost of CO_2 emissions that would not occur, or energy security costs that would not have to be borne). Analysis by NHTSA and others has shown that assuming a higher price of gasoline for a given model year has by far the largest impact on how high the maximum feasible standard can be set while remaining economically practicable.

On April 22, 2008, NHTSA issued a proposed rule including proposed standards for model years 2011-2015 which should result in a projected fleetwide average of 31.6 mpg. However, in its proposal NHTSA used the Energy Information Administration's (EIA) 2008 mid-range forecast for gasoline prices that range from $2.42/gallon in 2016 to $2.51/gallon in 2030—well below current prices. NHTSA's reliance on these highly unrealistic projections have the effect of artificially lowering the calculated "maximum feasible" fuel economy standards that NHTSA is directed by law to promulgate.

For modeling purposes only, NHTSA used EIA's higher gasoline price scenario: $3.14/gallon in 2016 to $3.74/gallon in 2030. This analysis demonstrated that fleet wide fuel economy of nearly 35 mpg in 2015 is cost-effectively achievable. Moreover, the Select Committee's investigation into the Bush Administration's response to the *Massachusetts v. EPA* Supreme Court decision (discussed above) also found that when EPA used the EIA 2007 high gasoline price projections of $2.75 in 2017 to $3.20 in 2030 to calculate its proposed automobile tailpipe emissions standards, it found that the car fleet could cost-effectively achieve an effective fuel economy standard of 43.3 mpg by 2018 and light trucks could achieve a standard of 30.6 mpg by 2017.

On June 11, 2008, Guy Caruso, then-Administrator of EIA, testified before the House Select Committee on Energy Independence and Global Warming. During questioning, Administrator Caruso agreed that NHTSA should use EIA's *high* gas price scenario in setting fuel economy standards. However, in a June 27, 2008 Select Committee hearing, the Department of Transportation refused to commit to doing so. On July 29, 2008, Chairman Markey and Congressman Todd Russell Platts introduced H.R. 6643, the "Accuracy in Fuel Economy Standards Act," which would compel NHTSA to take this common sense approach.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **Accurate Price Benchmarks for Fuel Economy Standards:** Congress should enact H.R. 6643, the "Accuracy in Fuel Economy Standards Act," to ensure that NHTSA uses the more accurate high gas price scenario developed by EIA when setting fuel economy standards.

- **Oversight of CAFE Implementation:** Congress should continue to aggressively oversee NHTSA's implementation of the fuel economy provisions in EISA, to ensure that NHTSA is using realistic and current assessments not only of projected gasoline prices, but also of the costs of fuel efficient technologies, the types of technologies that are available, the monetized indirect benefits of incorporating fuel efficient technologies, and the types of vehicles that are likely to be part of the automotive fleet.

C. DEPARTMENT OF ENERGY

1. Strategic Petroleum Reserve

As explained above, the Select Committee pursued aggressive oversight of the Department of Energy's management of the Strategic Petroleum Reserve, holding two hearings on the management of the SPR on April 24, 2008 and on deploying oil from the SPR on July 23, 2008. Recommendations on management of the SPR are reflected above.

2. Saudi Nuclear Agreement

On May 16, 2008, the United States signed a Memorandum of Understanding (MOU) with Saudi Arabia that would provide for the nuclear energy cooperation between the two countries. The MOU states, in part, that "participants intend to cooperate, subject to their respective national laws, in the areas of: development of mutually acceptable requirements for appropriately-sized light water reactors and fuel service arrangements for the Kingdom of Saudi Arabia; promoting the establishment of arrangements that would allow future civilian light water nuclear reactors deployed in the Kingdom of Saudi Arabia access to reliable nuclear fuel supplies and services; development of the Kingdom of Saudi Arabia's civilian nuclear energy use in a manner that contributes to global efforts to prevent nuclear energy proliferation."

During a May 22, 2008 Select Committee oversight hearing, Chairman Markey questioned Secretary Bodman about the need to provide nuclear power to Saudi Arabia, given that it has the world's largest oil reserves and huge potential for solar electricity generation. Chairman Markey noted that facilitating the development of nuclear technology in Saudi Arabia makes little sense given the volatility of the region and the country's massive solar energy potential and natural gas resources. Astonishingly, Secretary Bodman testified that he was not involved in the formulation or negotiation of the agreement. Following the hearing, Chairman Markey introduced H.R. 6298, which would prevent the United States from entering into any further nuclear agreements with Saudi Arabia and to ban any U.S. exports of any nuclear materials, equipment or technology to Saudi Arabia.

D. DEPARTMENT OF INTERIOR—ENDANGERED POLAR BEARS AND CHUKCHI SEA OIL AND GAS LEASING

The Bush Administration delayed a decision whether to list the polar bear under the Endangered Species Act until after it had completed an oil and gas lease sale in essential polar bear habitat off the coast of Alaska.

Polar bears depend on sea ice for nearly every aspect of life, including hunting Arctic ringed seals, which serve as their primary food. Arctic sea ice is already being affected by global warming. According to a study earlier this year by scientists from the National Center for Atmospheric Research (NCAR), the Arctic Ocean could be devoid of ice as early as 2040. Furthermore, in re-analyzing arctic sea ice data, NASA scientist Jay Zwally projected that the Arctic Ocean could be ice-free as early as the summer of 2012. At a briefing held by the Select Committee on the warming Arctic on September 25, 2007, Members heard from former Interior Department official Deborah Williams who spoke of how Alaska has warmed at four times the rate of the rest of the globe over the last 50 years.[411]

The United States has two polar bear populations, both in Alaska—the southern Beaufort Sea population and the Chukchi and Bering Seas population. There is significant overlap between these two populations in the western Beaufort and eastern Chukchi Sea. According to the Fish and Wildlife Service, both of these population stocks are currently in decline. The southern Beaufort Sea population has been estimated at roughly 1,500 bears and is believed to be declining. An accurate assessment of polar bear populations for the Chukchi and Bering Seas population does not exist, but it is thought that this population consists of approximately 2,000 bears and is also declining.[412]

The Bush Administration's own scientists project that the prospects for the polar bear's survival are bleak. Last year, Dr. Steven Amstrup, the government's leading polar bear scientist, headed up a team of scientists charged with examining the impacts of sea ice loss on polar bear populations. In a series of reports released last fall, Dr. Amstrup's team concluded that by mid-century, two-thirds of all the world's polar bears could disappear and that polar bears could be

[411] Briefing hosted by the Select Committee on Energy Independence and Global Warming entitled "Briefing on the Melting Arctic: Global Warming's Impacts on the Polar Region," Sept. 25, 2007.
[412] U.S. Fish and Wildlife Service, Marine Mammals Management, Polar Bear: Conservation Issues, at http://alaska.fws.gov/fisheries/mmm/polarbear/issues.htm (last visited Oct. 20, 2008).

gone entirely from Alaska. Dr. Amstrup's team also noted that based on recent observations, this dire assessment could actually be conservative.[413]

Despite the mounting scientific evidence that global warming endangers polar bears, the Bush Administration manipulated the process for listing under the Endangered Species Act to facilitate oil and gas leasing in the Chukchi Sea, an essential habitat area for polar bears. In September 2005, the Department of Interior's Minerals Management Service (MMS) had announced its intent to prepare an Environmental Impact Statement (EIS) for a lease sale in the Chukchi Sea Outer Continental Shelf planning area. Lease sale 193 would cover nearly 30 million acres in the Chukchi Sea.

On January 9, 2007, the Fish and Wildlife Service published a proposed rule to list the polar bear as threatened under the Endangered Species Act. However, the Service found that the designation of critical habitat was "not determinable."[414] The Secretary is required to make a designation of critical habitat "concurrently" with the determination to list a species under the Act unless the critical habitat for a species is "not then determinable."[415] The Interior Department chose at that time not to designate critical habitat for the polar bear, which likely would have included areas in the Chukchi Sea.

The MMS published its final EIS for the Chukchi Sea lease sale in June 2007, which concluded that polar bears would be extremely vulnerable to a potential oil spill in the Arctic Ocean, especially at certain times of year. "Oil spills have the greatest potential for affecting polar bears in part due to the difficulties involved in cleaning up spills in remote areas, given the wide variety of possible (sea) ice conditions in the Chukchi Sea."[416] In addition, despite referring to a large oil spill as an "unlikely event," the MMS estimates in the EIS that there is a 33-51 percent chance that an oil spill greater than or equal to 1,000 barrels will occur in offshore waters as a result of oil and gas activities.[417] In response to the draft EIS, EPA had submitted comments questioning MMS' assessment of the risk of an oil spill, stating that "the actual likelihood that a large oil spill would occur and significantly impact high-value resources should be considered much greater." EPA also suggested that the MMS assessment of the cumulative impact of oil and gas activities in northern Alaska was inadequate. However, it appears that MMS failed to address EPA's comments in the final EIS.

On January 2, 2008, MMS published its final notice of sale for the Chukchi Sea lease sale. The Endangered Species Act requires that the Secretary make a final determination as to whether a species warrants listing under the act within one year of the date of publication of the proposed rule. However, on January 7, 2008, Fish and Wildlife Director Dale Hall announced that the Service would miss its statutorily required deadline of January 9, 2008 for issuing a final

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[413] U.S. Geological Survey, New Polar Bear Finding, at http://www.usgs.gov/newsroom/special/polar_bears/ (last visited Oct. 20, 2008).
[414] U.S. Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants; 12-Month Petition Finding and Proposed Rule To List the Polar Bear (Ursus maritimus) as Threatened Throughout Its Range; Proposed Rule72 Fed. Reg. 1096, 1097 (Jan. 9, 2007).
[415] 16 U.S.C. Sec. 1533(6)(C)(ii).
[416] Minerals Management Service, Chukchi Sea Planning Area Oil and Gas Lease Sale 193, Final Environmental Impact Statement at II-38 (May 2007).
[417] Id. at ES-4.

listing decision for the polar bear.

Because the Bush Administration appeared to be delaying the Endangered Species Act listing decision for the polar bear until after it had held the Chukchi oil lease sale in polar bear habitat, the Select Committee held a hearing on January 17, 2008, entitled "On Thin Ice: the Future of the Polar Bear." This was the first Congressional hearing looking at the implications of the timing of these two critical decisions within the Interior Department. The Select Committee received testimony from the directors of MMS (the Interior Department agency responsible for conducting the Chukchi Sea oil lease sale) and the Fish and Wildlife Service (the agency responsible for listing the polar bear). During the hearing, Chairman Markey questioned the two directors whether the Secretary of the Interior could and should step in to delay the oil lease sale until after a decision on whether and how to protect the polar bear was made. Former Fish and Wildlife Service Director Jamie Rappaport Clark testified in support of the Secretary making the polar bear listing decision before going ahead with the lease sale, stating, "On the one hand [the Secretary] has an obvious statutory responsibility to make a decision based on the best science available, whether or not the polar bear deserves the protection of the Endangered Species Act. On the other hand, he has a somewhat discretionary decision on timing of oil and gas leasing in the Chukchi, very different decisions."[418]

Following the hearing, Chairman Markey introduced H.R. 5058, a bill which would delay the Chukchi Lease sale and related drilling activities until after the Fish and Wildlife Service had made a decision on whether or not to list the polar bear.

The Interior Department conducted the Chukchi Lease sale as scheduled on February 6, 2008. Subsequently, on May 15, 2008, the Fish and Wildlife Service issued a final rule listing the polar bear as "threatened" under the Endangered Species Act. However, in listing the polar bear as threatened, the Service left a loophole to allow oil and gas activities to continue in Alaska, which are contributing to the loss of the polar bear's Arctic habitat. Specifically, when issuing the "threatened" listing, the Administration simultaneously issued an interim final rule for the polar bear under section 4(d) of the ESA. This so-called "4(d) rule" was used to allow oil and gas activities to continue in Alaska as long as companies comply with existing regulations under the Marine Mammal Protection Act.

On October 6, 2008, in a settlement of litigation brought by environmental groups, the Fish and Wildlife Service reversed it earlier decision not to designate critical for polar bears. The settlement sets a deadline of June 30, 2010, for issuance of a final rule designating critical habitat.

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Recommendations: The 111th Congress and the next Administration should prioritize the following actions:

- **<u>Close Endangered Species Act Loophole</u>:** The Department of Interior must close the regulatory loophole in the polar bear listing that allows for oil and gas activities to proceed unchecked in essential polar bear habitat off the coast of Alaska.

[418] Id at 96-97.

- **Oversee Critical Habitat Designation:** Congress should provide oversight to ensure that the Department of Interior moves expeditiously to designate critical habitat for the polar bear.

E. EPA AND FEDERAL TRADE COMMISSION—OVERSIGHT OF THE VOLUNTARY CARBON OFFSET MARKET

In July 2007, the Select Committee held a hearing entitled "Voluntary Carbon Offsets: Getting What You Pay For," at which it examined the voluntary carbon offset market. Carbon offsets are based on the notion that individuals or companies can neutralize the greenhouse gas emissions attributable to some or all of their activities by supporting projects that either reduce emissions elsewhere or enhance biological sequestration of carbon. Common examples of offset projects include capturing and flaring of methane emissions from landfills or farm animal waste, substituting renewable electricity generation for conventional fossil fuel-based generation, undertaking energy efficiency improvements, and reforestation or no-till agricultural practices intended to increase sequestration of carbon in trees or soils.

Recently, a growing number of companies have begun to sell carbon offsets— intangible commodities representing the greenhouse gas reductions purportedly achieved by offset projects—both at retail to consumers and at wholesale to companies and other large-scale buyers. The voluntary offset market is growing dramatically. In the United States, there are now over 30 companies selling offsets at retail prices ranging from $5 to over $50 per ton of CO_2 equivalent. The value of the global voluntary offset market is estimated to be well over $100 million annually, and experts project that it easily could grow to several hundred million dollars annually in the foreseeable future.

Although few would contend that this voluntary market is likely to yield greenhouse gas reductions on a large enough scale to put a real dent in rising global emissions, it has the potential to make a nontrivial contribution. Perhaps more important, many believe this market provides a potentially important avenue for educating the public about global warming and giving citizens a sense of participation in addressing climate change. Notwithstanding its promise, the voluntary offset market has become a source of growing controversy. Some of this controversy centers on the debate over whether offsets are being used as a convenient excuse to avoid changes in behavior that could directly (and perhaps more significantly) reduce emissions. More important, however, have been a number of reports raising doubts as to whether consumers are really getting what they pay for when they buy offsets—that is, whether offsets actually represent real and permanent reductions. This problem is exacerbated by the fact that the voluntary offset market is unregulated and many offset providers do not give consumers adequate information about their projects or accounting methods. Consumers may be unaware of the complex accounting issues relating to offsets, and may have little idea of whether and how the provider has addressed these issues. Voluntary standards have proliferated, but there has been little or no government oversight.

Following the July 2007 hearing, Chairman Markey wrote to Chairman Deborah Platt Majoras of the Federal Trade Commission (FTC), urging the FTC to undertake a public process

designed to update its Guides for the Use of Environmental Marketing Claims (the so-called "green guides") to address voluntary carbon offsets—with the objective of preventing unfair or deceptive conduct in this market and assuring consumer confidence. Subsequently, Chairman Markey wrote to EPA Administrator Stephen Johnson, requesting that EPA take a leadership role in helping to develop standards governing the voluntary offset market and that it assist the FTC in implementing its mandate to protect consumers against unfair or deceptive trade practices. The FTC responded by agreeing to hold a series of public workshops on the voluntary carbon offset market, in preparation for the revision of its green guides. EPA, for its part, agreed to assist the FTC as well as to continue its own efforts to develop offset standards through its Climate Leaders program.

F. DEPARTMENT OF STATE

1. Hunt Oil

In September 2007, it was revealed that Hunt Oil Company and Kurdistan's regional government had signed a production-sharing contract for petroleum exploration in the Kurdistan region of northern Iraq. Both the U.S. State Department and the Iraqi Oil minister expressed alarm that the contract damaged the ongoing negotiations to create a national Iraqi oil revenue law.

Chairman Markey on October 2 and October 12, 2007, sent letters to Secretary of State Condoleezza Rice requesting a timeline of events surrounding the Hunt Oil contract and questioning the role of the Department of State in this episode. Chairman Markey expressed concern that Ray Hunt, CEO of Hunt Oil and a major fundraiser for President Bush, may have used his membership on the influential President's Foreign Intelligence Advisory Board to work with the Kurdistan government, or that Hunt's close ties with the Bush Administration had lent legitimacy to a practice that U.S. and Iraqi officials criticized.

On October 18, 2007, the State Department replied that Hunt Oil provided prior notice to the U.S. government of its intentions to sign an oil contract with the Kurdistan Regional Government, and that State Department officials told Hunt Oil that its company would "incur significant political and legal risk by signing contracts with any party before the Hydrocarbon Framework Law is passed by the Iraqi Parliament and that signature of such contracts would needlessly elevate tensions between the KRG [Kurdistan Regional Government] and the Government of Iraq." The State Department noted that the Hunt Oil contract negotiation "is not helpful" given that it "complicates negotiations" for the Hydrocarbon Framework Law.

The State Department refused to answer questions regarding Mr. Hunt's dual role as both President of Hunt Oil and also a senior foreign intelligence advisor to the President of the United States. Mr. Markey wrote to the White House on October 19, 2007 to ask when the White House knew of Hunt Oil's activities in Iraq, what mechanisms are in place to ensure that PFIAB members do not use classified information for personal gain or bias their advice on intelligence matters in light of their business interests, and how the White House will respond to other private companies who might pursue oil drilling rights in Iraq prior to the Iraqi government establishing an oil sharing agreement. The White House did not respond to this inquiry.

2. Human Rights

In recognition of the growing humanitarian impacts of climate change, the United Nations Human Rights Council—of which the United States is not a member—was presented with a resolution directing the UN High Commissioner for Human Rights to conduct a study of the impacts of climate change on human rights and encouraging UN members to contribute to the study. In response, Chairman Markey wrote a letter to State Department Undersecretary Paula Dobriansky, challenging the State Department to determine whether climate change would impact human rights, and whether this would create threats to our national security. Undersecretary Dobriansky responded that the State Department does not consider there to be any "direct formal relationship between" climate change and human rights, but acknowledges that protection of the environment "may further the realization of certain human rights." She noted further that the United States had "participated constructively" in informal negotiations on the resolution discussed above. The UN Human Rights Council ultimately adopted the resolution by consensus on March 28, 2008.[419]

G. CENTERS FOR DISEASE CONTROL AND PREVENTION

There has long been broad agreement throughout the public health community that climate change poses a serious threat to public health both in the United States and around the world. However, when Centers for Disease Control (CDC) Director Dr. Julie Gerberding was asked to testify before the Senate Committee on Environment and Public Works in October 2007, the White House censored her testimony.[420] She was prevented from stating what CDC's own scientists, other public health researchers, and the IPCC had concluded about climate change's impacts on health. In response, Chairman Markey wrote to Dr. Gerberding in December 2007 requesting her views on the threat to public health posed by global warming. In April 2008, the Select Committee held a hearing on public health and climate change, at which Dr. Howard Frumkin, Director of CDC's National Center on Environmental Health, testified. The Select Committee engaged in active oversight of the CDC testimony clearance process. At the hearing, Dr. Frumkin was able to clearly state what had been removed from Dr. Gerberding's testimony: "The CDC considers climate change a serious public health concern." This was the first time during Congressional testimony that a federal agency official acknowledged climate change could have major consequences for human health.

[419] See United Nations Human Rights Council, Resolution 7/23, Human Rights and Climate Change (Mar. 28, 2008), available at http://ap.ohchr.org/documents/E/HRC/resolutions/A_HRC_RES_7_23.pdf.
[420] See, e.g., Juliet Eilperin, "Cheney's Staff Cut Testimony on Warming," Washington Post, July 9, 2008, at A1.

IV. INTERNATIONAL EFFORTS

A. INTERNATIONAL CLIMATE NEGOTIATIONS

A global effort will be required to protect the planet from the looming climate crisis—putting international climate negotiations at the heart of the fight against global warming. As highlighted above, global greenhouse gas emissions will need to be cut by at least 50-85 percent by 2050 to prevent dangerous global warming. While the United States and other developed countries are responsible for most of the cumulative greenhouse gas concentrations in the atmosphere, and are among the highest per capita emitters in the world, the largest proportion of the projected growth in global greenhouse gas emissions over the coming decades will come from the developing world. The past two years have seen substantial new developments with regard to international climate negotiations. With the conclusion of an agreement in Bali, Indonesia in December 2007 establishing a "roadmap" for future negotiations, many are now looking towards the negotiation of a post-Kyoto global framework to govern international efforts in this sphere after 2012. The Bali roadmap calls for the completion of such an agreement at the Fifteenth Conference of the Parties to the UN Framework Convention on Climate Change at Copenhagen in December 2009.

United Nations Framework Convention on Climate Change

In 1992, the United Nations convened 172 nations at the Earth Summit in Rio de Janeiro for the first attempt of governments to fundamentally address global warming. From the summit, the United Nations Framework Convention on Climate Change (UNFCCC) emerged. It came into effect in 1994 and was ultimately ratified by 192 nations, including the United States. The Convention set the ultimate objective of stabilizing atmospheric greenhouse gas concentrations at safe levels and incorporated a voluntary initial goal that industrialized countries should take the lead in tackling the problem by cutting their emissions to 1990 levels by 2000.

The Kyoto Protocol

In 1995, the first meeting of the Conference of the Parties (COP) to the UNFCCC adopted the Berlin Mandate, which called for the negotiation of a new agreement that would augment the UNFCCC with stricter demands for reducing emissions. This led to the development of the Kyoto Protocol, which was signed in 1997 by 84 countries. The Protocol set mandatory targets for the reduction of greenhouse gas emissions from the world's developed countries by an average of 5.2 percent below 1990 levels between 2008 and 2012. Ultimately 175 countries—including virtually all developed countries other than the United States and Australia—ratified the Protocol, which officially entered into force in February 2005. Australia ratified the Protocol in December 2007, leaving the United States as the only industrialized country that has not done so.

Kyoto establishes a cap-and-trade system that allows developed countries to meet their commitments through trading of marketable credits under the International Emissions Trading System (IET). Kyoto's other "flexibility mechanisms"—Joint Implementation (JI) and the Clean

Development Mechanism (CDM)—allow developed countries to meet their emissions targets in part through the purchase of tradable offset credits generated by emission reduction projects in other countries. Through this array of market-based mechanisms, the Kyoto Protocol laid the groundwork for what has become known as the global "carbon market."

Developments Leading to Bali

The annual UNFCCC meeting in Montreal in 2005 was the first held after the Kyoto Protocol came into force. It launched the efforts to negotiate the next climate agreement that would come into effect at the end of the Kyoto Protocol commitment period in 2012. At the conclusion of the meeting both the Conference of the Parties—those countries including the United States who have ratified the UNFCCC—and the Members of the Kyoto Protocol had agreed to further dialogues toward a post-2012 framework.

The 2006 UNFCCC meeting in Nairobi did not make much progress on the negotiations for a post-2012 agreement, increasing the pressure to make significant progress at the 2007 UNFCCC meeting in Bali, Indonesia. In order to be ready to implement a new climate agreement in 2012, negotiations need to be concluded by the end of 2009. Therefore, countries were under pressure at Bali to agree to a negotiating mandate, such as the Berlin Mandate which guided the Kyoto Protocol negotiations, in order to bring negotiations to a successful conclusion in 2009.

Given the importance of moving the UNFCCC negotiations forward, Secretary-General Ban appointed three Special Envoys on Climate Change and convened a High-Level Event on Climate Change in New York on September 24, 2007. Approximately 160 countries, including 80 heads of State or Government, participated in the daylong discussion of the climate challenge. In preparation for Bali, attention was focused on global actions relating to mitigation, adaptation and investment in technology development and deployment, along with discussion of financial flows to facilitate such action. On September 26, 2007, the Select Committee hosted a briefing at which the three UN Special Envoys, together with Sigmar Gabriel, the German Federal Minister for the Environment, Nature Conservation and Nuclear Safety, discussed the state of play and prospects for international action on climate change.

United Nations Climate Change Conference in Bali, Indonesia

From December 3-15, 2007, representatives from more than 180 countries met in Bali, Indonesia for the United Nations Climate Change Conference—also known as COP 13 (the thirteenth conference of the parties to the UNFCCC). The principal item on the agenda was the development of a "roadmap" for the negotiation of a new global climate change agreement governing the period after 2012, when the Kyoto Protocol's commitment period ends. The Select Committee sent a staff delegation to the negotiations, and Chairman Markey delivered the first international address on climate to the meeting using virtual world ("Second Life") technology. On December 19, 2007, the Select Committee held a hearing entitled "After Bali – the UN Conference and its Impact on International Climate Change Policy" at which Christiana Figueres, the Costa Rican representatives at the Bali conference, and several other leading experts on the international negotiations testified.

The Bali Action Plan—the "roadmap" agreement reached at the conference—calls upon the parties to negotiate a new agreement to be adopted at the Fifteenth Conference of the Parties, to be held in Copenhagen, Denmark in December 2009.[421] The roadmap recognizes the findings of the IPCC's 2007 Fourth Assessment Report that global warming is unequivocal and that delay in reducing emissions increases the risk of severe climate change impacts and decreases the opportunity to achieve lower stabilization levels of greenhouse gases. The agreement further recognizes that "deep cuts in global emissions will be required" to avoid dangerous impacts from climate change and emphasizes the IPCC's findings regarding the "urgency to address climate change"—referring in a footnote to the IPCC's conclusions regarding the range of emission reductions required to meet certain atmospheric greenhouse gas stabilization targets. The draft roadmap agreement had originally included language, advocated by the EU and others, recognizing the need for emissions to peak within the next 10-15 years, for global emissions to be reduced by over 50 percent by 2050, and for developed countries to reduce emissions by 25-40 percent below 1990 levels by 2020. This language was dropped in the face of strong opposition from the United States, Russia, and Japan.

The roadmap identifies four major pillars of climate policy as the basis for future negotiations: mitigation, adaptation, technology development and transfer, and financial resources and investment. With regard to mitigation, the agreement calls for consideration of actions by both developed and developing countries. For developed countries, the roadmap calls for consideration of "measurable, reportable, and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives." This ambiguous language encompasses, but does not appear to require, absolute emissions caps for all developed country parties.

Perhaps most importantly, as several of the witnesses at the December 19, 2007 Select Committee hearing emphasized, the roadmap also included developing countries in the mitigation agreement for the first time. Developing nations agreed to consider "nationally appropriate mitigation actions" that are "measurable, reportable and verifiable" so long as they are supported by "measurable, reportable and verifiable" support in the form of technology transfer, financing, and capacity-building. In addition, the roadmap calls, among other things, for consideration of enhanced action on adaptation to climate change, technology transfer to developing countries, and financial support for mitigation and adaptation activities in developing countries.

In keeping with the Bali Conference's heightened focus on adaptation, the parties to the Kyoto Protocol established an Adaptation Fund Board to oversee the implementation of the Adaptation Fund established under the Kyoto Protocol. The Fund is financed through a 2 percent levy on CDM transactions and will be used to assist the developing country parties to Kyoto that are particularly vulnerable to the adverse impacts of climate change.

Delegates to the Bali Conference also considered policies to reduce emissions from deforestation and forest degradation in developing countries (referred to as "REDD"). Although

[421] Decision 1/CP.13, "Bali Action Plan," available at http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3.

deforestation and forest degradation account for roughly 20 percent of global carbon dioxide emissions, this area of climate change policy had never before been brought into the agreement. As a first step in this sphere, the Conference delegates agreed to "explore a range of actions, identify options and undertake efforts, including demonstration activities" to achieve "demonstrable, transparent, and verifiable" emissions reductions from deforestation and forest degradation.

Other international negotiations

In addition to the UN process outlined above, there have been a number of parallel international negotiation processes addressing climate change in recent years. Climate change was a major focus of the annual G8 summit held from June 6-8, 2007, in Heiligendamm, Germany. At the summit, the European Union, Canada and Japan agreed to "at least halve carbon dioxide emissions by 2050,"[422] but the United States declined to join in this agreement. All eight nations instead agreed that, in working to set a long-term global goal for emissions reductions, they would "consider seriously" the 50 percent reduction by 2050 commitment.[423] Participating parties agreed that "the UN climate process is the appropriate forum for negotiating future global action on climate change" and reiterated "the need to engage major emitting economies on how best to address the challenge of climate change."[424] The Joint Statement by the German G8 Presidency and the Heads of States of Brazil, China, India, Mexico and South Africa, stated that these developing countries "remain committed to contribute our fair share to tackle climate change in order to stabilize green house gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system."[425]

The week prior to the Heiligendamm summit, President Bush announced his support for a negotiation process involving the "major emitter" countries—both developed and developing—to establish a post-2012 framework for action on international climate change. In September 2007, President Bush hosted a meeting of 17 major economies on energy security and climate change in Washington, DC. The White House billed this "Major Economies" meeting as complementary to the United Nations climate change negotiation process. At the meeting, the White House advocated advancing clean energy technologies, setting long-term "aspirational" goals for global greenhouse gas emission reductions, and allowing each nation to set its own strategy for emissions reductions rather than agreeing to internationally binding obligations.

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[422] G8 Summit 2007, Heiligendamm, Chair's Summary (June 8, 2007), available at http://www.g-8.de/Content/EN/Artikel/__g8-summit/anlagen/chairs-summary,templateId=raw,property=publicationFile.pdf/chairs-summary.

[423] Id.; see also G8 Summit 2007, Heiligendamm, Summit Declaration: Growth and Responsibility in the World Economy at 16 (June 7, 2007), available at http://www.g-8.de/Content/EN/Artikel/__g8-summit/anlagen/2007-06-07-gipfeldokument-wirtschaft-eng,templateId=raw,property=publicationFile.pdf/2007-06-07-gipfeldokument-wirtschaft-eng.

[424] Id.

[425] G8 Summit 2007, Heiligendamm, Joint Statement by the German G8 Presidency and the Heads of State and/or Government of Brazil, China, India, Mexico and South Africa on the occasion of the G8 Summit in Heiligendamm, Germany, at 2 (June 8 2007), available at http://www.g-8.de/Content/EN/Artikel/__g8-summit/anlagen/o5-erklaerung-en,templateId=raw,property=publicationFile.pdf/o5-erklaerung-en.

Two more Major Economies meetings were held—one on January 31-31, 2008, in Honolulu, Hawaii, and one on April 17-18, 2008, in Paris France.

In July 2008, the G8 met in Hokkaido Japan. A leaders' meeting of the Major Economies process was held in conjunction with the G8 summit. Despite hopes that the leaders might announce a long-term global goal for emissions reductions, no such agreement was reached. Instead, the G8 opted only to "seek to share with all Parties to the UNFCCC the vision of, and together with them to consider and adopt in the UNFCCC negotiations, the goal of achieving at least 50% reduction of global emissions by 2050, recognizing that this global challenge can only be met by a global response, in particular, by the contributions from all major economies, consistent with the principle of common but differentiated responsibilities and respective capabilities."[426] The Major Economies leaders, for their part, "recognize[d] that deep cuts in global emissions will be necessary to achieve the [UN Framework] Convention's ultimate objective," called for the setting of a long-term global goal through the UN negotiation process, and called upon developed countries to "implement, consistent with international obligations, economy-wide mid-term goals and take corresponding actions in order to achieve absolute emission reductions and, where applicable, first stop the growth of emissions as soon as possible," and, finally, called upon developing countries to "pursue, in the context of sustainable development, nationally appropriate mitigation actions, supported and enabled by technology, financing and capacity-building, with a view to achieving a deviation from business as usual emissions."[427] In short, no firm emission reduction commitments were made by any party.

The Road to Copenhagen

With the negotiation of the Bali Action Plan and with President Bush's tenure nearing its completion, international attention has now turned to the process of negotiating a new post-2012 international climate agreement—slated to be completed by the Fifteenth Conference of the Parties to the UNFCCC, to be held in Copenhagen, Denmark in December 2009. Successful negotiation of a new agreement in that time frame will require the incoming U.S. administration to move with alacrity, as less than a year will remain between the inauguration of the 44th President of the United States and the Copenhagen meeting and it will take time for the new administration to put its team in place. It will be imperative that the 111th Congress work in concert with the new Administration in support of the negotiating process, as legislative actions will undoubtedly be necessary to support and help shape the Administration's negotiating positions on greenhouse gas emission reductions, clean technology financing, and international adaptation to climate change impacts.

[426] G8 Summit 2008, Hokkaido, Chair's Summary (July 9, 2008), available at http://www.g8summit.go.jp/eng/doc/doc080709_09_en.html.
[427] G8 Summit 2008, Hokkaido, Declaration of Leaders Meeting of Major Economies on Energy Security and Climate Change, available at http://www.g8summit.go.jp/eng/doc/doc080709_10_en.html.

B. SELECT COMMITTEE CONGRESSIONAL DELEGATIONS

Even as climate negotiations have progressed, the Select Committee has actively pursued international dialogue and cooperation on climate and energy solutions—most notably through three Congressional delegations to Greenland the European Union, Brazil, and India, respectively. Two of these—the Greenland/EU and India delegations—were led by Speaker Pelosi.

Greenland and the European Union—May 2008

In late May 2008, Chairman Markey and other members of the Select Committee joined Speaker Pelosi on a fact-finding Congressional delegation to Greenland, Germany, the United Kingdom, and Belgium. The trip explored both the severe impacts of global warming and the solutions many EU nations are taking to cut heat-trapping global warming emissions.

In Greenland, the delegation witnessed first-hand the effects of rising temperatures. Global warming is already having negative impacts on the livelihoods of Greenland's indigenous Inuit population of roughly 45,000. The loss of stable, year-round sea ice is disrupting traditional seal-hunting and fishing practices on which Inuit livelihoods depend. The melting of permafrost is causing extensive damage to homes and other infrastructure in Inuit villages. The Greenland Premier Hans Enoksen, national and local leaders, and residents all emphasized that changes to their environment are rapid and have far reaching economic and cultural impacts.

During a visit to Dr. Konrad Steffen's research station on the Greenland ice sheet, Select Committee members learned about the mounting scientific evidence that global warming is causing an alarming acceleration in the rate of melting of the Greenland ice sheet. Average temperatures in southern Greenland have increased by over 4 ˚F in the past two decades, and the area of Greenland's ice sheet that melts each summer has increased by 16 percent from 1979 to 2002. Several of Greenland's largest glaciers are now flowing towards the sea at nearly 8 miles per year, twice as fast as they did just 5 years ago. The ice sheet now dumps nearly three times as much ice into the sea as it did 10 years ago—enough every 2 to 3 days during the melting season to supply New York City with fresh water for an entire year. Scientists have also observed an alarming increase in "ice quakes" due to glacial movement—measuring up to 5.0 on the Richter scale—raising questions about the ice sheet's stability. These trends indicate that the accelerating melting of Greenland's ice sheet increases the risk that dangerous sea-level rise will occur sooner than previously predicted.

After witnessing the tangible impacts of global warming on Greenland, the delegation then traveled to Europe to discuss policy and technology solutions to effectively reduce carbon emissions. In Germany the delegation met with Chancellor Angela Merkel, Foreign Minister Frank-Walter Steinmeier, and Environmental Minister Sigmar Gabriel. They outlined Germany's three-pronged approach to reducing global warming pollution by increasing energy efficiency, expanding renewable energy use, and developing climate-friendly fossil fuel technology. Germany has committed to increasing energy efficiency by 20 percent and using 30 percent renewable energy by 2020. To achieve these objectives, it has instituted innovative policies. For example, national building standards are raised periodically to ensure continual

efficiency improvements in buildings, and Germany has created a national fund that provides low-interest loans for efficiency improvements. Their feed-in tariff law, which pays set amounts for electricity generated from renewable sources, has helped increase renewable electricity use from 1 percent in 2000 to 11 percent in 2006.

The development of climate-friendly energy technology is key to Germany's economic development strategy. Currently, Germany holds an impressive 20 percent share of the global energy technology market. The existing $100 billion market for environmentally friendly energy technology will double in the next 10 to 15 years, and a central economic question is who will supply this new technology developed in response to domestic policies.

Despite their successful domestic policies, the German leaders underscored the importance of an international climate agreement that commits all countries to equitable actions to reduce global warming pollution. The delegation was visiting Germany two weeks before the G8 summit hosted by Germany in Heiligendamm, discussed above, at which Chancellor Merkel made climate change a priority issue.

While in the United Kingdom, the delegation met with a number of Members of Parliament from the Labour, Conservative, and Liberal Democratic parties, and with the Secretary for the Environment David Miliband. At that time, the Labour government had recently introduced its draft climate bill and Parliament was preparing to move the legislation. The draft legislation set a minimum target of reducing UK emissions by 60 percent by 2050. (That target has since been increased to 80 percent below 1990 levels by 2050.) Central to the bill is the creation of a five-year carbon dioxide budget with three consecutive budgets in law at all time to provide balance between predictability and flexibility. According to Secretary Miliband, the carbon budgeting process will become fundamental to the British economy, and the "Chancellor of the Exchequer will have to count carbon as well as pounds." The legislation would also create a Committee on Climate Change as an independent, expert body to advise the government on setting and achieving emission reduction targets and creating the carbon budgets.

Across political parties, there was agreement that reducing global warming pollution was a top priority and that this global problem will not be solved without leadership from the United States. However, there was some disagreement on the domestic policies needed to achieve reductions. Cap-and-trade was seen as a priority, but some also viewed complementary green tax shifts as important. For example, the 2001 climate levy created a fiscally neutral tax on global warming pollution that supported pension reform and was supported by labor and businesses alike. Some also saw complementary policies as necessary in other sectors. In the building sector, zero-carbon houses currently receive a tax break and by 2016 new residential buildings are required to be carbon-neutral.

While in the United Kingdom, the delegation also met with Sir Nicholas Stern, the former World Bank economist and author of *The Stern Review: The Economics of Climate Change*. In his opinion, climate change reflects the greatest market failure in history and policymakers must approach it as a risk management issue, taking action now to prevent costly consequences later. He recommended auctioning allowances as much as possible in climate legislation and felt that strong targets and carbon trading in developed countries would bring China and India along in

the international agreements. Sir Stern encouraged the delegation to act regardless of other countries' actions with the admonition that "saying we are not going to do anything until others do is a recipe for doing nothing."

The trip concluded in Brussels where the delegation met with European Commission President Jose Manuel Barroso, European Commission Energy Minister Andris Piebalgs, and the Belgium Prime Minister Guy Verhofstadt. They discussed the recently agreed EU Climate and Energy Strategy which commits the EU to reduce global warming pollution by 20 percent below 1990 levels, increase energy efficiency by 20 percent, and use 20 percent renewable energy by 2020. To help facilitate the next international climate agreement, they also stated their willingness to reduce their emissions as much as 30 percent if other developed countries and the more economically advanced developed countries take on equitable commitments. The delegation also discussed lessons learned by the Europeans in the transportation sector. The EU has relied on voluntary fuel economy standards for vehicles and the use of extraordinarily high gasoline taxes in member countries. Carbon emissions from vehicles were increasing in spite of these policies, leading to a decision that mandatory fuel economy standards are now necessary. During the delegation's visit, the European Commission was beginning a process to require the new car fleet sold in the EU to meet the equivalent of a 47 miles per gallon standard by 2012. While the EU is pursuing a sustainable biofuels target, it has ruled out supporting development of coal-to-liquid fuels because they increase carbon emissions compared to gasoline.

Brazil—February 2008

In February 2008, Chairman Markey led a Congressional delegation to Brazil including Representatives Tom Davis, Lois Capps, Barbara Cubin, Mike Ferguson, and Jeff Flake. The delegation met with federal and state officials and business and scientific leaders to investigate Brazil's efforts to combat deforestation and climate change and to promote energy independence.

The delegation began with a visit to the city of Manaus, the capital of the State of Amazonas. There, participants attended briefings with scientists from the National Institute for Amazon Research (IPNA), Amazonas Minister for Planning and Economic Development Denis Minev, Amazonas Minister for Environment Virgilio Viana, and the Ariau Towers naturalist, Michael Cartwright. The hosts spoke of the importance of the Amazon rainforest to Brazil and the rest of the world. As Minister Viana noted, "the Amazon is a Brazilian resource that provides a global service." Deforestation and forest degradation are now threatening this important global carbon sink, oxygen generator, and hydrological cycle regulator. In the Amazon, half of the dry weight of trees is carbon, and in 2004—the peak year for deforestation—466 million tons of carbon dioxide was released from deforestation. This is over five times the emissions Brazil generates annually from burning fossil fuels. Deforestation has also devastated species biodiversity. Twenty-five percent of the world's species depend on the 2.7 million square miles of the Amazon rainforest. The loss of biodiversity affects the sustainability of local and global production of goods like latex, cork, fruit, nuts, timber, fibers, spices, natural oils, and medicine.

The Amazonas state ministers discussed the policies they were developing to increase the value of standing forests and reduce deforestation. Goods produced in a sustainable manner

from the forests are exempt from state taxes, and the ministers suggested that removing the international tariffs on these goods would further encourage sustainable development in their state. They were also developing a forest fund with the support of a large Brazilian bank and other international partners to provide subsistence payments to forest inhabitants that preserve their lands. They suggested that developed world countries should consider dedicating some pollution allowances in cap-and-trade legislation for avoided deforestation and hope that their forest fund will provide a model for partnerships with the developed world to protect forests.

The next stop for the delegation was Rio de Janiero, where Members focused on the potential of biofuels to increase energy independence and reduce global warming pollution. Marcos Jank, the CEO of Sao Paulo Sugarcane Agroindustry Union (UNICA), briefed the delegation on the successes and potential of sugarcane ethanol. Brazil is currently the world's leading producer of sugarcane ethanol fuel, which provides 50 percent of the country's transportation fuel. Eighty percent of the vehicles in Brazil have "flex fuel" capacity and can run on ethanol. Using the waste biomass from ethanol production, Brazil is currently able to supply 3 percent of its energy through sugarcane electricity. This is expected to rise to 15 percent by 2020. Mauricio Tolmasquim, the President of Energy Planning Office (EPE), attributed the success of Brazilian ethanol to the increase of flex fuel vehicle availability, low production costs, and an increase in global exports. Eduardo Feijo, the Brazilian National Association of Automakers (ANFAVEA) liaison, also noted the infrastructure support for ethanol; 94 percent of the Brazilian fuel stations offer a high percentage ethanol fuel whereas in the United States, only 7 percent offer E85 blends.

To learn more about the sustainability of ethanol, the delegation visited the Petrobras CENPES research facility operated by Brazil's nationalized Petrobras energy company. In a tour of the facility, Executive Director Carlos Taden Fraga, and Ricardo Castello Branco, Director of Petrobras' Renewable Energy Program, showed the delegation their work developing cellulosic ethanol from a sugarcane waste product (bagasse) and working to reduce traditional pollution emissions from vehicles.

The delegation's final stop was the capital city of Brasilia, where Members served as the U.S. delegation to the Global Legislators Organization for a Balanced Environment (GLOBE) Forum. At the Forum, they joined with fellow legislators from the G8 countries and five developing countries (Brazil, China, India, Mexico, and South Africa) in high level talks regarding the post-2012 international framework to address climate change. Working in the High Level Session and the Energy working group, the Congressional delegation discussed issues of global warming and ultimately produced a Climate Change Framework recommendation paper for the July 2008 G8 Summit in Hokkaido Japan.

The delegation ended the Brazil tour with official meetings with Tasso Azevedo, head of the recently created Brazilian Forest Service, Brazil State Secretary Everton Vargas, Environment Minister Marina da Silva, State Secretary Thelma King, and the President of Brazil's Chamber of Deputies (counterpart of the U.S. Speaker of the House), Arlindo Chinaglia. The Members and officials discussed how the United States and Brazil can work together towards the shared goals of preserving the Amazon and expanding the development of biofuels. Increased cooperation on sharing of satellite images and other monitoring technology to identify

and prevent illegal logging was suggested as a specific partnership that could have immediate impact.

The delegation ended the trip with a briefing on the latest sustainable agriculture research and practice in Brazil by John Carter, rancher and founder of Aliança da Terra, Dr. Paulo Moutinho of the Instituto de Pesquisa Ambiental da Amazonia, Dr. Daniel Zarin, professor with the University of Florida, and Dr. Daniel Nepstad of the Woods Hole Research Center. The group is attempting to bring ranchers and environmentalists together in support of certifications and sustainability standards for agricultural products produced in Brazil.

India—March 2008

In March 2008, Chairman Edward Markey and Ranking Member James Sensenbrenner accompanied Speaker Nancy Pelosi and other Members of Congress on a fact-finding congressional visit to India. The delegation explored the opportunities for the United States and India to strengthen efforts to reduce global warming pollution and invest in clean energy research, development, and deployment.

They began their visit in New Delhi hosted by Dr. Rajendra Pachauri, Chairman of the Nobel-prize winning Intergovernmental Panel on Climate Change, at the eco-friendly conference center of The Energy and Resources Institute (TERI). Dr. Pachauri and other members of the institute made presentations and answered the delegation's questions about climate change, its impact on India, and potential solutions. Stopping deforestation and providing incentives for reforestation were seen as important ways of reducing global warming pollution in the near term, providing a cushion for the deployment of other technologies. Addressing energy consumption in buildings was also singled out as important.

Dr. Pachauri and his colleagues were also optimistic about the potential of renewable energy in India and around the world. Just one percent of India's solar resources could meet the current power needs of the country, and China is already the largest solar market in the world. One of TERI's newest programs is the "Lighting a Billion Lives" initiative which is distributing solar-powered flashlights and lanterns in villages around the world where there is no electricity. The group was encouraged by Indian businesses' interest in renewables and efficiency technology. They pointed to the 300 Indian companies are already involved in the clean energy market generating at least $1 billion in revenues. The need to foster research and development and collaboration with developed world companies is clear, but intellectual property issues are currently hindering development. Finding a workable solution for all should be a high priority.

While in New Delhi, the delegation met with Prime Minister Manmohan Singh, Minister of External Affairs Shri Pranab Mukherjee, the Prime Minister's Special Envoy for Climate Change Shyam Saran, and a group of parliamentarians from various Indian political parties. They outlined India's domestic and international efforts to combat global warming and discussed areas of potential cooperation between India and the United States.

The Indian government views climate change as a threat to security. Global warming impacts have major economic and social consequences for India, including an increase in

weather-related disasters and diseases and a decline in food production and freshwater availability. The government is preparing a national climate action plan and will release it in the summer. The Prime Minister has already committed to keeping India's per-capita emissions below the average of the developed world. Continued cooperation with the United States on energy efficiency, renewable energy, and clean coal technology will be important to helping India meet this goal as it works to move hundred of millions of its citizens out of poverty.

The Indian government's view is that all multilateral climate agreements should be under the auspices of the United Nations Framework Convention on Climate Change. India was part of the global agreements reached in Rio and Kyoto and is supportive of the roadmap for next international climate agreement developed in Bali. The Indian government's position is that climate change is a global challenge that requires a global response, but the agreement must be equitable. Developed countries that are most responsible for the current problem must commit to reducing their emissions, and developing countries must commit to developing in a sustainable manner provided they receive technology and financial assistance.

The delegation next traveled to Dharamsala to meet with the Dalai Lama and to discuss with him a wide range of issues, including the environmental challenges in Tibet and his views on climate change. He expressed concern that the growing population was threatening the delicate Tibetan plateau ecosystems at the same time that global warming was causing rapid change. The rapid melting of the glaciers is a serious threat to water resources in Tibet, India, and China. He is encouraged by the recent progress being made by countries to cooperate on solutions to this and other global environmental challenges. Protecting the planet should be a priority because, as he noted, "its life is our life, its future our future."

The final stop was in Mumbai, where the delegation began with a briefing on India's nuclear power industry by Dr. S. K. Jain, Chairman of the Nuclear Power Corporation of India (NPCIL). Nuclear power currently provides 4,000 megawatts of power and is projected to increase 63,000 megawatts by 2030. In comparison, coal and natural gas provide 90,000 megawatts now, increasing to 390,000 megawatts in 2030 and renewables provide almost 11,000 megawatts now, increasing to 97,000 megawatts in 2030. The size of nuclear plants is limited by India's transmission grid which cannot accommodate plants over 500 megawatts. Five light water reactors and one fast breeder reactor are currently under construction, and the government has cleared two coastal sites for new plant construction.

The delegation also met with key Indian business leaders, including Mukesh Ambani and Jamshyd Godrej, to discuss India's rapidly growing energy needs and areas of potential cooperation to expand the deployment of renewable energy and energy efficient technologies. Mr. Ambani was enthusiastic about the ability of solar power to do for electricity what mobile telephones did for telecommunications. His solar company electrified 84 villages in just 3 months. Many of India's villages rely on diesel generators for electricity, and have been adversely affected by the high price of oil. Many villages can afford the 15 cents per kilowatt hour costs of the solar set up, but the goal is to drop the price to 10 cents, making electricity affordable to almost all villages. Green buildings are also taking off in India. In 2008, one million square feet of LEED-certified space will be built, adding to the already existing 9 million

square feet. Green buildings are being built even without government subsidies because they make economic sense given the cost of energy in India.

Indian companies are already participating in the global carbon market through the Clean Development Mechanism (CDM). For example, the Essar group has developed a variety of CDM projects including decreasing industrial emissions by switching to natural gas, heat recovery from steel plants, and wind projects in Tamil Nandu and Gujarat states. They are also exploring the development of solar power sites in Rajasthan state. The delegation discussed the inclusion of sectoral agreements in future international climate agreements. The Indian business leaders felt this could be a promising way to achieve emission reductions in energy intensive sectors in developing countries and to support sustainable development.

Technology development was also a key issue for the businessmen. India is going through a transformation. In the past, there was comparatively little investment in domestic technology development, which was seen as too risky. Indian businesses would instead gain access to technology through licensing agreements. Now as the country is becoming richer, there is more focus on technology and human resource development. Almost all the companies represented were partnering with companies in the United States and Europe to develop and patent new energy technologies. Continued technology cooperation between the two countries, coupled with reform to financial institutions to incorporate environmental costs and benefits in financing decisions, was seen by the group as critical to helping India's development, enhancing both countries' national security and reducing global warming pollution.

Additional Views of Rep. John Larson (D-CT) to the Select Committee on Energy Independence and Global Warming Final Staff Report

Representative John Larson has enjoyed hearing the views of his fellow committee members on issues of carbon pricing legislation. However, he feels that carbon tax legislation is the most transparent and effective tool to reduce carbon dioxide and other greenhouse gas emissions and increase U.S. energy security. Rep. Larson has introduced H.R. 3416: America's Energy Security Trust Fund Act, which is detailed below.

H.R. 3416: America's Energy Security Trust Fund Act

In 2005, the United States emitted over 6 billion metric tons of carbon dioxide (CO_2), an increase of 25 million tons over the previous year. The scientific community agrees that CO_2 and other greenhouse gas emissions from human activities are influencing changes in the earth's climate. Global warming is already having an impact, and future changes in the climate will have significant economic and environmental implications for coastal communities, public health, agricultural productivity, ecosystems and life as we know it.

One way to ensure that dangerous greenhouse gas emissions are reduced – a necessary priority for the next Congress – is through a carbon tax system. Such a system has been promoted by everyone from former Vice President Al Gore to N. Gregory Mankiw, former Chairman of President Bush's Council of Economic Advisers. **H.R. 3416, America's Energy Security Trust Fund Act**, is a carbon tax bill sponsored by Representative John B. Larson, a member of the Select Committee on Energy Independence and Global Warming. The bill is also cosponsored by twelve members of the House of Representatives, including one other member of the Select Committee.

Currently, polluters have no incentive to change their behavior and stop contributing to global warming—the America's Energy Security Trust Fund Act gives them one. Those who reduce polluting behaviors by cutting back on activities that lead to greenhouse gas emissions could actually come out ahead by receiving a bigger payroll tax rebate than they contribute to the fund: they would be rewarded for changing their behavior.

The America's Energy Security Trust Fund Act would reduce taxes on workers, set a price for CO_2 emissions, and create an incentive to use alternative energy. Specifically, the bill would:

- **Provide Tax Credits for Research and Development of Alternative Energy Technologies** like wind, hydrogen, fuel cells, solar and other zero emissions technologies. The first $10 billion or 1/6 of revenue in the trust fund, whichever is less, would be spent each year to finance tax credits for research and development in alternative energy.

- **Provide Transition Assistance for Affected Industries:** 1/12 of the fund's revenues would be dedicated to assistance for employees of industries negatively affected by

the resulting shift to clean energy technologies. This would be phased out over 10 years.

- **Reduce the burden of payroll taxes on working households.** The remaining funds would be divided equally among all individuals subject to the payroll tax to provide a payroll tax rebate. Seniors and individuals with disabilities, defined based on eligibility for Social Security, would receive the same amount. Because $727 billion of payroll taxes were collected in 2005, a tax at a rate of $15 per ton of CO_2 could lower payroll tax burdens by over 10 percent on average.

  For nearly three quarters of all households, payroll taxes are the single largest tax to the federal government. Because the payroll tax is a flat-rate tax up to a payroll limit of $97,500, it is generally acknowledged to be a regressive tax. Currently, those in the top 1 percent of the income scale pay only 2 percent of their income in payroll taxes, while those in the bottom 20 percent contribute 7.3 percent of income in payroll taxes. Revenues from a carbon tax could be used to reduce the tax burden on working households, and could have a profound effect on those households with earnings below the median income level. This rebate would benefit workers in the lower-end of the income scale the most.

How would the America's Energy Security Trust Fund Act work?

This bill would impose a per-unit tax on the carbon dioxide content of fossil fuels beginning at a rate of $15 per metric ton of CO_2 and increasing by 10 percent each year, also accounting for inflation. The rate is consistent with the broadly accepted goal of reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050. The tax would be phased in over a ten year period to allow industries to adapt. It should be emphasized, however, that the technology for clean energy already exists and therefore the rate of tax is aggressive.

The tax would be assessed on the CO_2 content of these fuels when they enter the economy: at oil refineries, coal processing plants and points of import. Therefore it would be easy to implement and administer—only about 2,000 entities would be taxed.

Demand for fossil fuels would fall in response to a carbon tax. As a result, carbon emissions would fall as well, by an estimated 700 million metric tons of CO_2 (12.1 percent). At the same time, demand for alternative sources of energy would increase, spurring innovation and competition, and would allow producers of alternative energy technologies to achieve economies of scale, which will eventually lower prices of that technology.

According to "A Green Employment Tax Swap: Using a Carbon Tax to Finance Payroll Tax Relief," a report by Gilbert E. Metcalf for the Brookings Institution and World Resources Institute, a tax of $15 per metric ton of CO_2 would nearly double the price of coal, assuming the industry fully passes the tax onto the consumer. Petroleum products would increase in price by nearly 13 percent and natural gas by almost 7 percent. This translates to approximately 13 cents per gallon of gasoline—a price increase of less than 7 percent.

What about good actors?

Carbon Capture and Storage (CCS) is an approach to mitigating climate change by capturing CO_2 from large point sources such as power plants and subsequently storing it away safely instead of releasing it into the atmosphere. We know how to capture and store CO_2. The AESTF Act will contribute to the development of CCS at the national level and encourage other technologies to reduce greenhouse gas emissions.

Because we want to encourage zero-emissions technologies, the bill would provide a refundable credit on all taxes paid for an entity that uses carbon capture and storage technology.

What about other Greenhouse Gases?

The bill requires the Secretary of the Treasury in consultation with the Secretary of Energy to design and implement a tax on other greenhouse gases like methane, nitrous oxide and other gases known to cause global warming. The goal is to ensure that for any entity taxed, a viable alternative to emitting these gases must exist in order to ensure that the tax will change polluting behaviors without simply being punitive. One benefit of including other greenhouse gases in the AESTF Act is that it can reduce the cost of reducing greenhouse gases. A recent study by researchers at MIT shows that early reductions in greenhouse gas emissions can be more inexpensively achieved if these other gases are included in the tax base.

How much money could it raise?

Emissions of carbon dioxide in 2005 were estimated to be just over 6 billion metric tons of CO_2 according to the Environmental Protection Agency (EPA). Had a carbon tax of $15 per ton of CO_2 been in place in 2005, the tax would have raised $89.2 billion.

What about other countries?

The United States is certainly not the only nation contributing to global warming. However, with only 5 percent of the world's population, in 2005 the U.S. was responsible for 22 percent of the CO_2 emitted worldwide from burning fossil fuels. This bill recognizes that the United States must lead the way but that the other major emitting countries must follow.

Additional Views of Rep. Stephanie Herseth Sandlin (D-SD at-large) to the Select Committee on Energy Independence and Global Warming Final Staff Report

Over the course of the 110th Congress, the Select Committee on Energy Independence and Global Warming has made significant and valuable contributions to the public debate and to Congress' efforts to develop responsible, forward-looking public policy regarding critical energy and climate change issues facing our nation. I have been very pleased and proud to serve with the distinguished members of this Select Committee, under the able leadership of Chairman Edward Markey. The Committee closely and diligently examined a wide range of difficult issues from numerous angles, with input from hundreds of experts, including more than 50 hearings.

I am confident that the Committee's efforts will guide future Congresses' work in ensuring that we meet the real and serious twin challenges of achieving energy independence and halting global warming. What's at stake is nothing less than our national security, our economic security, and our way of life in every corner of the country.

As the only member of the Committee who also serves on the Agriculture Committee, and the only one who represents a predominantly rural state, I have taken seriously my responsibility to ensure that issues affecting rural America and agriculture are addressed throughout this process. The good news is that as we seek to address these changes, rural America stands uniquely ready to play a vital role in the new energy economy.

If you look at my state of South Dakota from end-to-end, whether it is our vast fields of corn and soybeans in the eastern part of the state, the abundant wind resources across the state, or the great forests of the Black Hills in the West, South Dakota embodies the idea that we need a diversified approach to our national energy policy—and in particular we need to take advantage of new opportunities for renewable energy.

As we strive to meet our national energy needs, we must continue to recognize that rural America has much to offer. Rural states should be at the center of the solution as our national energy policy shifts and adjusts in ways that enhance our national and economic security; that promote both innovation and conservation; and that ultimately will ease the strain on families' and business owners' budgets.

With the passage of the original Renewable Fuel Standard in 2005 and the aggressive increase included in the 2007 energy bill, we have already taken initial key steps in the right direction, as we seek to take advantage of the contribution agricultural producers in rural states can make to reduce our dependence on foreign oil and overall carbon emissions through an increase in the production of biofuels, wind, and other types of renewable energy. But to be sure, there is more work to be done.

I agree with the scientific consensus that human activity has substantially increased the accumulation of greenhouse gasses and is contributing to a rise in average global temperature. This rise threatens to create a number of dramatic and negative impacts—raising sea levels, altering coastlines, increased risk of drought and forest fire, and changing weather patterns.

With much of the country's economy dependent on agriculture, which in turn depends on our climate, I recognize that global warming could have a profound effect on rural agricultural economies and our way of life.

Though there is no single solution to reducing the accumulation of greenhouse gases, I do see a number of positive steps we can take in the short-term to reduce global warming. I believe the federal government must be aggressive in its efforts to reduce greenhouse gas emissions. But, more than just creating penalties that reduce emissions, it is important to invest in new technologies, create incentives to increase efficiencies, and encourage greater reliance on a range of domestic energy sources with lower emission impacts—sources including increased domestic production of oil and gas, clean coal, oil shale, wind, solar, biofuels and more.

Many of the legislative proposals that have been introduced in the House fail to take the kind of comprehensive approach I support, and instead rely on mandatory reductions. My preference is to support a bill that also includes incentives to increase the use of renewable energies and rewards individual conservation practices.

Ultimately, we need a balanced legislative approach to these issues. I believe we can address the harmful consequences of climate change, while preventing the negative economic impacts some proposals could cause based on our nation's current reliance on electricity produced by coal, a significant source of carbon dioxide. A large part of the world's coal reserves are found in the U.S. and I believe we should devote the needed research and development resources to clean coal technologies, including promising carbon capture and sequestration projects.

Moreover, I believe the people and resources of rural America can play an important role in addressing climate change. Agricultural lands and forests naturally sequester carbon, and therefore can be managed to help reduce harmful amounts of carbon in the atmosphere. For example, current estimates of U.S. greenhouse gas markets indicate that U.S. farms have the potential to mitigate as much as 40 percent of our nation's total climate impact with practices such as soil carbon sequestration or methane capture. We also must do more to facilitate and encourage the use of the woody biomass that is already taken from public lands as part of responsible forest management plan as a source of cellulosic ethanol with significant potential.

Unfortunately, many recent proposals addressing climate change have been developed without fully engaging with agricultural experts. To address this oversight, I have been proactive in bringing representatives of the agricultural sector together to examine how best to craft a carbon sequestration offset program to maximize agriculture's participation, to look at the potential impact of a mandatory program on agricultural inputs, and to evaluate the potential benefits of a cap-and-trade system to agriculture. I have also engaged with my House colleagues to make sure they understand the role that our agricultural producers and forests can play as part of the solution to climate change.

In conclusion, I believe strongly that climate change and energy independence present both serious challenges and significant opportunities for rural America. I am grateful for this opportunity to provide additional views about the path forward. While these views do not

address or encompass every component of the full report, they do identify the key principles I continue to embrace as we look to craft effective public policy that recognizes the extremely diverse set of interests involved. I agree with much of what is expressed in the report, but have concerns with some of its provisions, and I look forward to continuing to work on these difficult, but essential, challenges in the future.

Appendix A

HEARINGS AND BRIEFINGS OF THE SELECT COMMITTEE ON ENERGY INDEPENDENCE AND GLOBAL WARMING

April 18, 2007
Geopolitical Implications of Rising Oil Dependence and Global Warming

Witness List:
- Ambassador Richard Haass, President, Council on Foreign Relations
- Vice Admiral Dennis McGinn, USN (Ret.), USN (Ret.), Vice President for Strategic Planning and Business Development
- Carl Pope, Executive Director, Sierra Club
- General Gordon R. Sullivan, USA (Ret.), USA (Ret.), President and Chief Operating Officer, Association of the United States Army
- James Woolsey, Vice President, Booz Allen Hamilton

April 26, 2007
Dangerous Global Warming

Witness List:
- Dr. James Hansen, Director, NASA Goddard Institute for Space Studies
- Dr. Judith Curry, Chair, School of Earth and Atmospheric Sciences, Georgia Institute of Technology
- Dr. Kristie Ebi, ESS, LLC and Lead author Human Health chapter, IPCC 4th Assessment, Working Group II
- Dr. Camille Parmesan, Assistant Professor, University of Texas
- Dr. John Helms, Professor Emeritus, University of California, Berkeley and Past President, Society of American Foresters

May 3, 2007
Economic Impacts of Global Warming: Part 1-Insurance

Witness List:
- John B. Stephenson, Director of Natural Resources and Environment, GAO,
- Mike Kreidler, Washington State Insurance Commissioner
- Frank Nutter, President, Reinsurance Association of America

May 9, 2007
Economics of Dependence on Foreign Oil – Rising Gasoline Prices

Witness List:
- Sylvia Estes, Pipeline and Industrial Group, Virginia Beach, VA
- Michael Mitternight, Factory Service Agency, Metairie, LA
- Terry Thomas, President and CEO, Community Bus Services Inc., Youngstown, OH
- Donn Teske, Farmer and President, Kansas Farmers Union, McPherson, KS
- John Felmy, Chief Economist, American Petroleum Institute

May 15, 2007
Perspectives on Energy and Climate Change: Prime Minister Fredrik Reinfeldt of Sweden

Witness List:
- Prime Minister Frederik Reinfeldt of Sweden

May 22, 2007
Economic Impacts of Global Warming: Green-Collar Jobs

Witness List:
- Jerome Ringo, President, Apollo Alliance
- Van Jones, President and Co-Founder, Ella Baker Center
- Elsa Barboza, Campaign Coordinator for Green Industries at the Strategic Concepts in Organizing and Policy Education (SCOPE)
- Bob Thelen, Chief Training Officer, Capital Area Michigan Works!

June 4, 2007
Global Warming Mountaintop 'Summit': Economic Impacts on New England.
Field Hearing on Cannon Mountain near Franconia, New Hampshire

Witness List:
- Timothy Perkins, Ph.D., Director, Proctor Maple Research Center, University of Vermont;
- Cameron Wake, Ph.D., Climate Change Research Center, University of New Hampshire;
- Alice Chamberlin, Special Assistant for Energy, Environment and Transportation, Governor John Lynch;
- Betsy Blaisdell, Manager, Environmental Stewardship Program, Timberland;
- Bill Koury, Former President, NH Wildlife Federation and avid New England sportsman.

June 8, 2007
Massachusetts v. U.S. EPA: Implications of the Supreme Court Verdict

Witness List:

Panel I
- The Honorable Stephen L. Johnson, Administrator, Environmental Protection Agency
- The Honorable Nicole Nason, Administrator, National Highway Traffic Safety Administration

Panel II
- The Honorable Jerry Brown, Attorney General of California
- The Honorable Martha Coakley, Attorney General of Massachusetts

June 19, 2007
Green Cities: Mayoral Initiatives to Reduce Global Warming Pollution

Witness List:
- The Honorable Richard Daley, Mayor of Chicago
- The Honorable Tom Potter, Mayor of Portland, OR
- The Honorable Pegeen Hanrahan, Mayor of Gainesville, FL

July 12, 2007
Plugging into Energy Independence with 150 MPG Vehicles

Witness List:
- Frank Gaffney, President, Center for Security Policy
  Rob Lowe, Actor and Advocate
- David Vieau, President and CEO, A123 Systems
- Fred Hoover, Washington representative for Austin Energy

July 18, 2007
Voluntary Carbon Offsets—Getting What You Pay For

Witness List:
- Derik Broekhoff, Senior Associate, World Resources Institute
- Joseph Romm, Senior Fellow, Center for American Progress
- Thomas Boucher, President and Chief Executive Officer, NativeEnergy LLC
- Russ George, President and Chief Executive Officer, Planktos, Inc.
- Erik Blachford, CEO, TerraPass Inc.

September 6, 2007
The Future of Coal under Carbon Cap and Trade

Witness List:

- David Freudenthal, Governor, Wyoming
- Michael Morris, CEO, American Electric Power
- Carl Bauer, Director, National Energy Tech. Laboratory
- Stuart Dalton, Director, Generation, Electric Power Research Institute
- Robert Sussman, Partner, Latham & Watkins, LLP
- David Hawkins, Director, Climate Center, National Resources Defense Council

September 20, 2007
Renewable Electricity Standards: Lighting the Way

Witness List:

Panel I

- The Honorable Bill Ritter, Governor of Colorado

Panel II

- Nancy Floyd, Nth Power, Founder and Managing Director
- Chris Hobson, Southern Company, Senior Vice President, Research and Environmental Affairs
- Bob Reedy, Florida Solar Research Center
- Mike Sloan, Wind Coalition, Director
- Dave Foster, Blue Green Coalition, United Steelworkers, Executive Director

September 25, 2007
Briefing: The Melting Arctic: Global Warming's Impacts on the Polar Region

Witness List:

- Stanley Tocktoo, Mayor, Shishmaref, Alaska
- Dr. Robert W. Corell, Program Director, The Heinz Center
- Dr. Sue Haseltine, Associate Director for Biology, USGS
- Dr. Glenn Juday, Professor of Forest Ecology, University of Alaska Fairbanks
- Deborah Williams, Alaska Conservation Solutions

September 26, 2007
Forging a Global Solution for Global Warming: International Perspectives

Witness List:

- The Honorable Gro Harlem Brundtland, UN Special Envoy on Climate Change, former Prime Minister of Norway and former chair of the World Commission of Environment and Development
- The Honorable Ricardo Lagos, UN Special Envoy on Climate Change, former Chilean President
- The Honorable Han Seung-soo, UN Special Envoy on Climate Change, former Minister of Foreign Affairs of the Republic of Korea and former President of the UN General Assembly
- The Honorable Sigmar Gabriel, Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Germany

October 10, 2007
The Business Opportunity in a Low-Carbon Energy Economy

Witness List:

- Alan Grisay, CEO, F&C Investments, member of the UK and EU Corporate Leaders' Groups on Climate Change
- Neil Carson, CEO Johnson Matthey plc, member of the UK Corporate Leaders' Group
- Ralph Izzo, Chairman, President and CEO, Public Service Enterprise Groupe Incorporated (PSEG), member of the Clean Energy Group and its Clean Air Policy Initiative
- Johnathan Lash, President , World Resources Institute, member U.S. Climate Action Partnership

October 18, 2007
Energy and Global Warming Solutions for Vulnerable Communities

Witness List:

- Mr. Martin Luther King III, C.E.O, Realizing the Dream, Inc.
- Mr. Mike Williams, Board Member, National Tribal Environmental Council
- Mr. Amjad Abdulla, Assistant Director General, Ministry of Environment, Energy and Water, Government of the Republic of Maldives
- Dr. Eileen Gauna, Professor, University of New Mexico

October 24, 2007
The Gas is Greener: The Future of Biofuels

Witness List:
- Adam Gardner, Guster and Reverb
- Don Endres, CEO, Vera Sun
- Steve Gatto, CEO, Bioenergy LLC
- Nathanael Greene, Natural Resources Defense Council
- Dr. Susan Leschine, University of Massachusets-Amhers, and founder of SunEthanol

November 1, 2007
A Spark Neglected: Wildfires and Global Warming

Witness List:
- Abigail Kimbell, Chief, U.S. Forest Service
- Dr. Steven Running, Professor of Ecology, University of Montana
- Michael Francis, Director of Forest Program and Deputy Vice President, Wilderness Society
- Dr. Michael Medler, Member of Firefigthers United for Saftey Ethics and Ecology, Assistant Professor at Huxley College

November 2, 2007
Bright Lights in the Cities: Pathways to an Energy-Efficient Future
Field Hearing in Seattle, Washington

Witness List:
- The Honorable Greg Nickels, Mayor of Seattle
- The Honorable Michael R. Bloomberg, Mayor of New York City
- The Honorable Manny Diaz, Mayor of Miami
- The Honorable Douglas H. Palmer, Mayor of Trenton
- The Honorable Antonio Villaraigosa, Mayor of Los Angeles

November 5, 2007
Youth Leadership for Clean Energy and Healthy Climate

Witness List:
- Billy Parish, Energy Action Coalition
- Brittany R. Cochran, Environmental Justice and Climate Change Initiative
- Cheryl Lockwood, Alaska Youth for Environmental Action
- Katelyn McCormick, Students Promoting Environmental Students
- Mike Reagan, California PIRG

November 7, 2007
Oil Shock: Potential for Crisis

Witness List:

- Carol P. Browner, former Administrator of the Environmental Protection Agency and current Principal of the Albright Group
- Admiral Dennis Blair, USN (Ret.), Former Commander in Chief, U.S. Pacific Command

November 14, 2007
State Leadership Toward A Low-Carbon Energy Future

Witness List:

- The Honorable Eliot Spitzer, Governor, The State of New York
- The Honorable Janet Napolitano, Governor, The State of Arizona

December 19, 2007
Bali – the UN Conference and its Impact on International Climate Change Policy

Witness List:

- Ms. Christiana Figueres, Official Negotiator, U.N. Framework Convention on Climate Change and the Kyoto Protocol, Costa Rica
- Mr. Philip Clapp, Deputy Managing Director, Pew Environment Group
- Mr. Alden Meyer, Director of Strategy and Policy, Union of Concerned Scientists
- Mr. Ned Helme, President, Center for Clean Air Policy
- Mr. Myron Ebell, Director, Energy and Global Warming Policy, Competitive Enterprise Institute

January 17, 2008
On Thin Ice: The Future of the Polar Bear

Witness List:

Panel I

- Mr. Dale Hall, Director, Fish and Wildlife Service
- Mr. Randall Luthi, Director, Minerals Management Service
- Dr. Steven Amstrup, Polar Bear Team Leader, U.S. Geological Survey

Panel II

- Ms. Jamie Rappaport Clark, Executive Vice President, Defenders of Wildlife
- Ms. Deborah Williams, President, Alaska Conservation Solutions
- Ms. Kassie Siegel, Director, Climate, Air and Energy Program, Center for Biological Diversity

January 23, 2008
Cap, Auction, and Trade: Auctions and Revenue Recycling Under Carbon Cap and Trade

Witness List:
- The Honorable Ian Bowles, Secretary of Energy and Environmental Affairs, Commonwealth of Massachusetts
- Peter Zapfel, Coordinator for Carbon Markets and Energy Policy, European Commission – Environment Directorate General
- Dallas Burtraw, Senior Fellow, Resources for the Future
- John Podesta, President and Chief Executive Officer, Center for American Progress
- Robert Greenstein, Executive Director, Center on Budget Policies and Priorities

January 30, 2008
Learning from a Laureate: Science, Security and Sustainability

Witness List:
- Dr. Rajendra Pachauri, Chairman, Intergovernmental Panel on Climate Change

February 14, 2008
Fire and Rain: How Destruction of Tropical Forests is Fueling Climate Change

Witness List:
- Dr. Thomas Lovejoy, President, The Heinz Center
- Mr. Stuart Eizenstat, Partner, Covington & Burling, on behalf of Sustainable Forestry Management
- Ms. Stephanie Meeks, Acting President and CEO, The Nature Conservancy

March 12, 2008
Nuclear Power in a Warming World: Solution or Illusion?

Witness List:
- Amory Lovins, Cofounder, Chairman, and Chief Scientist of the Rocky Mountain Institute
- Sharon Squassoni, Senior Associate in the Nonproliferation Program of the Carnegie Endowment for International Peace
- David Lochbaum, Director of the Nuclear Safety Project for the Union of Concerned Scientists
- Alex Flint, Senior Vice President, Government Affairs, Nuclear Energy Institute

February 26, 2008
Food for Thought: Sustainability from Counter to Compost

Witness List:

- Dan Beard, Chief Administrative Officer (CAO), House of Representatives
- Carina Wong, Executive Director, Chez Panisse Foundation
- Patricia D. Millner, Ph.D, Research Microbiologist in the Sustainable Agricultural Systems Laboratory and Environmental Microbial Systems Laboratory, USDA
- Tom Kelly, Ph.D., Chief Sustainability Officer, University of New Hampshire Office of Sustainability

March 6, 2008
Blowing in the Wind: Renewable Energy as the Answer to an Economy Adrift

Witness List:

- Bianca Jagger, Chair, World Future Council
- Vic Abate, Vice President, Renewable Energy, General Electric
- Tom Buis, President, National Farmers Union
- Barbara Lockwood, Manager, Renewable Energy Arizona Public Service Co.
- Blair Sweezey, Senior Director, Solar Markets and Public Policy, Applied Materials
- Bill Unger, Partner Emeritus, Mayfield Fund, representing Environmental Entrepreneurs

March 13, 2008
Massachusetts v U.S. EPA Part II: Implications of the Supreme Court Decision

Witness List:

Panel I

- The Honorable Stephen L. Johnson, Administrator, Environmental Protection Agency

Panel II

- The Honorable Roderick Bremby, Secretary, Kansas Department of Health and Environment
- The Honorable Josh Svaty, Member of the Kansas House of Representatives
- Lisa Heinzerling, Professor of Law, Georgetown University Law Center
- David Bookbinder, Chief Climate Counsel, Sierra Club
- Peter S. Glaser, Partner, Troutman Sanders

April 1, 2008
Drilling for Answers: Oil Company Profits, Runaway Prices and the Pursuit of Alternatives

Witness List:

- Mr. J. Stephen Simon, Senior Vice President, Exxon Mobil Corp.
- Mr. John Hofmeister, President, Shell Oil Company
- Mr. Robert A. Malone, Chairman and President, BP America, Inc.
- Mr. Peter Robertson, Vice Chairman, Chevron
- Mr. John Lowe, Executive Vice President, ConocoPhillips

April 2, 2008
From the Wright Brothers to the Right Solutions: Curbing Soaring Aviation Emissions.

Witness List:

- Dan Elwell, FAA Assistant Administrator for Aviation Policy, Planning, and Environment
- Bob Meyers, Principal Deputy Assistant Administrator for the Office of Air and Radiation, U.S. Environmental Protection Agency
- Tom Windmuller, Senior Vice President, International Air Transport Association
- James May, President and CEO, Air Transport Association
- Deron Lovaas, Natural Resources Defense Council

April 9, 2008
Healthy Planet, Healthy People: Global Warming and Public Health

Witness List:

- Howard Frumkin, M.D., M.P.H., Ph.D., Center for Disease Control, Director of National Center for Environmental Health, Agency for Toxic Substances and Disease Registry
- Jonathan Patz, M.D., M.P.H., Professor and Director of Global Environmental Health, University of Wisconsin at Madison
- Georges Benjamin, M.D., F.A.C.P., F.A.C.E.P. (Emeritus), Executive Director, American Public Health Association
- Mark Jacobson, Ph.D., Director, Atmosphere and Energy Program and Professor of Civil and Environmental Engineering at Stanford University
- Dana Best, M.D., M.P.H., F.A.A.P., American Academy of Pediatrics

April 16, 2008
Green Capital: Seeding Innovation and the Future Economy

Witness List:
- Mr. Dan Braun, Director, Global Environmental Finance
- Mr. David Prend, Co-founder and Managing General Partner, RockPort CapitalPartners
- Mr. Daniel R. Abbasi, Director, MissionPoint Capital Partners

April 24, 2008
Pumping up Prices: The Strategic Petroleum Reserve and Record Gas Prices

Witness List:
- Dr. Mark Cooper, Director of Research, Consumer Federation of America
- Mr. Dave Berry, Vice President, Swift Transportation Company, Inc., Chairman, Energy and Environment Policy Committee, American Trucking Association
- Mr. Frank Rusco, Acting Director, Natural Resources and Environment, GAO
- Ms. Melanie Kenderdine, Associate Director, Strategic Planning, MIT Energy Initiative
- Mr. Kevin Book, Senior Vice President, Senior Analyst, Energy Policy, Oil & Alternative Energy, Friedman, Billings, Ramsey & Company, Inc

April 29, 2008
Rising Tides, Rising Temperatures: Global Warming Effects on Oceans

Witness List:
- Sylvia Earle, Explorer-in-Residence, National Geographic Society
- Dr. Vikki Spruill, President and CEO of The Ocean Conservancy
- Dr. Jane Lubchenco, Department of Zoology, Oregon State University
- Dr. Joan Kleypas, National Center for Atmospheric Research, Boulder, Colorado

May 8, 2008
Negawatts: The Role of Efficiency Policies in Climate Legislation

Witness List:
- The Honorable Paul DeCotis, Deputy Secretary of Energy, State of New York
- The Honorable Dian Grueneich, Commissioner, California Public Utilities Commission
- Steven Kline, Vice President for Environment and Federal Affairs, Pacific Gas and Electric Corporation
- Richard Cowart, Director, Regulatory Assistance Project
- George Sakellaris, President and CEO, Ameresco, Inc.

May 14, 2008
Building Green, Saving Green: Constructing Sustainable and Energy-Efficient Buildings

Witness List:
- Ed Norton, Actor and Trustee of Enterprise Community Partners
- The Honorable Gavin Newsom, Mayor of San Francisco
- Kent Peterson, President, American Society of Heating, Refrigerating and Air-Conditioning Engineers
- Michelle Moore, Senior Vice President of Policy and Market Development, U.S. Green Building Council
- Tony Stall, Vice President Marketing for Dryvit Systems Inc.

May 22, 2008
Oversight of the Bush Administration's Energy Policy with DOE Sec. Bodman

Witness List:
- The Honorable Samuel Bodman, Secretary, U.S. Department of Energy

June 11, 2008
The Future of Oil: Peak Prices, Peak Production, Piqued Consumers

Witness List:
- Guy Caruso, Administrator, Energy Information Administration
- Adam Sieminski, Chief Energy Economist, Deutsche Bank
- Amy Myers Jaffe, Energy Studies Fellow at the James Baker Institute for Public Policy
- Athan Manuel, Director of Land Protection Programs, Sierra Club
- Karen Harbert, Managing Director and Executive Vice President, Institute for 21st Century Energy U.S. Chamber of Commerce

June 18, 2008
Planning Communities for a Changing Climate—Smart Growth, Public Demand and Private Opportunity

Witness List:
- Dr. Sultan Al-Jaber, CEO, Masdar Initiative, Abu Dhabi, United Arab Emirates
- Steve Hewitt, City Administrator, Greensburg, Kansas
- Gregory Cohen, President and CEO, American Highway Users Alliance
- David Goldberg, Director of Communications, Smart Growth America
- Steve Winkleman, Transportation Director, Center for Clean Air Policy

June 23, 2008
Briefing: Global Warming Twenty Years Later: Tipping Points Near

Witness List:
- Dr. James Hansen

June 25, 2008
National Security Implications of Global Climate Change

Witness List:
Panel I:
- Dr. Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council
- Mr. Rolf Mowatt-Larsen, Director, Intelligence and Counterintelligence, U.S. Department of Energy

Panel II:
- The Right Honorable Margaret Beckett, Member of Parliament, Former Foreign Minister of the United Kingdom
- VADM Paul Gaffney, President, Monmouth University and Former President, National Defense University
- Dr. Kent Hughes Butts, Professor of Political-Military Strategy, Center for Strategic Leadership, U.S. Army War College
- Marlo Lewis, Senior Fellow, Competitive Enterprise Institute
- Lee Lane, Resident Fellow, American Enterprise Institute

June 26, 2008
$4 Gasoline and Fuel Economy: Auto Industry at a Crossroads

Witness List:
- The Honorable Tyler Duvall, Assistant Secretary for Policy, Department of Transportation
- Mr. Dominique Thormann, Senior Vice President, Nissan North America, Inc.
- Mr. Shai Agassi, Founder and CEO, Project Better Place
- Mr. Torben Holm, Consultant, DONG Energy A/S
- Mr. Jeffrey R. Holmstead, Partner, Bracewell & Giuliani LLP

July 10, 2008
Global Warming Effects on Extreme Weather

Witness List:
- Jimmy O. Adegoke, Ph.D, Associate Professor, University of Missouri – Kansas City
- Heather Cooley, Senior Research Associate, Pacific Institute
- Jay S. Golden, Ph.D, Director, National Center of Excellence, SMART Innovations for Urban Climate & Energy, Global Institute of Sustainability, Arizona State University
- Angela Licata, Deputy Commissioner, New York City Bureau of Environmental Planning and Analysis
- Dan Keppen, Executive Director, Family Farm Alliance

July 23, 2008
Deploying Oil from the Strategic Petroleum Reserve

Witness List:
- Mr. C. Kyle Simpson, Policy Director, Brownstein, Hyatt, Farber, Schreck
- Dr. Joe Romm, Senior Fellow, Center for American Progress
- James May, President and CEO, Air Transport Association of America

July 28, 2008
The Economics of Global Warming: Shaping How U.S. Companies are Doing Business
Field Hearing in Hartford, Connecticut

Witness List:
- George David, Chairman, United Technologies Corporation
- Dan Esty, Hillhouse Professor of Environmental Law and Policy at Yale University, Director of the Yale Center for Environmental Law and Policy an the Center for Business & Environment
- John Rice, Vice Chairman, General Electrics and CEO, General Electrics Infrastructure

July 30, 2008
What's Cooking with Natural Gas?: Hearing to Examine Fuel's Role in Global Warming Solutions

Witness List:
- Aubrey McClendon, CEO, Chesapeake Energy
- Clay Harris, CEO, Suez LNG North America
- David Manning, Executive VP, National Grid
- Rich Wells, Vice President Energy, The Dow Chemical Company
- John German, Manager Environmental and Energy Analysis, American Honda
- Mark Smith, Executive Director, Independent Petroleum Association of Mountain States

July 31, 2008
Renewing America's Future: Energy Visions of Tomorrow, Today

Witness List:
- Ms. Cathy Zoi, Chief Executive Officer, Alliance for Climate Protection
- Dr. Andrew Frank, Professor, Mechanical and Aeronautical Engineering, University of California at Davis
- Gregory Yurek, Ph.D, Founder, Chairman, and CEO, American Superconductor Corporation
- Aristides A. N. Patrinos, Ph.D, President, Synthetic Genomics
- Steven Lockard, CEO, TPI Composites

September 10, 2008
Investing in the Future: R&D Needs to Meet America's Energy and Climate Challenges

Witness List:
- Dr. Susan Hockfield, President, Massachusetts Institute of Technology
- Dr. Stephen Forrest, Vice President of Research, University of Michigan
- Dr. Jack Fellows, Vice President, University Corporation on Atmospheric Research
- Dr. Daniel Kammen, Professor, UC-Berkley

September 18, 2008
The Green Road to Economic Recovery

Witness List:
- Mr. Bracken Hendricks, Senior Fellow, Center for American Progress
- Dr. Robert Pollin, Co-Director, Political Economy Research Institute, University of Massachusetts-Amherst
- Mr. Fred Redmond, Vice President, United Steelworkers
- Mr. Byron Kennard, Executive Director, Center for Small Business and the Environment
- Dr. Margo Thorning, Senior Vice President and Chief Economist, American Council for Capital Formation

September 25, 2008
The Future of LIHEAP Funding: Will Families Get the Cold Shoulder this Winter?

Witness List:
- The Honorable Deval Patrick, Governor, Commonwealth of Massachusetts
- Mr. Howard Gruenspecht, Acting Administrator, Energy Information Administration
- Mr. Mark Wolfe, Executive Director, National Energy Assistance Directors' Association
- Mr. John Drew, Executive Vice President, Action for Boston Community Development, Inc.