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**TESTIMONY SUBMITTED TO THE  
COMMITTEE ON FOREIGN AFFAIRS  
U.S. HOUSE OF REPRESENTATIVES**

**HEARING ON  
U.S. RE-ENGAGEMENT IN THE GLOBAL EFFORT TO  
FIGHT CLIMATE CHANGE  
MAY 15, 2007**

Mr. Chairman and distinguished members of the Committee, good morning and thank you for inviting me to testify about a matter of compelling national and global significance. I am David Jhirad, Vice-President for Science and Research, of the World Resources Institute.

The World Resources Institute provides analysis and builds practical solutions to the world's most urgent environment and development challenges. We work in partnership with scientists, businesses, governments, and non-governmental organizations in more than seventy countries. For over 25 years, the World Resources Institute has provided information, tools, and analysis to address climate change and the degradation of ecosystems, while working to improve people's lives.

**An Opportunity for US Leadership and Multi-faceted Innovation**

According to the International Energy Agency (IEA), the world has embarked on an energy path that is incompatible with achieving a stable climate for the Earth and its people. The IEA also confirms that the international community is following an energy trajectory that is financially and economically unsustainable, and poses serious threats of regional and global conflict.

The United States and the international community are faced with daunting challenges in transforming this situation. Long-term solutions will require: stabilizing greenhouse gas concentrations in the atmosphere at acceptable levels; enhancing energy security and reducing the risk of economic and political disruption; eliminating energy poverty for over four billion people on the planet; and mobilizing over \$20 trillion in capital investment for energy infrastructure by the year 2030, mostly from private sources.

Visionary and sustained political leadership, international co-operation, and multifaceted innovation will be needed to implement transformational solutions. Innovations on a truly breathtaking scale will have to occur in policy, technology, and investment to assure global security and sustainability. Energy technology innovation and deployment on an unprecedented global scale, amounting to a new industrial revolution, will be a vital and necessary part of the solution.

## The End of the Scientific Debate and Calls for Action

In February 2007, the Intergovernmental Panel on Climate Change (IPCC) released its report on climate change science. The report states that it is “unequivocal” that the Earth’s climate is warming, and confirms that the current atmospheric concentration of carbon dioxide and methane, two important greenhouse gases (GHGs), “exceeds by far the natural range over the last 650,000 years.” Further, the IPCC concludes that it is now “very likely” (greater than 90% probability) that greenhouse gas emissions from human activities have caused “most of the observed increase in globally averaged temperatures since the mid-20th century.”

While any level of warming may have consequences, many scientists believe we must limit global warming to no more than 2 degrees Celsius above current levels to avoid the worst impacts of climate change. To limit global warming to less than 2 degrees Celsius, atmospheric carbon dioxide concentrations must not exceed 450-500 parts per million (the current level is approximately 380 ppm and rising at more than 2 ppm per year). To achieve this, global emissions would need to decrease dramatically during this century, on the order of 60 to 80 percent below current levels.

To underscore the validity of the science, a declaration issued jointly by the Academies of Science of Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, UK, and USA in 2005, stated,

*“The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action.... We urge all nations, in the line with the UNFCCC principles, to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies. As national science academies, we commit to working with governments to help develop and implement the national and international response to the challenge of climate change.”*

The scientific debate is largely over on the cause of global climate change – the focus has turned to action. It is essential that the United States take strong action at the national level to reduce emissions. The rest of the world cannot solve this problem without the U. S. Action by the U.S. will make clear that in tomorrow’s markets there will be a price for carbon, and will give U.S. companies an advantage in preparing to compete in those markets.

That is why twenty-one leading U.S. businesses including large energy consumers and customers such as General Electric, AIG, Alcoa, Caterpillar, DuPont, John Deere, Duke Energy, and General Motors joined with WRI and five environmental organizations to urge Congress to enact mandatory measures to “slow, stop and reverse” the growth in U.S. GHG emissions. The United States Climate Action Partnership (US CAP) on January 22, 2007, issued “A Call for Action” which provided recommendations to Congress and the Administration on mandatory, economy-wide policy design to achieve emissions reductions of 60-80% by 2050.

## Exemplary Action by the United States

Effective and credible leadership by the United States in the international arena demands that we implement strong federal legislation that captures the twin benefits of reduced petroleum consumption and greenhouse gas emissions. This will allow the U.S. to play a more constructive role in international fora, to enhance existing and to create new bilateral and multilateral arrangements, and to develop partnerships that engage the private sector in global emission reduction opportunities, both domestically and internationally.

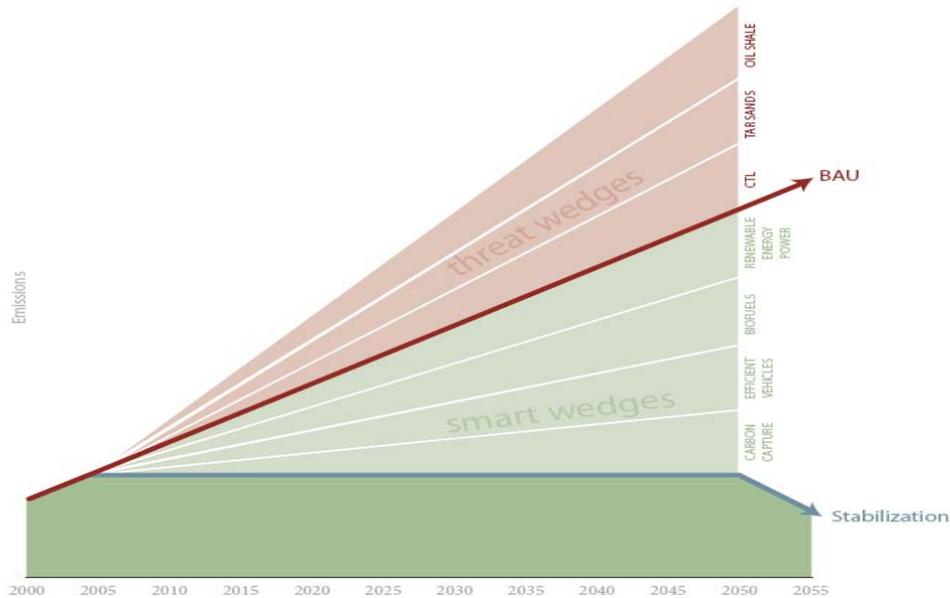
Establishing a price for carbon in the United States through significant mandatory legislation will improve our stature in the international arena, and will build the credibility of U.S. institutions and companies throughout the world. A price on greenhouse gas emissions can lead to changes in consumer choices, corporate behavior, and new investment. A large problem historically has been our failure to use markets to define the value of energy security. If it is worth a dollar a gallon or more of a subsidy for replacing oil with ethanol, then that dollar should be a tax on all oil products, and not just on gasoline. Other countries such as Sweden charge an oil security fee for their strategic reserve, whereas ours is subsidized.

We know how to create markets – and make them work. This is a vital starting point if we are to re-engage the rest of the world. It is also an important step because the scale of the greenhouse gas reductions required is enormous. The world needs to reduce long term emissions by 60 to 80% from energy, transport, industries, agriculture, and land use.

The solution is to catalyze a massive transformation in energy technology development and deployment, both in industrialized and in developing economies. The drivers for this transformation are straightforward: **government policy and private sector investment**. Most importantly, the transition of the energy sector to a diversified, low-carbon system offers an opportunity to research, develop, and manufacture advanced technologies that will clean the air, improve people's health, and provide greater economic and political security and stability.

A paper published by the journal *Science* by two Princeton researchers in 2004 demonstrated graphically how a suite of existing technological options could be used to reduce GHG concentrations to a level that is sufficient to avoid the most dangerous effects of climate change. They illustrate this point by breaking the required emission reductions down into manageable (though still large) “wedges,” each provided by a different technology or set of technologies. At WRI, we have modified this very useful concept to include an indication that not all energy choices will yield emissions reductions – in fact, our analysis shows that some of the potentially appealing political choices to enhance energy security could have significant negative impacts on greenhouse gas emissions. Figure 1 offers a visualization of this modified wedges concept.

**Figure 1: Smart Wedges and Threat Wedges**



Source: World Resources Institute

As the figure illustrates, the concept is based on the comparison of a business as usual (BAU) projection of GHG emissions into the future with the desired trajectory of stable global emissions through the year 2050. The triangle-shaped gap between the two lines can be divided into smaller portions, each of which represents a technology option. The paper presented 15 such options, each with the potential to reduce emissions in 2050 by one gigaton of carbon per year, and argued that implementing only 7 of these would be sufficient to avoid the worst effects of climate change.

However, the range of policy and technology choices available that are not included in BAU assumptions includes a number of options that could *raise* emissions significantly. These are likely to be driven particularly by energy security concerns and/or consistently high oil prices, and include:

- Production of synthetic liquid fuels from coal (known as coal-to-liquids, or CTL),
- Extraction of heavy oils from so called “tar sands,” and
- Production of oil from crushed rocks called “oil shale.”

Considering oil security issues in isolation, these options offer some advantages: although high-cost, they depend on fuels that are available in abundance in countries such as the United States and Canada. However, from a climate perspective they represent a serious threat. CTL gives rise to roughly double the emissions of oil-based fuels, and both tar sands and oil shale require significant quantities of energy and water to process. Extensive application of one or more of these technologies could have fatal effects on efforts to limit climate change. We term these “threat wedges” to contrast with the “smart wedges” of the Princeton work.

This visual illustration conveys a simple, powerful idea: that, despite the scale of the problem, we have the potential to solve it if we can deploy today’s technologies at

sufficient scale. The wedges approach offers us a way of coming to grips with the problem of taking technologies to scale, and raises questions that are vitally important for both policy makers and private sector actors. How are such wedges to be realized in national policy? What are the needs in terms of technology, capital, market actors, and regulatory environment? How do we move from today's market and legislative conditions to those appropriate to the enormous task of realizing a wedge?

### **The International Dimension**

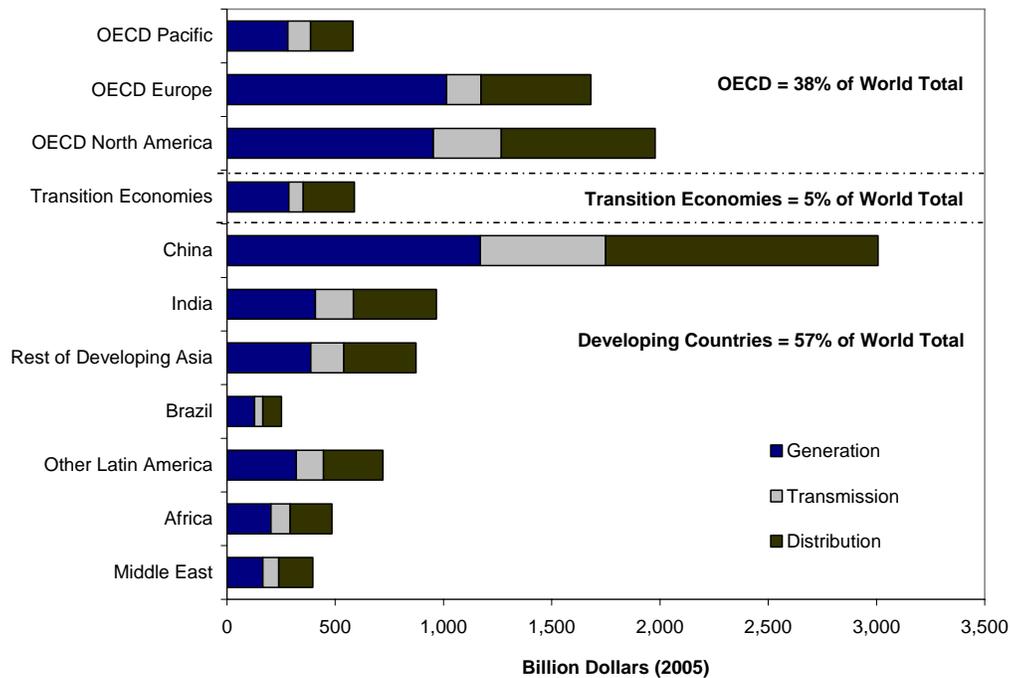
When we look at the international level, the list of questions gets longer. How can the wedges concept fit within the development plans of developing countries? What is the balance between in-country policy and international mechanisms in bringing these wedges to market? How can the governance and decision making structures within developing countries lead to smarter and cleaner investment choices? How can developed countries work with India and China to bring wedge technologies to market?

If greenhouse gases are not an immediate concern in countries such as India and China, energy issues are. A rush for investment, energy security concerns, and the staggering cost of pollution in terms of human life all make clean, efficient technologies highly desirable in the developing world, as elsewhere. Both Indian and Chinese energy markets are dominated by domestic capital resources, and both tend to strongly favor high-end technology.

There is considerable scope to engage both private sector and government players in the promotion of clean technology markets. Just as for most technologies, this will no longer be a question of isolated countries but of global markets serving national demands. Because India and China are large and growing energy consumers in global markets, **there is a strong case to be made to include India and China as member countries, speaking from my own experience as the Vice-Chairman of the Governing Board of the International Energy Agency.**

There is also an international dimension to capital flows to low carbon technologies. Layered on top of the country-specific aspect of capital investment is the network of investment players that can support large scale deployment of technology. In China, for instance, the vast majority of capital deployed in the energy sector is domestic, and much is not constrained by the same requirements for return on investment as in more liberalized markets. According to the *World Energy Outlook* the largest investment requirements in the power sector, some \$3 trillion, will occur in China.

**Figure 2: Cumulative Power Sector Investment by Region, 2005-2030**



Source: IEA, *World Energy Outlook, 2006*

While the majority of capital invested in these countries is domestic, the sovereign risk characteristics of these countries can differ significantly, which can influence the types of international lenders that are willing to invest in these markets. This aspect of investment risk, combined with the technological capacity of a country to deploy technologies, as well as the local policies and measures that govern them, can influence technology investment flows to Brazil, Russia, India, and China.

### Financial Innovation

While it would be easy to suggest that greater policy certainty will drive more investment flows into wedge technologies, total regulatory certainty is often not feasible. Financial innovation is required as part of the broader design of policies and institutional structures framed for wedge implementation.

Just as there is no technological silver bullet, there is no single investment structure that would fit the requirements of this diverse market. Because different segments of the financial community can support different levels of risk, a range of custom-designed instruments will be required in order to finance low carbon technology deployment. This could include targeted policies to promote low carbon exports, as public resources alone will certainly not prove sufficient to meet all the financing requirements. There needs to be a degree of cooperation between players in international capital markets that goes beyond traditional pools of capital.

## Policy Innovation

Investment on the scale required to implement the climate wedges can only be mobilized with an adequate policy framework. Accordingly, public policy will be critical in enabling providers of technology and capital to establish working markets.

At the same time, investors and technology providers will have to work in the absence of clear policy, at least in some parts of the world. Climate change is so pervasive that its policy drivers will inevitably overlap with those in other policy spheres, such as energy, security, agriculture, and development. Understanding how these policies will emerge and interact is vital to successful low-carbon technology deployment.

To be effective and to spur technological innovation, a policy framework must provide incentives to invest in cleaner technologies, such as regulatory mandates, prices, or taxes. In addition, it must reduce investor risk by providing clear, reliable signals over timescales that allow adequate returns on investment.

- The policies need to be clear and unambiguous. This argues for simplicity and a minimum of bureaucratic detail. It also means that the political leadership behind the policies needs to be clear and credible, to create confidence that policy direction will be maintained.
- Policy signals need to apply over a timescale that counts. Too short, and they do not provide enough confidence among investors that they can plan for adequate returns.
- Policies only give clear signals if they are mandatory, legal, and enforceable. By themselves, voluntary measures are unlikely to be significant drivers of the wedges, because so many of the technology responses, at least in their early stages, entail additional costs. The scope of companies to adopt more costly options while their competitors are not obliged to do so is inevitably limited.
- Price signals may emerge gradually, and take time to command investor confidence. For some technology options, there may be a role for government research and development support to bring new technologies to the point where carbon prices set by policy are sufficient to let the market take over.

**Energy security** is high on the political agenda, pushed by both fuel prices and geopolitical concerns. For technologies such as renewable energy and efficiency improvements, the policy responses to energy security concerns complement the “smart” climate wedges. However, energy security is also the main driver behind the “threat” wedges that could divert major effort in technology and capital into making the climate problem worse.

**Agriculture** policy has dominated biofuels policy, particularly in the United States and Europe, and will continue to have an important role. From an energy perspective this means that sub-optimal methods for producing biofuels, in particular the use of starch-based crops, will continue to attract public support disproportionate to their actual energy benefits.

**Trade** issues are of great importance, given the international scale of wedge deployment. Countries apply tariffs to trade in technologies and services that can impede investment. Related issues such as intellectual property protection and the liberalization of domestic energy markets are also critical and will be shaped by political considerations wider than even the wedges vision.

Many different policy approaches *could* be taken to advance selected wedges. Any or all of these might be applied in different jurisdictions, though many of them may be far from optimal. Policy approaches such as cap-and-trade and carbon taxes are not mutually exclusive. In addition, policy design does not start from scratch. Where existing policies such as vehicle efficiency standards, renewable energy portfolio standards, or biofuels subsidies exist there will be a strong preference for incrementally improving those policies over designing fundamentally new ones, unless there is a strong consensus that existing policies have failed.

Investors in any wedge technology should expect to encounter any or all of these policies in the countries in which they operate. For instance, the sale of efficient vehicles at present is affected in the U.S. by performance standards (CAFE) and technology support (e.g., HOV lane rights for hybrid vehicles); in Europe by voluntary agreements (ACEA), fuel taxes (all member states), and congestion charging (London); in China by performance standards; in India by mandates (compressed natural gas for public vehicles in Delhi); and so on. While some wedges (particularly those in the power sector) will be more likely than others to get a straightforward price signal through a cap-and-trade system, many such proposals currently in the U.S. Congress also cover transport fuels. The variety of policy tools is the likely permanent state of any market.

### **Promoting Clean and Efficient Energy Technologies in the International Arena**

The European Union has acted on the realization that the clean technologies of the future require domestic policies that create private investment and innovation. So Germany and Denmark have overtaken the U.S. on solar and wind electricity respectively. Not just in terms of the installed megawatts of power generation, but in terms of employment generation, economic benefits and a globally competitive industry.

There are now 26 companies and NGOs in the US Climate Action Partnership asking for mandatory climate policy in the U.S., because they know that to compete in global markets tomorrow they need clear and mandatory policy today. The U.S. needs to be competitive in the global marketplace for clean energy. This market will develop whether or not we participate. The key issue for the U.S. is whether it will lag behind its competitors, as it has done for many of the telecom and automotive innovations that were developed in the U.S. but built elsewhere, or whether the U. S. will be a market leader in the energy revolution of our millennium, with the creation of wealth that flows from such leadership.

There is major scope to expand Federal programs that promote clean energy exports and technology partnerships. For a world in which global energy investments will exceed \$20 billion over the next twenty-five years, U.S. efforts have been grossly under-funded. The U.S. investment in new technology initiatives, such as the US Methane to Markets

Program, the Carbon Sequestration Leadership Forum, and the International Partnership for a Hydrogen Economy, is much too small to have any impact. Very few of the provisions of the Energy Policy Act of 1992 have been implemented owing to a lack of Federal funding. In particular, the Interagency Working Group to support a Clean Energy Technology Exports Initiative, has not yielded important outcomes.

The United States Agency for International Development (USAID) needs to ramp up considerably its policies and programs that promote clean energy technologies. Programs need to focus on developing markets for such technology, through improving policy and regulatory frameworks, and removing barriers to private investment. An example of a successful promote clean and efficient energy technologies in developing counter programs, now ended, was FINERCA-Financing Renewable Energy in Central America. The market development activities implemented via this program were a key component of the increased investment activity now taking place in the region. The modest \$5 million in technical assistance, business development, policy and targeted training interventions leveraged over \$70 million of new capital to the sector. There is a crying need for this type of market development program in other renewable energy and efficiency markets.

For countries such as India and China, the Foreign Commercial Service needs to build its knowledge of US technologies, investors and companies in order to engage effectively with markets and joint-venture partners in these countries. Such engagement could be enhanced considerably through trade and reverse-trade missions in clean energy technology. Currently, such programs are under-staffed and resourced.

The Overseas Private Investment Corporation (OPIC) and the Export Import Bank (EXIM) should collaborate actively with U.S. companies seeking to invest in clean energy technologies in emerging markets, and provide an array of incentives for such investments.

There is a persuasive argument for a funded mechanism in the Executive Branch to ensure the coherence and effectiveness of government programs that promote the use of clean energy in international markets. Accountability and “management for results” should form the core values this initiative.

It is clear that Federal programs of the kind proposed can work. They already engage key countries and regions, and create private-public partnerships that are vital in developing successful commercial markets in clean technology. Congress could increase their chances for success by authorizing additional resources, and by creating incentives for companies to enter new markets. Congress can also provide a framework so that the large-scale private capital and investment community is actively engaged. (Citigroup recently announced the creation of a \$50 billion fund for low carbon investments).

### **Climate Change and Security Impacts: Opportunities for Foreign Policy Leadership**

The U.S. global effort will also need to focus on adaptation. Unfortunately, it is the poorest and least able to cope with climate change, which will be most significantly affected; we need solutions that address this reality. The array of U.S. foreign assistance

and foreign policy agencies will need expertise in security to help navigate the impacts of climate change on developing countries. But the U.S. cannot act unilaterally, and will need to work collaboratively with all industrialized and developing countries.

As the recent IPCC report points out, there are uncertainties as to the timing and magnitude of impacts. But we have enough certainty to correlate these events with their policy/security implications. Our systems of governance, including everything from individual nation-states to multinational systems, including finance and trade, all operate within tolerances. Climate change is increasingly a critical dimension of those tolerances, and we need to take it into account as a driver in the viability of all international systems. Beyond a certain level of change, it can be argued reasonably that climate change impacts become a profound challenge to the foundations of the global, industrial civilization

As pointed out by the recent report by a group of generals and senior military personnel, “National Security and the Threat of Climate Change,” climate change, national security, and energy dependence are a related set of global challenges. Climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanization, industrialization, and economic development.

**Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world.** The above report states that, “Unlike most conventional security threats that involve a single entity acting in specific ways at different points in time, climate change has the potential to result in multiple chronic conditions, occurring globally within the same timeframe. Economic and environmental conditions in already fragile areas will further erode as food production declines, diseases increase, clean water becomes increasingly scarce, and populations migrate in search of resources.”

**Asia, where hundreds of millions of people rely on waters from vanishing glaciers on the Tibetan plateau, could be among the hardest hit regions.** Almost 40 percent of Asia’s population of nearly 4 billion lives within forty-five miles of its nearly 130,000-mile-long coastline. Sea level rise, water availability affecting agricultural productivity, and increased effects of infectious disease are the primary climate impacts expected to cause serious problems in Asia. With higher sea level, coastal regions would also be subject to increased wind and flood damage due to storm surges associated with more intense tropical storms. (The number and intensity of strong cyclones has increased since 1950s; 21 extreme storm surges occurred over the period 1950-2004, of which 14 occurred during 1986-2004.)

Climate change related melting of glaciers could seriously affect a half billion people in the Himalaya-Hindu-Kush region and a quarter billion people in China who depend on glacial melt for their water supplies. As glaciers melt, river runoff will initially increase in winter or spring but eventually will decrease as a result of loss of ice resources. Consequences for downstream agriculture, which relies on this water for irrigation, and on livestock, will be unfavorable.

The location and topography of Bangladesh make it one of the most vulnerable countries in the world to a rise in sea level. Situated on the Bay of Bengal, it has a population of almost 150 million, and has a coastline exceeding 300 miles. About 10 percent of

Bangladesh is within three feet of mean sea level. Over the next century, population rise, land scarcity, and frequent flooding coupled with increased storm surge and sea level rise could cause millions of people to cross the border into India. Migration across the border with India is already such a concern that India is building a fence to control illegal immigration.

According to the report, “National Security and the Threat of Climate Change,” climate change will also significantly contribute to existing tensions in the African continent. It can facilitate weakened governance, economic collapses, massive human migrations, and potential conflicts, and could place heavy demands on international military forces. The challenges Africa will face as a result of climate change could present serious threats to even the most stable of governments. As climate changes and agricultural patterns are disrupted, with reduced rainfall and increasing desertification of the sub-Saharan region, migrations to Europe and within the African continent will undoubtedly increase. Sea level rise could also result in the displacement of large numbers of people on the African continent.

Our foreign aid and security assistance agenda will face new and difficult problems, and the U.S. will need to re-engage with the international community in a constructive way on both mitigation and adaptation. We currently focus on the 2 billion people at the top of the global economic pyramid, but we also need to serve the 4 billion at the base of the pyramid who could be the markets of tomorrow.

Leadership requires a vision of **where** we want to go as a nation. Taking strong domestic action that stabilizes the climate of our planet and assures energy and economic security for the entire world is a goal worthy of the United States. Congress has an important role to play in re-establishing American leadership, in clarifying our national and international policy, and in persevering long enough to show results.