

CHINA'S ENERGY POLICIES AND THEIR ENVIRONMENTAL IMPACTS

HEARING

BEFORE THE

U.S.-CHINA ECONOMIC AND SECURITY
REVIEW COMMISSION

ONE HUNDRED TENTH CONGRESS
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CHINA'S ENERGY POLICIES AND THEIR ENVIRONMENTAL IMPACTS

Wednesday, August 13, 2008

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

The Commission met in Room 562 Dirksen Senate Office Building at 9:15 a.m., Chairman Larry M. Wortzel, Chairman, and Commissioners William A. Reinsch and Daniel M. Slane (Hearing Cochairs), presiding.

OPENING STATEMENT OF CHAIRMAN LARRY M. WORTZEL

CHAIRMAN WORTZEL: Good morning. Welcome to the ninth hearing of the U.S.-China Economic and Security Review Commission's reporting cycle for 2008. Thank you all for joining us and appreciate your time among the witnesses or the panelists.

At this hearing, we're exploring China's energy policies and the environmental effects of those policies. It's a critical topic for both the United States and China, given that both countries are the two top consumers and producers of coal and China has now surpassed the United States in the production of greenhouse gas emissions.

We visited China in April, and our purpose was to focus on some of the pollution mitigation efforts, and actually we saw some pretty impressive things. We also saw an awful lot of pollution.

There's no question that there's shared interest and opportunities available for cooperation in research and policy between China and the United States.

Today's panels are going to assess the reforms of China's energy and environmental policymaking structures, the effects of China's greenhouse gas emissions, and its approach to climate change, and the potential for U.S.-China civil nuclear cooperation.

We hope during the hearing to hear suggestions on how to maximize cooperation with China on reducing its emissions and how to ensure that American security and technology interests are protected as China expands its civil nuclear industry.

I'll turn the proceedings over now to Commissioner Dan Slane

for his opening statement, and we welcome all of you and thank you for your interest in the Commission's work.

OPENING STATEMENT OF COMMISSIONER DANIEL M. SLANE HEARING COCHAIR

HEARING COCHAIR SLANE: Thanks, Larry. I also want to thank our expert witnesses and members of the public for attending today's hearing. This hearing will address a wide range of topics, from China's domestic energy and environmental policies, to China's participation in international climate change agreements, to the opportunities and challenges of civil nuclear cooperation between China and the United States.

The fact that we're covering so much ground today reflects the complexity of energy and environmental issues and of the challenges those issues pose to the U.S.-China relationship.

China and the United States face similar problems. The two countries are the world's leading polluters and the leading global consumers of energy. These similar challenges create opportunities for cooperation between the United States and China and some of these opportunities have been embraced.

For example, under the leadership of the United Nations Development Program, California has begun to serve as a model for Chinese provinces as they seek to implement more robust climate change mitigation strategies.

Unfortunately, political stalemates undermine other opportunities for cooperation. China continues to insist that because developed countries have produced the bulk of cumulative pollution emissions, they must take primary responsibility for combating climate change.

The United States claims that efforts at climate change mitigation by the developed world will accomplish little if China and India do not participate as well. In order to make progress on mitigating the effect of climate change, it is essential that the United States and China find a way to move beyond this impasse.

Some of our witnesses today are experts in global climate change and in international climate change policymaking structures, and we hope that they will help us find ways to move forward on these issues.

Civil nuclear cooperation between the U.S. and China provides another promising avenue of cooperation between the two countries. Technology transfers related to civil nuclear energy can benefit U.S. companies and aid China in its quest for sources of clean energy.

However, it would be dangerous to ignore the potential security implications of nuclear cooperation with China. We look forward to

learning more about those important issues over the course of the day.

Now, I'd like to defer to Commissioner Reinsch.

**OPENING STATEMENT OF COMMISSIONER WILLIAM A.
REINSCH, HEARING COCHAIR**

HEARING COCHAIR REINSCH: Thank you.

As with so many things in China, environment and energy policy are in flux. In recent months, we've seen the State Environmental Protection Administration raised to ministerial status and the creation of the National Energy Commission.

Will these changes increase the independence and efficacy of China's energy and environmental bureaucracies? And if so, what changes in policy and enforcement can we expect to see? Or are these changes in name only, likely to produce few improvements in either case?

We're pleased to have with us today several leading experts on China's environmental and energy policies, and we look forward to hearing their views on these questions.

It will also be important for us to hear about the extent to which these central level changes make a difference on the ground in the provinces. Even the best of intentions in the central government in Beijing often get lost in translation in the provinces.

Will that be the case with environmental policy when the stakes for jobs and economic growth might be high? These questions are important as we think about how the United States might best cooperate with China in addressing our mutual environment and energy problems.

If central-level policies continue to bear little resemblance to local realities, then encouraging changes in policy may be an ineffective approach.

Thanks again to all of our expert witnesses for appearing here today. I want to indicate that Vice Chairman Bartholomew will be joining us a little bit later, unfortunately, after this panel as will, other commissioners in addition to the ones that are already here.

Let me introduce the two witnesses for this panel that we're honored to have with us:

Ms. Katharine Fredriksen, Acting Assistant Secretary of Energy for Policy and International Affairs; and Mr. Scott Fulton, Principal Deputy Assistant Administrator for International Affairs at the U.S. Environmental Protection Agency.

Ms. Fredriksen, as I said, is the Acting Assistant Secretary for the Office of Policy and International Affairs at DOE. She represents the agency before Congress, works with other federal agencies to

ensure a comprehensive energy strategy that meets the nation's growing energy demands and supports the international efforts of the office to secure the nation's energy diversity.

We've asked Ms. Fredriksen to speak on China's energy policies and U.S.-China energy cooperation.

Mr. Fulton is the Principal DAS of the Office of International Affairs at EPA. As such, he is the senior ranking career official in EPA's International program and is responsible for the full range of EPA's international environmental policy development and program implementation.

We've asked Mr. Fulton to discuss the environmental impacts of China's energy consumption and U.S.-China cooperation on energy and the environment.

Thank you both for coming. We look forward to hearing from you. Your full written statements will be placed in the record. We ask our witnesses to confine their oral statements to seven minutes, but since there's only two of you and not that many of us, if you go a bit over, we won't bludgeon you into submission.

Why don't we begin with Ms. Fredriksen, and then we'll go to Mr. Fulton, and then have questions after that.

Thank you.

PANEL I: ADMINISTRATION PERSPECTIVES

STATEMENT OF MS. KATHARINE A. FREDRIKSEN ACTING ASSISTANT SECRETARY OF POLICY AND INTERNATIONAL AFFAIRS, U.S. DEPARTMENT OF ENERGY WASHINGTON, DC

MS. FREDRIKSEN: Thank you, Mr. Chairman and members of the Commission, for providing me this opportunity to appear again before you to talk about the department's engagement with China on energy issues.

This is really a critical time for the U.S.-China relationship. Global energy demand is at unprecedented levels. And we need cleaner and more environmentally sustainable energy development. These are challenges that we can't face alone. We need to work together with the major economies of the world every step of the way.

China's energy consumption patterns are going to continue to impact global energy markets and the environment over the coming decades. China, as you mentioned earlier, is the world's second-largest energy consumer and has already surpassed the U.S. in its climate emissions.

China like the U.S. is constrained by its growing demand for

energy resources and its need to balance energy requirements with environmentally responsible policies.

The size of our two countries and our combined impact on global energy markets inextricably link our energy security goals.

The International Energy Agency projects that between 2005 and 2030, China's energy consumption will increase from 25 percent less than the U.S. to over 30 percent more. China has responded to these energy needs not only by increasing domestic production but also by seeking overseas oil and gas reserves.

They've also diversified to add renewable energy and they're increasing their energy efficiency.

Oil consumption and CO2 emissions associated with on-road transportation are rising dramatically from China's increased vehicle population. Just two years ago, China became the world's number two vehicle market behind the United States and the world's number three vehicle producer, reflecting an annual growthrate of over 20 percent since 2004.

By 2025, DOE Argonne National Labs has projected that China will have over 300 million cars on the road as compared to 30 million today. If you'll recall, in 1990, private vehicle ownership was forbidden in China. So you're seeing incredible growth rates in transportation.

We partner with China in a number of ways, both multilaterally and bilaterally, that can help both of our countries achieve our energy security goals.

This cooperation can help meet the environmental challenges posed by the energy sector as well as address the overall health and stability of global energy markets.

One example of a policy that is worthy of greater focus is China's use of fuel subsidies. At the June meeting of the G8 plus Chinese, Indian and South Korean energy ministers, in Japan, the world's top energy consuming countries agreed on the need to phase out fuel price subsidies.

China took that first step of phasing out its subsidies in June and raised its domestic gas prices by 17 percent. These are important first steps toward the eventual marketization of China's fuel prices.

As China's growing demand for energy increasingly affects the environment, both within and outside its borders, its role as a global stakeholder becomes even more pronounced.

The U.S. continues to advocate that China, along with other investors, endorse the Extractive Industries Transparency Initiative and cooperate more closely with the International Energy Agency. These steps, particularly taken by China, will strengthen our efforts internationally to promote good governance and increasing

accountability to foster sustainable growth.

China's commitment to participate fully on the Joint Oil Data Initiative is a positive sign in this regard. This was another commitment we had at the G8 Energy Ministerial.

Complying with JODI requires that participants provide timely, reliable and complete data on energy production and consumption, and that data is made public. By joining with the U.S. and our international partners in JODI, China is taking an important step to alleviate market uncertainty.

While we participate in many bilateral and multilateral mechanisms together, which I describe in greater detail, in my written testimony, I'd like to focus here on two bilateral vehicles of cooperation, namely, our Strategic Economic Dialogue and the Energy Policy Dialogue.

The Strategic Economic Dialogue is a biannual, cabinet level dialogue initiated in December of 2006. We recently held our fourth meeting of the Dialogue in Annapolis, Maryland, and we covered a wide range of economic issues which included energy and the environment.

Significantly for energy and the environment, and I know you'll hear more about this from Scott, is that we signed a Ten-Year Energy and Environment Cooperation Framework that is going to guide our collaboration over the next decade.

We identified five initial framework goals: clean, efficient and secure electricity production and transmission; clean water; clean air; clean and efficient transportation; and conservation of forest and wetland ecosystems.

The Department of Energy leads the task forces for electricity and transportation. Each of these task forces is currently developing action plans for concrete cooperation with a goal to finish the draft of these plans to be approved at SED V to be held in December in Beijing this year.

The Energy Policy Dialogue was inaugurated in May 2004, and it's a bilateral vehicle between the Department of Energy and the Chinese NDRC. We discuss mutual economic issues, explore energy technology cooperation, and policy measures.

We've used this Dialogue to underscore the importance of market forces in determining energy product prices and appropriate supply distribution. We will hold our next meeting of the annual EPD likely in October in Beijing this year.

Given that the Olympics are underway, I'd like to take this opportunity to let you know that the department worked very closely with the developer of the Olympic Village in Beijing to reduce heating and cooling loads, improve lighting efficiency, save water, and serve

as models of what the next generation of housing can be in China.

As a result, the Olympic Village is about 50 percent more efficient than similar buildings in Beijing and last week received LEED Gold Designation.

The engagement between our two countries allows us to identify common goals and to find solutions that are beneficial to both of our countries.

Because we are the world's largest carbon dioxide emitters and consumers of coal, and the largest oil importers, the U.S. and China have an obligation to show responsible leadership in meeting tomorrow's energy challenges today. By working together, we will be more effective in meeting these challenges.

This concludes my oral statement, Mr. Chairman, and I'd be happy to respond to any questions you or the other commissioners may have.

[The statement follows:]

**Prepared Statement of Ms. Katharine A. Fredriksen
Acting Assistant Secretary of Policy and International Affairs, U.S.
Department of Energy, Washington, DC**

STATEMENT OF
KATHARINE A. FREDRIKSEN
ACTING ASSISTANT SECRETARY
OFFICE OF POLICY AND INTERNATIONAL AFFAIRS
U.S. DEPARTMENT OF ENERGY

BEFORE THE
U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

AUGUST 13, 2008

I. Introduction

Thank you, Chairman and members of the Commission, for providing this opportunity for me to discuss with you the Department of Energy's engagement with China on energy issues.

This conversation takes place at a critical time in the bilateral U.S.-China relationship. Global energy demand is growing rapidly, as is the world's desire for cleaner and more environmentally sustainable energy development. These are not challenges the United States can face alone, and more importantly they are challenges that require the major economies of the world to work together every step of the way.

China's energy consumption patterns will continue to impact global energy markets and the environment over the coming decades. At this time, China is the world's second largest energy consumer. Indeed, China has already surpassed the United States as the world's leading carbon dioxide emitter. Chinese greenhouse gas emissions are projected to continue to grow to 28 percent of the world total in 2030, accounting for about 50 percent of global coal-related emissions, based on the DOE's Energy Information Administration assessment, which is consistent with International Energy Agency estimates.

China is thus, like the United States, constrained by ever-growing demands for energy resources and the need to balance its energy requirements with environmentally responsible policies. The size of our two countries and our combined impact on global energy markets inextricably link our energy security goals. Working cooperatively with the Chinese to both develop new energy technologies and increase the energy efficiency of our economies is a worthy goal that we believe will contribute to a stable bilateral relationship.

II. China's Energy Outlook

The International Energy Agency's *World Energy Outlook 2007* projects that between 2005 and 2030, China's energy consumption will increase from 25 percent less than U.S. consumption to 30 percent more.¹ In 2030, China's projected primary energy demand will be composed of 62.8 percent coal, 21.1 percent oil, 5.2 percent natural gas, and 8.1 percent renewables. Nuclear energy is projected to represent a 1.8 percent share of Chinese energy consumption.²

China has responded to its energy needs by expanding domestic production of oil and gas and adding renewable energy, energy efficiency, and overseas supply. In its 11th Five-Year Plan (2006-2010), China set aggressive goals for improving energy efficiency, increasing the use of renewable energy sources, and reducing energy consumption. Two priority goals are to reduce energy intensity by 20 percent between 2006 and 2010, and purchase renewable energy to cover 10 percent of the total electricity generation by 2010. China to date has only achieved a fraction of these goals. For instance, in 2006, China's energy intensity decreased by 1.2 percent, which missed the yearly national target of 4 percent. However, this decrease is a movement in the targeted direction since in the previous three years China's energy intensity grew by 4.9 percent, 5.5 percent, and 0.2 percent, respectively, from 2003 to 2005, year over year.

The IEA projections show coal continuing to play a major role meeting in China's energy demand. In fact, China's coal demand has nearly doubled since 2000.³ For the foreseeable future, China is forecast to continue to lead the world in both production and consumption of coal, using it primarily to fuel its industrial and electric power sectors. Between 2005 and 2030, China's electric power sector is projected to grow its coal demand at a rate of 4.9 percent per year, while its industrial sector is projected to increase its demand at an average rate of 2.1 percent per year.⁴

Civilian use of nuclear power is likely to increase globally due to increasing fossil fuel prices, dramatic growth in energy demand, and the environmental benefits of greenhouse gas emissions-free nuclear energy. Between 2005 and 2030, Chinese electricity production from civilian nuclear energy represented 2.1 percent of 2005 electricity production, and the IEA projects that it will increase to a 3 percent share by 2030, falling short of the Chinese government's recent projections.⁵

While China's 11th Five Year Plan calls for civilian nuclear energy production to account for 4 percent of China's total primary energy use by 2020, Zhang Guobao, Director of the newly formed National Energy Administration, recently stated that this percentage will

¹ International Energy Agency, *World Energy Outlook 2007: China and India Insights* (OECD/IEA, 2007) (hereinafter "WEO").

² WEO 287

³ WEO 119

⁴ WEO 344, 293

⁵ WEO 346

likely be increased to 5 percent instead. The IEA's World Energy Outlook projects China's nuclear energy production to fall short of the 4 percent goal.⁶

In addition to the industrial and electric power sectors, China's transportation sector is forecast to grow and require increasing amounts of energy. In 2006, China became the world's number two vehicle market, and number three vehicle producer, reflecting an annual growth rate of over 20 percent since 2004. In fact, by 2025, China is projected to have over 300 million cars on the road, compared to approximately 30 million today.⁷ Seven out of eight car buyers in China are buying their family's first vehicle.⁸ Oil consumption and carbon dioxide (CO₂) emissions associated with on-road transportation are rising dramatically from China's increasing vehicle population.

III. Department of Energy Engagement with China

The Administration supports many of China's energy policies and its stated commitments in the Five Year Plan to diversify its energy resources, increase energy efficiency and improve its environmental protection. We are partnering with China multilaterally and bilaterally in a number of ways that help China achieve that goal while increasing opportunities for U.S. companies to demonstrate and sell technologies in a fair and transparent market, that can help meet the environmental challenges posed by the energy sector.

China's energy policies are important not just to itself but to the health and stability of global energy markets. One example of a policy that is worthy of greater focus is China's use of subsidies. Although subsidies are widely-used means for governments to exert influence, China must be cautious with its pricing control policy. Fuel price subsidies are unsustainable in the long-term. At the G8 plus China, India, and South Korea Energy Ministerial meeting in Aomori, Japan earlier this year, the world's top energy consumers agreed on the need to end fuel price subsidies. During the June meeting of the Fourth U.S.-China Strategic Economic Dialogue, Co-Chair Wang Qishan, a Vice Premier in China's State Council, agreed to reduce China's fuel price subsidy. While these are important steps towards the eventual "marketization" of Chinese fuel prices, we would encourage further actions on the Chinese side. Our engagement with China provides important lines of communication through which alternative policy options and lessons learned by both sides can be conveyed and studied.

An example of mutually beneficial cooperation involves China's Shenhua Group, which has developed a process that combines American, German, and Japanese technologies with its own innovations to construct a first-of-a-kind coal liquefaction plant in Erdos, China. Once commissioned later this year, the plant's operational experiences could contribute to U.S. clean coal technology development.

⁶ WEO 346

⁷ Projection of Chinese Motor Vehicle Growth, Oil Demand, and CO₂ Emissions through 2050 Energy Division, Argonne National Laboratory December 2006

⁸ www.chinadaily.com.cn/bizchina/2008-04/22/content_6635789.htm

China's global economic impact generates a concomitant global responsibility. As China's growing demand for energy increasingly affects the environment – both within and outside its borders – China's role as a global stakeholder becomes more pronounced. The U.S. continues to advocate that China, along with other investors, endorse the Extractive Industries Transparency Initiative (EITI) and other transparency and internationally accepted measures. EITI is an international effort by states, civil society, and industry to improve transparency and accountability by introducing disclosure standards for both extracting industries and governments, with the goal of reduce corruption and poverty. 11 nations currently support the effort, and there are 23 candidate countries. Such steps, particularly by China, would strengthen U.S. and international efforts in promoting good governance and increasing accountability to foster sustainable growth, particularly in developing countries endowed with oil, gas, and mineral resources.

The United States and China take part in several international cooperative mechanisms to help meet our shared energy challenges. Among these mechanisms are:

- Asia-Pacific Partnership on Clean Development and Climate (APP)
- Carbon Sequestration Leadership Forum (CSLF)
- Generation IV International Forum (GEN-IV)
- Methane-to-Markets initiative (M2M)
- International Partnership for the Hydrogen Economy (IPHE)

DOE has two principal bilateral vehicles of cooperation -- Strategic Economic Dialogue (SED) and the Energy Policy dialogue (EPD) to address our nations' intertwined energy security challenges and opportunities. We utilize these mechanisms to identify and track areas of mutually beneficial cooperation, and policies and practices that hinder or support our mutual goals.

U.S.-China Strategic Economic Dialogue (SED)

The Strategic Economic Dialogue (SED) is a bi-annual, Cabinet-level dialogue initiated in December 2006. It is a strategic management mechanism designed to promote stable, prosperous bilateral economic relations. It has been chaired for the United States by Henry Paulson, the Treasury Secretary, and for China by high-ranking members of the State Council. It was previously co-chaired by Vice Premier Wu Yi, and beginning with SED IV it is co-chaired by Vice Premier Wang Qishan.

The Third and Fourth U.S.-China Strategic Economic Dialogues were held this past December and June in Beijing, China and Annapolis, Maryland, respectively.

Based on discussions at SED III, a Memorandum of Understanding between the United States Departments of Agriculture (USDA) and Energy and the National Development and Reform Commission (NDRC) of the People's Republic of China on Cooperation in the Development of Biofuels was signed. Since then the DOE and USDA have been collaborating in a plan of work with the NDRC to develop mutually beneficial U.S.-

Chinese commercial and business opportunities as well as to support enhanced usage and production of biofuels.

During the Washington International Renewable Energy Conference, held in March 2008, DOE, USDA, and NDRC met to discuss a work plan to support the MOU, and in April the parties met to narrow the scope of their discussion on specific areas of potential collaboration, including biomass resource assessment, science and technology information exchange, and further bilateral dialogue. Collaboration continues between U.S. and Chinese scientists with the intention of beginning cooperative projects by fall 2008.

At SED IV, U.S. and Chinese leaders discussed a wide range of economic issues including: joint opportunities in energy and the environment; managing financial and macroeconomic cycles; investing in people; trade and competitiveness; and enhancing the bilateral investment environment. More importantly for energy and the environment, at SED III, U.S. and Chinese Ministers created a working group to develop a government-to-government framework for extensive U.S.-Chinese cooperation over the next ten years to address energy security, climate change, and environmental sustainability. At SED IV, the United States and China signed a Ten Year Energy and Environment Cooperation Framework (Cooperation Framework) and identified five initial Cooperation Framework goals. These goals are: clean, efficient, and secure electricity production and transmission; clean water; clean air; clean and efficient transportation; and conservation of forest and wetland ecosystems.

Cabinet agencies from both countries participate in the Cooperation Framework. The U.S. agencies are: the Departments of Energy, Treasury, State, and Commerce; and the Environmental Protection Agency. The Chinese agencies are: the National Development and Reform Commission (NDRC); the State Forestry Administration; the National Energy Administration; and the Ministries of Finance, Environmental Protection, Science and Technology, and Foreign Affairs.

The Cooperation Framework establishes five joint task forces focused on five functional areas, each coinciding with one of the Cooperation Framework's initial goals: : clean, efficient, and secure electricity production and transmission; clean water; clean air; clean and efficient transportation; and conservation of forest and wetland ecosystems. The Department of Energy is responsible for the task forces on electricity and transportation. Each of these task forces is developing action plans for concrete cooperation, with a goal to complete finalized and agreed-to plans in time for the SED V, due to be held in Beijing later this year.

The U.S.-China Energy Policy Dialogue (EPD)

The EPD was inaugurated in May of 2004 as a bilateral vehicle by which the United States and China can exchange energy security views, discuss mutual economic issues, and explore energy technology options. DOE has used this dialogue to underscore the

importance of market forces in determining energy product prices and appropriate supply distribution. The third EPD meeting was held in September 2007 in San Francisco.

One of the important outcomes of the third EPD meeting was that the Department of Energy and the NDRC signed the Memorandum of Understanding (MOU) Concerning Industrial Energy Efficiency Cooperation. It seeks to improve China's industrial energy efficiency, increase mutual energy security, reduce emissions, and provide opportunities to export energy efficient U.S. products and services to China. This cooperative mechanism allows us to demonstrate to the Chinese how the products, practices and services utilized in DOE's *Save Energy Now* initiative, help the U.S. manufacturing sector reduce its energy intensity and carbon dioxide emissions. The Chinese see this MOU as one means through which to pursue their goal of reducing energy use per unit of GDP by 20 percent between 2005 and 2010. Up to a dozen of China's most energy-intensive enterprises will be chosen for energy use audits. In September 2008, U.S. technical teams will demonstrate auditing practices at these enterprises. At the same time, a Chinese contingent will travel to the United States to attend energy efficiency training seminars and participate in site visits. The goal is to train Chinese auditors who can begin auditing plants and further train their own auditors and advance the implementation of energy efficiency practices in China's industrial sector. This activity is important because the global focus on industrial energy efficiency is increasing, promoted by the United States, the UN Industrial Development Organization (UNIDO), the International Organization for Standardization (ISO), the Asia Pacific Economic Cooperation, (APEC), and the G8.

Other Major Activities

Other important bilateral and multilateral activities include the United States-China Fossil Energy Protocol, the U.S.-China Oil and Gas Industry Forum (OGIF), the co-funded U.S.-China Energy and Environmental Technology Center (EETC), the Global Nuclear Energy Partnership (GNEP), FutureGen, and cooperation under DOE-NDRC agreement on the peaceful uses of nuclear technology (PUNT), discussions on strategic petroleum reserves, and fusion energy research.

U.S.-China Fossil Energy Protocol. Originally signed in 2000, and renewed for five years in 2005, the Fossil Energy Protocol between DOE and China's Ministry of Science and Technology (MOST) promotes cooperation in science and technology in the fossil energy sector. Through the Protocol, the United States can showcase its advanced technology, services, and commercial know-how in China while simultaneously encouraging cooperative research and development with viable commercial outcomes.

A Permanent Coordinating Group (PCG) manages the Protocol. The DOE Assistant Secretary for Fossil Energy chairs the PCG for the U.S. side, while the Secretary General of the MOST's High Technology Bureau chairs it for the Chinese. One solid success of this initiative is a feasibility study resulting in construction of a coal liquefaction facility in China utilizing advanced U.S. technology. It is the first commercial-scale facility of its kind in the world.

The U.S.-China Oil and Gas Industry Forum (OGIF). OGIF is jointly chaired by the Department of Energy's Office of Fossil Energy and the Department of Commerce, on the United States side, and by the NDRC on the Chinese side. The OGIF partnership has met annually since 1998 and is a public-private bilateral initiative bringing government and industry representatives of both countries together to discuss our common goals. These goals include development of secure, reliable and economic sources of oil and natural gas while facilitating investment in the energy industry. The eighth OGIF was held last fall in San Francisco, and the next one is planned for this fall in China.

The United States-China Energy and Environmental Technology Center (EETC). The EETC is an initiative centered at Tulane and Tsinghua Universities co-funded by DOE and MOST, three objectives of which are to: (1) provide training programs in environmental policies, legislation, and technology, as well as cost-effective approaches to these programs, (2) develop markets for U.S. clean coal technologies, and (3) help minimize the local, regional, and global environmental impact of China's energy consumption.

Earlier this year, a multimillion-dollar investment by U.S. and Chinese companies that will be coordinated by the EETC was announced. This joint venture will extract coal bed methane from coal mines in Henan Province. Methane from coal mines can cause more than 20 times the amount of global warming than CO₂. This venture has the capacity to greatly reduce the global warming potential of the participating coal mines.

Global Nuclear Energy Partnership (GNEP). GNEP is a global initiative that works toward the expansion of peaceful proliferation-resistant nuclear energy for greenhouse gas emissions free, sustainable electricity production. GNEP supports establishment of reliable, cost-efficient supply frameworks that reduce nuclear proliferation risks. China joined GNEP in September 2007 and is a full GNEP Partner and a Vice Chair of the GNEP Steering Group.

In September 2007, the Department of Energy and NDRC signed the U.S.-China Bilateral Civil Nuclear Energy Cooperative Action Plan. The Action Plan is intended to complement and reinforce multilateral collaborations being conducted under GNEP. The first technical working group meeting under the Bilateral Action Plan was held at Argonne National Laboratory on April 23-24, 2008. Both sides discussed four areas of proposed cooperation: 1) Separations Technology; 2) Fuels and Materials Development; 3) Fast Reactor Technology; and 4) Safeguards Planning. Additional discussions on these areas will be held in the coming months.

The second GNEP Steering Group meeting took place in Jordan on May 14-15, 2008. GNEP Partners, of which there are 21, include: Australia, Canada, France, Japan, Kazakhstan, Russia, and South Korea. At the meeting, 23 countries and three international organizations were invited to join GNEP as Observers. The next GNEP Ministerial will take place in Paris on October 1, 2008.

FutureGen. In 2003, the Department of Energy announced the FutureGen initiative. It is a plan to use clean coal technologies to demonstrate the possibility of developing a coal-based power plant that emits nearly zero greenhouse gases while producing both electricity and, as a by-product, hydrogen. In January of this year, a restructured FutureGen program was announced to employ carbon capture and storage (CCS) techniques in coal power plants to develop nearly emissions-free coal-based power plants. Federal funding will support multiple commercial demonstration plants, with the goal of reducing CO₂ output by up to 90 percent. These plants can be up and running by 2015. Taking advantage of research and development in CCS, integrated gasification combined cycle (IGCC), and pulverized coal technology, this approach will permit the demonstration plants to capture and sequester twice the carbon dioxide as the original 2003 FutureGen plan. Chinese entities, which participated in the FutureGen project as first proposed, are welcome to bid for participation under the current Funding Opportunity Announcement.

Peaceful Uses of Nuclear Technology (PUNT) Agreement. In 1998, DOE and China's State Development and Planning Commission, the predecessor of the NDRC, signed the PUNT Agreement to exchange information and to cooperatively address mutually defined nuclear concerns. In 2002, a Joint Coordinating Committee (JCC) and three Joint Working Groups (JWGs) under the JCC were established. Since 2004, U.S. and Chinese nonproliferation cooperation under the PUNT Agreement has achieved significant progress on topics ranging from: export controls; material protection, control and accounting; safeguards; and emergency management, among others. U.S.-Chinese PUNT meetings have proven to be effective nonproliferation confidence building measures. For example, during the 4th JCC in May 2007, both sides endorsed the proposed establishment of a group to focus on nuclear emergency management and a sub-group on radiological source security. The next meeting of the JCC is planned for winter 2008.

Strategic Petroleum Reserves (SPR). The United States has asked the Chinese to explore maintaining an SPR to improve its energy security and to alleviate energy supply shortages in the energy market. The United States joined with the IEA in both 2002 and 2006 in holding stockholding workshops in China. These workshops assist the Chinese in their planning for building and holding strategic petroleum reserves. China is building an SPR in three phases, which are said to be scheduled for completion by 2020. Reports on China's progress in stocking these reserves conflict, so it is difficult to ascertain China's state of readiness to participate with other nations, including IEA member states, in a severe oil supply emergency. The Chinese are reluctant to divulge information about their SPR, as they view it as a sensitive issue of national security. Meanwhile, through such mechanisms as the EPD and SED, the United States engages China in meaningful dialogue about the importance of developing an SPR and the vital role that transparency plays in this process.

The Chinese have also been invited by the IEA to participate in its Emergency Response Exercises, which simulate IEA and oil market responses to global oil supply emergencies. China participated in the IEA exercises in 2004, but could not participate in the June 2008 exercise due to its earthquake response efforts. China has also attended meetings of

the IEA's emergency planning and oil markets committees, and there are plans to continue encouraging Chinese participation there, with the goal of familiarizing the Chinese with market-sensitive energy security policies and measures.

In a related development, we see China's commitment to participate in the Joint Oil Data Initiative (JODI) as a positive sign in this regard. In a statement following the June 2008 G8+3 Energy Ministers meeting in Aomori, Japan, China joined the G8 countries, India, and South Korea, in committing to participate fully in the JODI. Complying with JODI requires participants to provide timely, reliable and complete data to the initiative. By joining the United States and its international partners in JODI, China is taking an important step in alleviating oil supply uncertainty.

U.S.-China Collaborative Programs on Fusion. The United States and China have been collaborating on fusion energy research. If successful, fusion energy could offer an abundant, economical and clean source of energy. The primary focus of this collaboration has been U.S. support in the design and operation of a plasma control system for the Experimental Advanced Superconducting Tokamak (EAST) facility at the Academy of Sciences Institute of Plasma Physics (ASIPP) in Hefei. EAST became operational in September 2006. In return for U.S support for EAST, China has provided support for the D-IIID tokamak device located in the United States.

The main collaborative activity involving the United States and China (as well as five other members – the European Union, Japan, Russian Federation, Korea, and India) is the multi-billion dollar ITER experiment that is under construction in Cadarache, France. ITER will be the first fusion science facility capable of producing sustained burning plasma. The mission for ITER is to demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes. With its participation in ITER and a growing domestic program, the Chinese appear ready to strongly pursue the development of fusion as a potential future energy source.

IV. Conclusion

The Department of Energy is committed to advancing solutions, together with our international partners, that address global energy challenges and support both U.S. and international energy security. The United States is committed to playing a leadership role in reducing the impact of energy on the environment.

The United States recognizes that energy security, a sustainable environment, and economic prosperity are important for both the United States and China. How each of us addresses these challenges will have global ramifications. The engagement between our two countries that I have described above, conducted with good will and mutual respect on both sides, allows us to identify common goals and define solutions beneficial to both countries. Because we are the world's largest carbon dioxide emitters and the largest consumers of coal and the largest oil importers, the United States and China have an obligation to show responsible leadership in beginning to address tomorrow's energy

challenges today. Working together, we will both be more effective in meeting these challenges.

That concludes my statement Mr.Chairman, and I would be happy to respond to any questions you or the other members may have. Thank you.

HEARING COCHAIR REINSCH: Thank you.
Mr. Fulton.

**STATEMENT OF SCOTT FULTON
PRINCIPAL DEPUTY ASSISTANT ADMINISTRATOR
OFFICE OF INTERNATIONAL AFFAIRS
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC**

MR. FULTON: Thank you, Mr. Chairman and members of the Commission, for the invitation to be with you here this morning. It's my privilege to follow-up on last year's testimony by EPA's former Assistant Administrator for International Affairs, Judith Ayres. I understand she was with you. And join with Ms. Fredriksen, with whom we've been working very closely since the inception of the Strategic Economic Dialogue process that she has mentioned.

I've been with the Office of International Affairs for something right around a year, I guess, but can attest that the agency has no more important bilateral relationship than the one it has with China. Administrator Steve Johnson has participated in each of the Strategic Economic Dialogue sessions to date and expects to participate as well at the fifth SED session this December, which has been mentioned.

Whatever follows the SED process or carries forward into the next administration, EPA remains very much committed to its relationship with China and working on environmental problems.

Today's hearing is a welcome opportunity for us to take stock, reflect on the opportunities and obstacles before us, and frankly benefit from the Commission's insight and advice.

As this is my first time appearing before you, it's also a chance for me to understand better how we at EPA can be of service to you in the satisfaction of your mission.

The current press coverage of air quality in Beijing during the Olympics highlights some of the issues that we've been trying to help our Chinese counterparts address for a number of years, efforts that we see as having been positively catalyzed by the SED process.

The time and expense that the Chinese government has invested in attempting to clear the air over various Olympic venues in just one urban area, just for a period of several weeks, testifies to the

complexity of the task and to the economic costs involved. If there has been a single constant message that we've tried to convey to our Chinese counterparts under the rubric of the SED, it's been this: that investing in environment is part and parcel of a sustained economic success and enhanced energy security.

As the Olympics are demonstrating, attention to environmental protection can also influence national prestige and international respect. It will be for us very interesting to see whether and how Beijing's Olympic experience this year will affect China's environmental policies and priorities in the months and years to come.

One encouraging sign in this regard has been China's reported intention to begin monitoring ground level ozone and fine particulate matter first in Beijing while the games are underway this month and then in other cities at some point next year. We will be in further dialogue with them in relation to this effort and will provide advice and assistance as appropriate.

In view of the experience of the moment and what we're expecting over the next several months, if the Commission's schedule contemplates a hearing of this kind again next summer, that should serve, we think, as a choice moment for assessing forward movement in the wake of the Beijing Olympics.

One of the most important lessons that we've learned over the years in working with China is that relatively few environmental outcomes in China are determined by that country's environmental regulatory authority working alone, and despite, as was mentioned by one of the commissioners, the elevation of this year to the status of ministry, in other words, the former State Environmental Protection Administration, or SEPA, being elevated to the Ministry on Environmental Protection, MEP, EPA's Chinese counterparts still appear to operate on the basis of a limited mandate and an imperfect division of labor vis-à-vis other government organizations.

Depending on the issue at hand, we have found it necessary to develop working relationships with a number of other Chinese ministries, Science and Technology, Water Resources, the Quarantine and Inspection Service, to name a few, and also with regional environmental authorities in Shanghai and Shenzhen for example.

As indicated in my written statement, making progress with China at the interface between energy and environment requires the cooperation and support of the National Development and Reform Commission, NDRC.

It's been our experience that the priorities of MEP, the Environment Ministry, and those of NDRC are not always identical. The Chinese have done a fair amount to try to overcome these institutional gaps, but differences remain that need to be worked

around or worked through.

On the positive side, our colleagues at MEP have increasingly recognized that the more that their regulations affect economic realities on the ground, the more credible their monitoring and enforcement capabilities need to be. And as a result, they appear to be fully on board with a long-term cooperative relationship that builds on their regulatory and enforcement capacity and strengthens their legal foundations.

They are also open in principle to more actively engaging public opinion in pursuit of China's officially sanctioned environmental goals and have had some promising discussions with us and others relating to the management and accessibility of environmental information.

We expect for the foreseeable future to continue to collaborate with China on these issues along with China's challenges with air and water quality, chemicals management and hazardous waste management.

We at EPA can never solve China's environmental problems nor is it our mandate to do so, but we think we've made some important contributions in several areas and can continue to do so in concert with others here in the U.S. and also in the international community that share a concern for China's environment and China's contributions to the environmental situation in the global commons.

So with that, I'll conclude my remarks. I'm happy to supplement my prepared statement by responding to your questions and observations. Thank you.

[The statement follows:]

Prepared Statement of Scott Fulton, Principal Deputy Assistant Administrator, Office of International Affairs, U.S. Environmental Protection Agency, Washington, DC

It is a pleasure to share with the Commission our thoughts on China's response to the environmental challenges posed by that country's energy policies and actual energy consumption. This is an important distinction: policy and actual outcomes may differ—and in China, often do.

Let me note at the outset that not all of China's environmental challenges are uniquely associated with energy policy per se. Other forces related to urbanization, agriculture, and international trade also have significant environmental impacts in China. What follows is necessarily an incomplete picture of a complex, dynamic situation.

It is also worth noting that both the U.S. and Chinese governments have embraced the notion that energy security, economic prosperity, and environmental sustainability are interlinked. This is one of the fundamental tenets of the U.S.-China Strategic Economic Dialogue (SED), in which my Agency has been active since its inception nearly two years ago.

Economic Drivers

After one of the world's most impressive reductions in energy intensity—a drop of around two thirds in just over 20 years—China's economy began to become more energy intensive at the start of the current decade. (For background on this point, see the June 15, 2007, testimony before this Commission by Jeffrey Logan of the World Resources Institute.) For the first time, increases in energy consumption began to outpace economic growth, as China's production of highly energy intensive commodities like steel, paper, concrete, etc., powered overwhelmingly by coal, grew rapidly in the first years of this century. Our colleagues at the Department of Energy have estimated that China's use of coal will increase at an average rate of 3.2% per year through 2030. A substantial portion of China's industrial output—upwards of 80% in some sub-sectors—still comes from state-owned enterprises. An analysis cited last year in the New York Times suggests that China's aluminum sector alone consumes more energy than all of the country's commercial facilities combined. As a recent (7/28/08) article in the China Daily put it, "...an increase in heavy exports is stalling the country's progress towards sustainable development."

At the same time, huge growth in the size of China's vehicular fleet, driven in part by rising consumer demand, compels the authorities in Beijing to seek additional sources of foreign oil. The government has sought to cushion the impact of rising oil prices on Chinese consumers with subsidies and price controls. China's fuel price increases this past June, the first in eight months, suggest that economic realities may begin to sink in, as the government works to ease economic pressure on China's refineries. Whether this development has implications for our cooperation on low sulfur fuels is still unclear. I will come back to this point later in my remarks.

As we know, China's current (11th) Five Year Plan (FYP) commits the nation to reduce its energy intensity by 20% by the end of 2010. This is a very ambitious goal—even with the motivation provided by this year's Olympic Games, meeting it seems unlikely. According to the Asian Development Bank, China's energy intensity per unit of GDP actually rose 0.8% in the first six months of 2006. On the other hand, official Chinese sources claim that energy intensity declined 1.23% in 2006 and by more than 3% in 2007. Now that the 11th FYP has passed its mid-point, we need more current information to ascertain China's progress on this vital dimension of energy intensity.

Part of the problem seems to be that the central government, in its determination to rein in growth in pollution and energy-intensive sectors, is limiting the access to domestic capital that Chinese firms need to improve their energy efficiency and reduce emissions. Hence, we see China launching a Green Credit Policy last year that seems more geared to depriving finance from bad actors than providing finance to correct environmental problems or develop environmentally responsible small/medium enterprise. Still, the concept of Green Credit seems to be gaining credence in China, thanks in good measure to work by the International Finance Corporation and the U.S. Treasury Department.

The good news is that China seems to be moving in an economic direction that favors more positive environmental outcomes—slower growth in steel and concrete, faster growth in broadband and services. The reality, however, is that macroeconomic change takes time and requires broad social and political consensus supported by effective policies. In 2007, the Chinese government targeted GDP growth of 7.5%; what they got was 11.4%, with fixed asset investment (buildings and infrastructure) growing at rates of 30-40% in many places. That's still a lot of growth in energy-intensive sectors such as aluminum, cement, and steel, as well as new growth in the automotive and consumer products sectors. And while China has done much to close down smaller, inefficient power plants, its net power generation continues to grow as energy demand growth shows no sign of abating.

Challenges of Environmental Governance

I understand that members of the Commission visited Hong Kong in early April of this year and heard

insightful observations about environmental cooperation and reform on the mainland. One informed interlocutor suggested that the locus of real environmental results in China is with regional partners, like Guangdong Province. On the one hand, we are told that environmental and energy efficiency indicators increasingly are being incorporated into the performance objectives of regional and local officials throughout China. On the other hand, their salaries continue to come from budgets controlled by the same regional and local officials who are also responsible for high employment and economic prosperity. As yet, we know of no Chinese local or provincial official who has been fired for failing to meet an environmental or energy efficiency metric.

In March of this year, as part of a larger restructuring of China's central government apparatus, the State Environmental Protection Administration—SEPA, as we had come to call it for years—was elevated and redesignated as the Ministry of Environmental Protection (MEP). One of the questions posed by the Commission in connection with this hearing rightly focuses on the significance of this action. It is too early to tell whether SEPA's transition to MEP will lead to significant improvement in either China's environmental capabilities or in U.S.-China environmental cooperation. A recent report cited addition of 50 new MEP staff and two new departments at the Ministry's Beijing headquarters. But this only brings their HQ staff complement to several hundred, and we have yet to see the creation of separate, media-specific departments that would signal a major upgrade in MEP's portfolio.

Any large nation with continental-scale variation in regional conditions needs to balance centrally defined environmental standards with regional flexibility in implementing those standards. Here in the U.S., we accomplish this by delegating much planning, permitting, inspection, and enforcement activity to State environmental authorities, with EPA providing oversight and intervening when national standards are not being properly implemented or enforced. EPA's ten regional offices throughout the U.S. embody the Agency's national authority and provide oversight and assistance to State regulators as needed.

China has taken initial steps to establish some form of intermediate presence through the creation of six Regional Supervision Centers (RSCs) located in Beijing, Xian, Shenyang, Chengdu, Guangzhou, and Nanjing. Currently the RSCs have limited authorities and resources; their functions vis-à-vis provincial and local governments are still being defined. My Agency has undertaken an arrangement with the Asian Development Bank to help strengthen the capacity of the RSCs to improve environmental enforcement at the sub-national level. EPA believes that enhanced implementation and enforcement of environmental laws is one of the most promising areas of our cooperative agenda with MEP.

Even in this area, however, the U.S. should not act in isolation from the international community. Many governments and international organizations share our interest in strengthening China's environmental enforcement capabilities. By way of example, in the coming year the European Union plans to launch an environmental governance initiative for China valued at 15 million Euros. And earlier this year, the Government of Norway committed \$20 million to a cooperative program with China on climate change—an investment that will require attention to governance and accountability issues if it is to succeed. We should be reaching out actively to such potential partners, to ensure that our limited resources are not duplicating the well funded efforts of others, and to take advantage of potential synergies.

Working the Energy-Environment Interface with China

China's environmental enforcement challenges are even more apparent when one focuses on the energy sector. The transition from SEPA to MEP has not altered the fact that energy policy is the domain of the National Development and Reform Commission (NDRC), the steward of China's economic planning function. Indeed, the March 2008 restructuring seems to have further consolidated NDRC's hold on national energy policy by creating a new National Energy Bureau, headed by NDRC vice chairman, Zhang Guobao. Earlier speculation about creation of an "energy super-ministry" independent of NDRC has

proven unfounded, at least so far. New national energy legislation has been drafted but has yet to be acted upon.

NDRC's dominance of the energy-environment policy interface in China is reflected in its prominent role under the SED and under the SED's legacy initiative, the Ten Year Framework for Energy and Environment Cooperation. This has been a mixed blessing. While EPA has been able to engage in productive dialog with NDRC on several issues, we have been unable to achieve practical breakthroughs in other areas. As I believe our DOE colleagues will agree, it appears that the March restructuring has generated some institutional ambiguity that NDRC has not yet resolved with other parts of the Chinese central government.

Even earlier, despite best efforts of our Treasury Department colleagues, progress with NDRC under the SED umbrella has been challenging. One important example concerns China's transition to low sulfur automotive fuel on a national scale. Several years ago, SEPA announced that China would adopt a series of increasingly strict vehicular emission controls that generally track with the European Union's Euro I-VI standards. This is all to the good—in China as elsewhere in the world, transportation is fast becoming the principal source of urban air pollution and related public health concerns. EPA has been actively engaged in the international effort to address this problem, both bilaterally and via the UN Partnership for Clean Fuels and Vehicles. Chinese government and commercial organizations have participated in this effort, and Beijing hosted a meeting of the Partnership earlier this year, with participants from 22 countries in attendance.

However, a 2006 study by the International Council for Clean Transportation (ICCT) highlighted a problem that continues to confront China to this day: the fuel quality standards needed to support China's increasingly rigorous tailpipe emission controls are not in place, nor has the national government, to our knowledge, publicly indicated any intention to implement them. Without a reliable supply of low sulfur fuel, it will be impossible to achieve the Euro emission standards (e.g. the Euro IV standards scheduled for implementation in 2010). This is a particularly curious situation given China's integrated five year planning cycle and NDRC's central role therein. If in fact progressively tighter vehicular emission controls are a matter of national Chinese policy, NDRC should be eager to tap foreign experience in making the transition to cleaner, low sulfur fuels as efficiently and as economically as possible. In theory, the issue lends itself well to the interdisciplinary engagement offered by the SED process, where energy and environmental problems can be considered in the context of commercial, technological, and other considerations.

Despite some encouraging signals at SED III last December, we have been unable to make significant progress with China on this question of low sulfur fuel to accompany stricter emission controls. We have made it clear to the Chinese side that EPA views the low sulfur fuel issue as something of a test case for the Ten Year Framework for Energy and Environment Cooperation, one of the premier outcomes of SED IV this past June. It is possible that China's fuel price increases announced shortly after SED IV signal a greater willingness to engage on this question. With continued support from Secretary Paulson's staff at Treasury, we are hopeful that real progress can be made on this front by the time of SED V in December.

Perhaps the broader point here, based on our limited experience under the SED, is that China's economic future could benefit from greater integration between energy and environmental policies. If the Commission is not already familiar with it, I can commend to your attention a 2007 World Bank study entitled, Sustainable Energy in China: The Closing Window of Opportunity, which addresses this problem and others bearing on the sustainability of China's energy sector.

Assessing Consequences and Costs

The Commission has asked for the Administration's policy and perspectives on the environmental consequences and costs of China's energy consumption, both to China and to citizens here in the U.S. Let me speak to the latter question first.

One encounters occasional statements in the press to the effect that "EPA has estimated that X percent of Y pollutant deposited in/near the West Coast of the United States originates in China". Let me assure the Commission that such statements are inaccurate. EPA has not at this juncture ascribed a fixed proportion of this country's air pollution burden, or that of any region of our country, to sources in any one foreign nation. EPA experts participate in various national and international efforts to address this question. One of the most promising is a study by the National Academy of Sciences, commissioned earlier this year by EPA and several other U.S. Government agencies, to assess the significance of international transport of air pollutants. This effort will seek to summarize the state of knowledge regarding:

- the international flows of air pollutants into and out of the United States and across its various regions on continental and intercontinental scales
- the impact of these flows on the achievement of environmental policy objectives related to air quality or pollutant deposition in the United States and abroad, including impacts on air quality and climate change

Academy studies are deliberate undertakings and this one is no exception; we expect the results to be made public late next year.

The environmental costs and consequences of energy consumption within China have been addressed by several authoritative sources in recent years, albeit not without controversy. Last summer, considerable press coverage surrounded a World Bank study, carried out in consultation with SEPA and various Chinese experts, addressing the environmental cost of pollution in China. One of the findings suggests that ambient air pollution affects public health in China to the tune of 3.8% of GDP. Another indicates that crop damage from acid rain amounts to 1.8% of China's agricultural production. In her testimony before this Commission last year, Jennifer Turner of the Wilson Center's China Environment Forum (CEF) cited a number of other estimated pollution impacts.

Perhaps the most sophisticated attempt to quantify the health damages of air pollution in China in recent months has been last year's Harvard University study, Clearing the Air: The Health and Economic Damages of Air Pollution in China (Cambridge, MA, 2007). Careful to point out the limitations of such estimates, the authors have estimated that China's national health damages due to air pollution *in 1997* amounted to 1.8% of GDP, with a range of 0.65% to 4.7% of GDP depending on various parameter inputs. It is reasonable to assume that the current value, over ten years later, would be substantially higher. The Harvard study also includes a useful survey of previous efforts to value China's pollution burden.

Collaborative Responses

How should EPA respond to this situation? How can we, a domestic U.S. regulatory agency, make a difference in China's energy and environmental profile, while advancing core U.S. interests? Let me offer several suggestions regarding a path forward.

- 1) *Continue with what works.* We seem to be nearing a watershed in our efforts to help China launch a national sulfur dioxide emissions trading system for that country's power sector. Having recently completed the Joint Economic Study of pollution abatement policies in our respective electric power sectors, we believe that China is positioned to proceed with SOX emissions trading on a national scale. Much remains to be done in terms of institutional capacity building, but we are confident that China is committed to this critical policy reform, one that will provide cost-effective environmental benefits. I should also note that the Asia-Pacific Partnership on Clean

Development and Climate (APP), in which EPA participates actively, is an Administration priority designed to accelerate development and deployment of clean energy technologies, and to help meet energy security, air quality, and climate change goals in ways that promote sustainable economic growth and poverty reduction. EPA's Office of International Affairs also co-chairs the Environment Working Group (EWG) of the U.S.-China Joint Commission on Commerce and Trade (JCCT), along with the U.S. Department of Commerce and China's MEP. The EWG seeks to enhance cooperation between the U.S. and China on environmental protection issues while promoting commercial relations and trade in the environmental sector. The EWG is currently organizing the first U.S.-China Environmental Industries Forum. By bringing U.S. and Chinese government and industry representatives together, the event should serve to facilitate the development of policies, relationships, and projects that support the deployment of environmental technologies while addressing environmental concerns.

- 2) *Strive for greater public access to accurate environmental information.* An informed public and a transparent regulatory process are bedrocks of sound environmental policy. China has made considerable strides on these fronts in recent years, but much environmental information remains off-limits or unevenly available. We look forward to incorporating into EPA's formal program of cooperation with MEP a range of activities on environmental information management.
- 3) *Coordinate more actively on China's environmental challenges, domestically and internationally.* EPA's Office of International Affairs has already engaged productively on China with the Asian Development Bank, the U.S. Business Council for Sustainable Development, the World Environment Center, and other interested organizations, at home and overseas. We plan to expand the discussion on China with other potential partners—e.g. the European Commission, UN Environment Program, the World Bank. The challenges of environmental quality in China are far too great for any one country to address in a vacuum. Some of China's energy-related environmental impacts (e.g., mercury emissions from coal combustion) are already the focus of international attention. And we owe it to the American taxpayer to ensure that our efforts gain maximum leverage from other sources.
- 4) *Seek greater integration of energy and environmental policies in China.* This has been and remains an important goal of the Asia-Pacific Partnership already mentioned. Additionally, through the SED's Ten Year Framework, we hope to integrate environmental outcomes into joint action plans on "Clean and Efficient Transportation" and "Clean, Efficient, and Secure Electricity Production and Transmission." Our cooperation with MEP will enhance their ability to design and implement economically sound regulatory programs in support of Ten Year Framework energy goals. Working with our U.S. interagency partners, we will promote win-win efforts in China such as "green credit", energy efficiency consumer labeling, and reduced barriers to trade in environmental goods and services.
- 5) *Pursue productive contacts with Chinese sub-national jurisdictions.* We are working with USG partners as well as NGOs, States, and the academic community to help China improve environmental governance at both the national and provincial level. Some of the most innovative environmental policy initiatives in China are coming out of selected provinces and municipalities (e.g., Beijing, Guangzhou, Shenzhen, and Guangdong Province). At the same time, implementation and enforcement on the ground remains a weak link in China's environmental governance system. Pilot projects outside of Beijing have long been part of EPA's cooperative repertoire in China, but it may be time to shift our focus more toward sub-national jurisdictions. Capacity building work with MEP's regional supervision centers may offer a channel in which to advance this goal. Other avenues include the eight APP sectoral task forces and, potentially, the concept of "EcoPartnerships" being developed under the Ten Year Framework.

Let me close by restating the obvious: there is only so much that EPA can do in and with China. Resources (both human and financial) are always limited, and our first duty is to the citizens of the United States. But we are confident that, within our modest means, a well targeted collaborative effort with China will pay

ample dividends on our investment, to the benefit of our people, the people of China, and the international community.

Thank you for your attention. I welcome your questions and comments.

PANEL I: Discussion, Questions and Answers

HEARING COCHAIR REINSCH: Thank you.

Commissioner Wortzel has the first questions.

CHAIRMAN WORTZEL: I thank both of you for your thoughtful written statements and testimony here.

I have a question, actually a couple of related ones, for each of you. Ms. Fredriksen, what's your experience so far with the IPR protection that's been given to the technology used in the feasibility study on coal liquefaction? Have you seen any attempts to reverse engineer it by the Chinese? How is it funded? And who developed it? Was it developed privately or by government here in the U.S.?

And then I'll move to Mr. Fulton and give you both a chance to answer. Mr. Fulton, in your written testimony, you had some interesting things on the regional supervision centers, which I understand are just forming, but can you talk a little bit about how they envision monitoring and sampling? Is it static or are they going to travel?

What struck me, and I guess you can't speak for the Chinese government, but one of the biggest pollution areas is central Henan, Hubei, Hunan, those areas in there, and they haven't done anything. It looks like they've kind of missed that whole area.

Thank you.

MS. FREDRIKSEN: Let me respond to the question you had on IPR. China's actually probably going to leapfrog the United States to CTL. They've already got quite a number of liquefaction units. They've been using them primarily for industrial purposes and also to produce products such as fertilizers from the syngas. They have made--through strong encouragement through our bilateral dialogue--commitments to cease direct liquefaction and move to indirect, which will allow for carbon capture.

They have approximately 25 gasification units on order that range equally from companies such as Siemens to GE, et cetera, and so they have really, in our opinion, have helped to buy down the technology costs of these gasification units because they are moving aggressively forward to meet their demands for energy as well as other chemicals.

And so they have been able to be first movers out of the box and

buy in such quantities, I think, and from different sources of our U.S. manufacturers. We have not seen any attempts yet, and I believe that the companies can speak for themselves, but we have not seen it at the government any challenges on IPR right now with this.

I think they are moving so quickly that they are having to buy in such quantities that they are making it to their advantage to not have time to spend to reengineer yet.

CHAIRMAN WORTZEL: Thanks. I guess it was Taiyuan Iron and Steel, the new plant there, is just amazing to look at, but the older ones aren't so hot.

MR. FULTON: Thank you, Mr. Chairman. There are a lot of pieces in China's internal equation that are in flux relating to environmental protection. We've got an environment ministry that is still quite small by U.S. standards, several hundred people strong as opposed to what we have here, 17,000 people in the federal part of environmental protection.

We have a fairly nascent structure in these regional supervision centers. I think they're appropriately viewed as kind of start-up enterprises at this point. We're trying to build on the U.S. model where the Environmental Protection Agency, there are ten regional offices. Those regional offices work collaboratively with the states and their region, the hope being that by and large the primary environmental protection will be provided at the state level in our system with federal government enablement and oversight being provided.

If you take that kind of concept and look at it in the Chinese system, there are some challenges that need to be worked through. The provincial governments are quite strong and historically fairly autonomous, and there is some growth that definitely needs to take place yet in figuring out how this regional piece, this expression of the national government presence at the regional level can effectively work with the provincial governments to advance their capacity, hold them accountable for achieving national environmental objectives and the like.

I think it's not surprising at this point that we would see gaps in coverage within China. I'm also imagining there's probably wide variability in the speed of uptake by the regional supervision centers depending on the particular region within which they are operating and the relative political strength of the provincial leadership vis-à-vis the national government.

So we agree that it's a promising development. We're trying to create some sister relationships, if you will, between the regional supervision centers and our regional offices so that the methodologies of playing this dual rule of enabling and also providing oversight for

the national government to the provincial governments can at least learn from the U.S. experience.

On your question about monitoring and sampling of air quality and whether it tended to be static or traveling, I'll have to get back to the Commission with a more informed answer on that. My understanding is that they will have air quality monitors much like what we have, which are by and large stationary, which are augmented as appropriate based on air quality indications, by mobile monitoring efforts. But I could try to provide a more informed answer on that.

CHAIRMAN WORTZEL: Thank you.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Slane.

HEARING COCHAIR SLANE: Thank you. First, I wanted to thank both of you for taking the time to come here today. We have been trying to figure out how to promote air quality in China, and it seems to us that they are most interested in gasification because of all of their coal issues.

What I'm being told is that they have 29 gasification plants there, but they're using them to make ammonia and not synthetic gas. And did I understand your testimony that they're now placing orders and were actually going to use the gasification plants to make synthetic gas and then power turbine generators from there?

MS. FREDRIKSEN: We've got a couple of activities underway that we know of. One is, as you said, on ammonia because they have had a fertilizer challenge. They are looking at now making diesel fuel for industrial use as well as for vehicle transportation use, and that's what a bulk of the new gasification units that are on order from U.S. companies will be used for.

On the syngas, we've seen some of that, and we're seeing it a great deal more in our collaboration which we work with EPA on in coal bed methane and coal mine methane activities where they are trying to produce, use the methane gas to help produce electricity and also, as you know, it helps with mine safety.

And so they are moving in that direction. I think you're seeing it also in electricity production with their IGCC unit that they've got one demonstration and their GreenGen production IGCC unit as well. So I think that they are doing this both for industrial, chemicals, as well as fuels, as well as electricity.

HEARING COCHAIR SLANE: Thank you.

HEARING COCHAIR REINSCH: Commissioner Fiedler.

COMMISSIONER FIEDLER: I've a couple of questions. First, an observation. When we were in Taiyuan, we drove 100 kilometers south, and witnessed what I characterize as a clash between science and politics. All along both sides of the highway for 100 clicks were

two rows of trees a meter apart, freshly planted, as if somebody had read in a book that trees put off oxygen but failed to read that sulfur dioxide kills trees.

I have every expectation that a year from now that those trees will be dead because you couldn't see the mountains a kilometer away from the road. So the issue of regional or provincial environmental enforcement seems to me most critical.

Are we engaged in exchanges that are focused on provincial officials? Everyone describes the central authorities as essentially powerless to enforce. Therefore, the solution seems to lie in the provincial officials.

What is also your observation of the politics of incentives that exist or don't exist among provincial officials to, in fact, enforce existing Chinese regulations? First question. Both of you.

MS. FREDRIKSEN: I know Scott will take a big piece of this, and I think you're right. We've seen that to give a particular example, building efficiency. They've got, they have the codes and standards. The enforcement is a problem because there's about only one out of every five new buildings that are actually built to code, and we see that as a problem, and we're seeing it in environment as well as the statistics of them building a coal-fired power plant. It's actually not one a week; it's about two a week.

Those again are unpermitted. They're illegal. So how do we address this? And we are in our framework for the ten-year cooperation trying to get to that very thing, trying to get to how do you involve the mayors, how do you involve the provincial governments? Because you are right, by the decentralization of China's governmental system, it's had some pluses and minuses, and those minuses are very fragmented compliance and misaligned incentives.

So we're trying to take that approach of where do you want to be in ten years, and then let's figure out because a lot of this isn't technology-based, it's policy problems.

COMMISSIONER FIEDLER: Politics.

MS. FREDRIKSEN: I know that EPA will talk and I know Scott will talk about what we're trying to do on SO2 and creating systems like we have here for trading. But we're trying to do that in not only the energy policies and environmental policies, but we're trying to really get down into the provincial.

We're seeing where we have a lot more success in dealing with the Beijing Development and Reform Commission, the BDRC, for example, working with Shanghai, working with Shenyang, where every new building cannot add to the load for electricity. They've got to find an offset on emissions and so they're having to turn to geothermal,

for example.

We're seeing these kinds of policies be put in place and move forward, and we still have some of the habitual bad folks in the provinces that were named earlier, and we've got to get through that. But that is exactly what we're trying to do because we will only accomplish just as in the United States through local government. We can't do it from Washington, D.C.

So we have to have those provinces on board, and one of the things that we're very excited about at the SED IV in Annapolis last month or in June, we announced the formation of eco-partnerships, and it will get to that very piece of the state and province collaboration, where there's a solar city in California, for example, and a city in China that wants to become a solar city. How do they do it? Well, that's not what we can help them with; that's what the cities can do together.

By creating these eco-partnerships, we're actually leveraging what our expertise is, which is our state officials and our state governments and our private sector enterprises to get involved and do it with the Chinese and do it from a bottom up approach, and so that's one of the things we're very excited about and we're going to launch and actually ink the first two eco-partnerships in December when we travel over to Beijing.

MR. FULTON: Last fall, an annex was added to the EPA-SEPA, now MEP, MOU to deal specifically with enforcement and compliance inspection activity, and the collaborative work pursuant to that annex has proceeded apace since then.

But I think it's fair to say that there's a lot of heavy lifting to be done in moving China to a place where there's a kind of accountability mechanisms in place that we've accepted as a basic part of our infrastructure for sometime now in this country.

The annex that we have with MEP does contemplate capacity building relating to not just the national authorities but also the provincial authorities. So I think there is an expectation that there will be movement in that direction and appreciation of the fact that's where the real opportunities and gains, potential gains, are present.

But they're also some not inconsiderable challenges in dealing with language difficulties, dialect differences, and that sort of thing, in the different regions that make deployment of capacity building work related to enforcement and compliance monitoring challenging.

But we are engaged as an agency. We kind of understand where this needs to go to be effective. We see the intersections between training up government personnel to be the accountability mechanism, but also finding ways to enable civil society to be part of the eyes and ears for the environment, just as they are in this country.

Those tools that again we see as an inherent part of our system for civil society engagements still have to be constructed and built there. In order to do that, there's some education of the Chinese government that needs to occur where they come to see that as a value and a mechanism for helping get the job done, and I don't know that we're there yet.

We also see, I think, the intersection between enforcement of the laws that on the books and the formation of a broader, the need for formation of a broader societal ethic that sees environmental protection as a value at a sufficient level that will ensure that it gets the appropriate response, and that's a function of education. It's a function of seeing the linkages between environment and energy sustainability and these other issues.

So all of that to say your point is well-taken. I think that's where one of the primary challenges lie, is really getting to a place where the folks who are doing the on-the-ground work in China are doing it in a way that is fully responsible from an environmental protection standpoint in the provincial governments.

On SO₂, just briefly, EPA has been working with China for a number of years to try to ensure some movement in the direction of a national SO₂ strategy, building on the United States' experience with cap and trade system for SO₂ management, which is generally regarded as a pretty successful program, and that effort, we think, got a helpful push from the SED process at last December's meeting at SED III, where the Chinese did agree to implement a national program for SO₂ management.

And that got some further attention in SED V. Our sense is that some of the staffing up that we see at MEP--they have been adding some personnel and resources focused on trying to satisfy that objective. So at the moment we are somewhat optimistic that we will see something of consequence emerge in terms of a national SO₂ management program.

That being said, we'll still have the challenges in trying to ensure accountability with that program.

COMMISSIONER FIEDLER: Thank you very much.

HEARING COCHAIR REINSCH: Thank you. Commissioner Shea.

COMMISSIONER SHEA: Thank you both for being here. I have two questions. The first question is for Ms. Fredriksen and the second question can be for both of you.

Last year, we heard testimony from the CEO of FutureGen, and I believe from an administration witness who talked about FutureGen and U.S.-Chinese cooperation through FutureGen. It's my understanding that FutureGen has been put on hold. I don't know if

I've appropriately characterized that, but I was just wondering if you can give us a status report of what's going on with FutureGen?

Secondly, this is a follow-up to Commissioner Fiedler's question. I'm going to read something from Elizabeth Economy from Foreign Affairs, a Foreign Affairs article from last year.

She writes: Given the lack of transparent information and official accountability or independent legal system in China, the United States will have to get much smarter about how to cooperate with China in order to assist its environmental protection efforts.

Above all, the U.S. must devise a limited and coherent set of priorities. China's needs are vast, but its capacity is poor. Therefore, launching one or two significant initiatives over the next five to ten years would do more good than a vast array of uncoordinated projects.

And she suggests climate change, illegal timber trade, institutional changes such as strengthening the legal system in China regarding environmental protection as a good one or two initiatives.

We've heard other testimony that people ought to be working with the provincial governments and let the states in the United States work with the provincial governments, sort of let a thousand flowers bloom approach.

I was wondering is this a false choice or, you know, basically comment on Ms. Economy, Professor Economy's statement about limiting or having a coherent set of priorities?

MS. FREDRIKSEN: I'll do my first two and then let Scott speak for EPA. The status of FutureGen is that, yes, we went through a restructuring to look at the state of technology and how far we had come from when FutureGen was first conceived.

When it was first developed, we had no IGCC. It was not commercial. We didn't see that, in addition to the carbon capture piece of it. Since that time, IGCC has become very commercial. We've got--

COMMISSIONER SHEA: Could you define IGCC? I'm acronym-phobic.

MS. FREDRIKSEN: I'm sorry. Integrated Gasification Combined Cycle.

COMMISSIONER SHEA: Okay.

MS. FREDRIKSEN: It's where you gasify coal and produce a synthesis gas, which then turns a turbine to produce electricity.

What we didn't have was the carbon capture piece and the carbon capture and storage piece. In our regional partnerships, we have seven regional Carbon Capture and Sequestration Partnerships in the United States, as well as chairing the Carbon Sequestration Leadership Forum, which is a network of governments around the world sharing and collaborating on carbon capture and sequestration.

But that's where the technology was lagging, and in order to meet our objectives that we have and the need we have to get to capturing carbon and doing something with it other than just making plants carbon capture ready, we reengineered the concept of FutureGen to really focus on what we needed which is the bang for the buck on getting the carbon captured.

And so we've enhanced our budget. We've enhanced our approach and we've announced now there's a funding opportunity availability that is open right now, taking comment from the public on projects that we could go and partner where there is an existing or a planned for IGCC as well as an existing regular non-IGCC plant.

The government would back the carbon capture and sequestration piece. It's somewhere around a \$400 million per plant cost, and the government would assume that. In partnership with what the EPA is doing on issuing regulations and guidelines on sequestration, we're going to actually try to move this forward so that we can achieve our goals by 2015 of having commercialized carbon capture and sequestration.

Where does that affect the Chinese? The Chinese do have an IGCC plant that's moving forward. I believe Peabody Coal is one of the partners. And they signed their partnership last December alongside our SED. They were there, and I think that's significant because that is showing private sector, U.S. private sector engagement in China.

China still does not have CCS. No one does. We do not have it commercially available. The funding opportunity that's open on the FutureGen project now is open to international bidders. So we're hoping to see international players come and get engaged in that.

In the ten-year framework for electricity, we certainly see nuclear renewables and coal and they have corresponding policies that are associated as well as technology collaboration. So we will continue to move forward on our collaboration with China via these bilateral mechanisms as well as through multilateral mechanisms, such as the Asia Pacific Partnership, for example.

Your next question was about the suggestion that we focus on a couple of key things, and I think that is what was really the birth of the idea of the Ten-Year Framework. There were some very smart people that had long-time engagements with China. Henry Kissinger, for example, is one of those luminaries.

He said you need to focus on something that the Chinese have in common with you, that they want to achieve, and energy and environment make total sense. They are arguably two of the most successful pieces of the SED because we do have very shared and common goals in these areas.

So we focused on them to design objectives that will actually achieve something, and you're right. When we looked at how many bilateral cooperation agreements we had, ranging from vehicle batteries to biofuels to coal cooperation, we saw that we had to have the policy piece. We have a mandate to displace gasoline in this country and create 36 billion gallons of ethanol, cellulosic ethanol primarily, by 2022. They don't have a similar policy. So they could create all the biofuel all day and where is it going to go? You could create biofuels and they don't have a biofuel industry because they have no objectives to have a blend. So we're trying to bring in the strategic-ness of how you focus our bilateral cooperation so that you're actually achieving something.

They have an advantage over us, when we look at electricity. We're trying to retrofit a grid here to make it a smart grid. They actually need to build the transmission lines. So they can actually integrate renewables into a system that currently doesn't exist as they need to electrify their country completely. That's an opportunity. They actually have an advantage over us because we have to go through and retrofit a system that exists already. Same thing on transportation. They're growing their vehicle market. Ours is a very mature market. We're going to try to retrofit plug-in hybrids and get vehicle fleet turnovers. They can actually be first movers and folks can actually buy plug-in electric vehicles and can actually get hydrogen fuel cell vehicles advanced.

And so those are the types of things that we're trying to do, bring that strategic nature into some very focused goals, which are the five focus goals that I mentioned earlier in my testimony, and we believe that by doing that, we will actually achieve greater returns than we can do in just a bilateral way and just with the Department of Energy by itself working with its Chinese counterparts.

I'll say one more thing about that. China's bureaucracy is very fragmented, and as Scott mentioned, the Ministry of Environmental Protection, the NDRC and the MEP have conflicting goals sometimes. The NDRC could still trump those other ministries, and what we've done through the framework agreement is create an equal position at the table. So just as on our side the Ten-Year Plan is going to make DOE and EPA and Agriculture and Transportation work together to implement these action plans on these goals, the same thing will happen on the Chinese side.

So this is a truly change in thinking for them. One, they don't do that. They never have. They don't strategically beyond a five-year goal. They're not technology-based. They don't have achievability. They're pretty much failing in all of their goals that they have under the 11th Five Year Plan.

So we're trying to help them, while also helping ourselves, and we're going to get them to work together, just like we've got to learn to all work together, and so I think that is one of the truly great benefits of the approach that we're taking with the Ten-Year Plan, and it is based on we can do better if we just focus on a couple of things.

COMMISSIONER SHEA: Okay. Thank you.

MR. FULTON: Yes. It's hard to disagree with the notion that we should prioritize our work and focus on those areas that are going to make the biggest difference and have the biggest impact. I think we would certainly agree with that.

As a domestic agency that has a primarily domestic focus, we're kind of forced to do that in any case, and we're not in a position to respond positively to everything the Chinese might like to work with us on, and we really are pushed to a place of needing to prioritize our activities in a way that I think fundamentally looks at places where we have a common interest to some degree, and where there are opportunities for success, and then trying to find what the levers for helping ensure that success might be.

I would agree with Kathy that the ten-year framework is an effort. It's more than one or two areas of focus. It's five areas of focus, and there is further granularity within each of those areas of focus, but my sense is that we are trying to prioritize those things that both will be determinative of success, but also provide a laboratory for learning on the Chinese part and a place where this development of the sense of the importance of these issues can grow, which then would be transferrable to other areas.

Within our clean air goal, for example, SO₂ will be the primary area of focus. We don't think there will be a thousand flowers blooming within the context of the work plan under that goal.

Under the clean water goal, we'll be focused on watershed management and the basic infrastructure that's necessary to protect water resources, ideas like water quality standards, some sort of permitting regime of some kind that can help ensure compliance with the standards. Trying to build the infrastructure serves as the lever for accomplishing the goal.

COMMISSIONER SHEA: Thank you.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman.

I want to thank both witnesses for being here in the middle of August. I have a question for first Ms. Fredriksen and then for Mr. Fulton.

My understanding is that China does not have a market-based pricing system for energy. Can you talk to me a little bit about that

and particularly for industrial sectors?

MS. FREDRIKSEN: You're correct and because they've capped and subsidized both fuels, et cetera, well, they've constrained the downstream end. Let me say that. They constrained the downstream end and they leave the upstream end open.

So their nationally owned companies do feel the squeeze on that both from electricity production as well as refining product into gasoline or diesel distillates. And so because of that, they have been having pretty hefty payouts from the government to the oil companies and the electricity companies in order to make them whole.

And so by them taking the first step on--

COMMISSIONER MULLOY: Who's paying?

MS. FREDRIKSEN: The national government.

COMMISSIONER MULLOY: National government.

MS. FREDRIKSEN: Yes. Their treasury.

COMMISSIONER MULLOY: Right.

MS. FREDRIKSEN: Those are in the billions, and so even though they have a 1.3 trillion surplus, that will quickly get eroded when you're paying out billions for energy subsidies, and so they know they have to take steps, and I think what they did when they lifted or reduced the first subsidy and raised the fuel prices, that was pretty significant because we were at about \$145 barrel oil, and so for China and countries like India, Indonesia, Malaysia, to take these first steps put these countries in a--

COMMISSIONER MULLOY: I want to follow up.

MS. FREDRIKSEN: Sure.

COMMISSIONER MULLOY: They're providing billions of subsidies to industry who are producing goods. Are some of those goods, do you think, exported to the United States?

MS. FREDRIKSEN: There's primarily domestic consumption for their electricity. The end results, be it steel or cement--

COMMISSIONER MULLOY: Steel?

MS. FREDRIKSEN: Steel, yes. Cement, yes. The United States, about one out of every two foundations poured in the United States is using Chinese cement.

COMMISSIONER MULLOY: Would you think of that type of subsidy being a subsidy that should and could be countervailed by an anti-subsidy law in terms of the goods coming into the United States?

Have you guys looked at that or thought about that?

MS. FREDRIKSEN: I'm sure that's one of the big issues that I will defer to the Trade Representative's Office and the WTO context, but--

COMMISSIONER MULLOY: Do you know whether they are? Has there ever been any interagency discussion on that that you're

aware of?

MS. FREDRIKSEN: I'm not an expert on those types of things. I know we are clearly not in violation of WTO because we do subsidize some of our agricultural products, for example.

What we're trying to have them do is move to more targeted subsidies.

COMMISSIONER MULLOY: Okay.

MS. FREDRIKSEN: For example, like our LIHEAP Program where we do help low income families with their energy bills. Clearly there is a class diversification growing in China and they don't need to be subsidizing those folks who don't need it for gasoline and diesel fuel, for example.

COMMISSIONER MULLOY: When you subsidize something, people will use more of it.

MS. FREDRIKSEN: Absolutely.

COMMISSIONER MULLOY: At a cheaper price. Okay.

MS. FREDRIKSEN: It's a market distortion.

COMMISSIONER MULLOY: So there's both, two reasons for going after the subsidy, it would seem to me. It encourages more energy consumption than would normally be the case. Secondly, it can be an export subsidy to their goods coming into our market, I presume.

MS. FREDRIKSEN: Correct.

COMMISSIONER MULLOY: Okay. I have a question for Mr. Fulton. I'm a great admirer of the EPA. I had a chance to work on the first U.N. Conference on the Human Environment when I was an FSO at State over 35 years ago. And Ruckelshaus was just getting EPA up and going, and there was a guy named Fitzhugh Green who ran the International Office, terrific guy.

I understand the United States has considered a supporting the establishment of something called the Clean Technology Fund in the World Bank. Are you familiar with that?

My understanding is this fund would be used to deploy climate change mitigation technologies to developing countries. And there would be World Bank assistance or helping to fund that. Would China fit in that definition as a developing country, and would they be getting financial assistance from the World Bank to use those technologies? Do you know what's contemplated?

MS. FREDRIKSEN: Yes.

MR. FULTON: Do you think that's what's contemplated? I think unless the marker moves on how a developing country is defined in the broader context of the climate negotiations such that China is viewed in a different light, if they are continued to be seen as a developing country, then they would have access potentially to that funding source.

COMMISSIONER MULLOY: Do you think that would cause a political problem in the United States, the fact that China has about 1.8 trillion and is using its sovereign wealth fund to buy up assets in this country, that we would be making contributions to the World Bank to subsidize those kinds of technologies going to China?

MR. FULTON: I would imagine that there would be a political dimension to that, yes, sir.

COMMISSIONER MULLOY: Okay. Thank you. Did you want to add something to that, Ms. Fredriksen?

MS. FREDRIKSEN: Only that it's cooperation with the other countries that are donating to the fund makes it a very sizable commitment, and it's going to be project driven. So applications will be made by project developers in all the developing countries, and there will have to be some aspect of a competition because clearly there's a defined set of funds.

But I think one of the things that we're trying to also accomplish with the fund is achieving some strategic objectives as well. We feel quite strongly that the fund ought to have some type of conditions such as if you have a tariff restriction on that clean energy or clean environmental good, then that tariff ought to be lifted.

The World Bank has supported eliminating the tariffs on 40 clean environmental goods and we feel strongly that that ought to be expanded, but we are trying to get others to at least agree to that 40. China is one of the two largest producers of those 40 goods, Mexico being the other one.

The United States doesn't actually produce any of them and we buy them all. And so it ought to be that those tariffs are reduced or eliminated, and on the 40, they should be eliminated, and we shouldn't have restrictions on being able to have access to clean energy and clean environmental goods and services.

So that's one aspect of it, that I think the fund is trying to also get to. You can have a wind turbine or you can have a waste water treatment system, but you can't impose tariffs or domestic content restrictions on those things to come from only your country.

COMMISSIONER MULLOY: Thank you.

HEARING COCHAIR REINSCH: Thank you.

Ms. Fredriksen, I have one question to follow up on something that Mr. Mulloy raised. When you mentioned that the Chinese had raised oil prices 17 percent, what does that leave in terms of subsidy?

I assume, you implied in your last comment that that does not take them to a market rate. What's the remaining gap?

MS. FREDRIKSEN: I'd have to get back to you on that. They've clearly in the international world, they're not the worst offender. The Middle East actually is and Latin America. And we are seeing the

largest growth in oil consumption in those countries that have subsidized prices. 80 percent of the use or increase in demand is by countries that are subsidizing.

The only way to truly let consumers see and be driven to be more efficient is by seeing true price, market prices, and so we think Asia is taking those first steps where we're disappointed that the Middle East and Latin America have not done that, but when a country such as China does take that first step, and it is a first step, but we agreed that we had to have a plan to phase these out, and we know that they can't be just eliminated tomorrow.

It will cause widespread panic, and I think the markets would go crazy, but having a plan in place, and that's what we're working with with China and India on--we're hoping that we'll continue to see improvement in this arena.

HEARING COCHAIR REINSCH: I appreciate that. I think if you could have someone send the staff here just a note about what your estimate of the remaining subsidy is, that would be helpful in our deliberations.

Now, I have two commissioners that each have indicated they have one more question. Is that right?

CHAIRMAN WORTZEL: Yes.

HEARING COCHAIR REINSCH: Well, that makes three. I don't know if we'll have time for three, but let's begin with Mr. Fiedler, and if you could just each have one, that would be great.

COMMISSIONER FIEDLER: Really? Then I'll choose.

HEARING COCHAIR REINSCH: Sorry.

COMMISSIONER FIEDLER: We haven't talked in-depth about China's water problem, which most directly affects its population. And from what I'm reading, it is a severe problem. Could you describe the problem a little bit for us?

MR. FULTON: Well, our understanding is that the surface water bodies in China by and large suffer a high degree of degradation. That has implications for their drinking water sources as well given the synergies between surface water and groundwater, and I'm sure as in most developing country settings, a fair amount of drinking water is taken directly from surface water bodies.

So it's a problem of significant proportions. The good news is that the Chinese government at this juncture seems to recognize the problem at the national level at least. They brought into this ten-year framework process a specific set of objectives relating to protection of watersheds, which they see as being fundamental to improving the quality of drinking water in the country.

The Clean Water Action Plan that we've developed with them under the water goal will be an effort to move forward on that. So I

think, step number one in dealing with a problem is identifying it and appreciating it. I think the Chinese are there at this point.

So hopefully we'll find our way through this collaborative process to step two, which is coming up with the infrastructure that will actually ensure forward movement and doing something about it.

COMMISSIONER FIEDLER: Mr. Chairman, if you would permit me, just to ask her to send some information? I read your testimony on the petroleum reserve, and would just simply like to ask for you to forward us, if you can in an unclassified way, the difference between their reserve last year and this year.

MS. FREDRIKSEN: Yes.

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SECRETARY KATHERINE FREDRIKSEN**

COMMITTEE: U.S.-CHINA SECURITY AND ECONOMIC
REVIEW COMMISSION (USCC)

HEARING DATE: AUGUST 13, 2008

WITNESS: ACTING ASSISTANT SECRETARY
KATHARINE FREDRIKSEN

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China's SPR will be filled in four phases, and each phase will be composed of a number of sites across the country. Filling began in 2006, and all four phases of China's SPR are not slated to be filled until 2020. On June 14, 2007, Assistant Secretary Karen A. Harbert appeared before the USCC and presented DOE's awareness of China's SPR status. Assistant Secretary Harbert noted that one site, consisting of 52 above-ground storage tanks and containing a 33 million barrel capacity, had been filled.

It has been reported that, as of July, China's SPR was filled to a capacity equal to around 33 million barrels, the same level that Assistant Secretary Harbert stated last year.¹ However, as I noted in my written submission to this Commission, it is difficult to accurately determine the true status of China's SPR. China drew down its reserves to an undisclosed extent in response to the May 12 Wenchuan earthquake. Further, various provinces operate independent reserves outside of the national SPR. Guangdong, for example, reportedly holds a commercial oil reserve equal to up to 20 days of its consumption.² The national oil companies also maintain their own stockpiles. These factors highlight the difficulty inherent in determining not only the current level to which China's SPR has been filled, but also China's overall state of readiness in case of an oil supply crisis.

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WITNESS: ACTING ASSISTANT SECRETARY
KATHARINE FREDRIKSEN

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Lack of information on the composition of China's subsidies makes it nearly impossible to state with any degree of certainty by what percentage Chinese fuel prices are subsidized. However, the IEA and other sources do provide

¹ LEE Geng, and Michael J. Economides, "China's S.P.R. Pumping Up Prices," Energy Tribune, July 21, 2008, <http://www.energytribune.com>.

² Interfax China, "Guangdong lobbying for rights to build national oil reserve depots - report," July 23, 2008, <http://www.interfact.cn/news/4249>.

very rough estimates of China's oil subsidies: US\$40 billion in 2008³ and US\$22 billion in 2007.⁴ These numbers likely represent only the subsidies for crude oil from the national government. .At the provincial and municipal levels, additional subsidies in numerous forms, such as tax rebates, are provided.

COMMISSIONER FIEDLER: Thank you.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Wortzel.

CHAIRMAN WORTZEL: I just want to clarify a shocking point, Assistant Secretary Fredriksen. Did you say one of two foundations poured in the United States is Chinese cement?

MS. FREDRIKSEN: Uh-huh.

CHAIRMAN WORTZEL: Do we have a way of knowing that this isn't the same kind of cement that was used in the foundations of schools in Mianyang?

MS. FREDRIKSEN: We do have an initiative underway to work with China on earthquake resistant housing. It's something that the United States Department of Energy laboratories have great expertise in, and China is not the only hopefully beneficiary of that technology, but yes, that is the current estimate of house cement.

And so it's one of the reasons why the Cement Task Force under the Asia Pacific Partnership is so important because it is probably, for every one ton of cement, you produce one ton of CO₂, and so you have the greatest opportunities to reduce climate emissions and greenhouse gas emissions if you actually get to formulating a cement from a different process. And so that's one of the primary objectives under the Asia Pacific Partnership Task Force and one that we are looking forward to moving quickly forward on with some projects in China under APP.

HEARING COCHAIR REINSCH: Commissioner Mulloy has the last question.

³Bradsher, Keith, " Fuel Subsidies for Some Make Oil More Expensive for All," International Herald Tribune, July 28, 2008.

⁴ Ibid.

COMMISSIONER MULLOY: Thank you.

I just have a quick one for Ms. Fredriksen. Some years ago this Commission strongly recommended that the Chinese be brought into some kind of affiliation with the IEA and I see on pages eight and nine of your testimony, you talk about that.

Some of the other testimony talks about bringing them in as a formal member. Can you tell me is it because they're not a democracy that they can't become a formal member of the IEA and are there efforts to bring them in anyway? Just give me a quick understanding of that.

MS. FREDRIKSEN: Surely. Currently membership in the IEA requires that you, one, be an OECD country member, and, two, that you have strategic petroleum reserve equal to 90 days of consumption.

They clearly are not a member of the OECD. That's one of the ones. But, two, their SPR is in no way up to the 90-day levels. They've got about 15 days approximately in reserves. And they had to do a release after the earthquake because they had a significant supply disruption.

We've made advancements with them on both of those fronts. We have had commitments from China that they will cooperate with the IEA in case of a severe supply disruption. So if we had a global supply disruption and the IEA determined that its 27-member countries needed to release reserves, China has agreed to cooperate in that effort.

Now we have been engaging them to attend and cooperate with the IEA and we are looking at the membership requirements and whether or not if we were to delink the OECD membership requirement, what other criteria would we want to make sure are there?

Because OECD membership has a full range of criterion that we don't want to lose by making that delinkage.

And we continue to work with them on the SPR. I think the reshuffle in their organization, in their government, in creating this new National Energy Commission and who will manage the SPR has been one of the issues that we've been working closely with them on. We have continued efforts in that regard, and it is one that we will actually be more fully discussing with them at our Energy Policy Dialogue in October.

COMMISSIONER MULLOY: Thank you very much.

HEARING COCHAIR REINSCH: Thank you, and thanks to you both for your time and for your very helpful answers.

We'll go on now to the next panel, Dr. Downs and Mr. Cunningham.

PANEL II: CHINA'S ENERGY POLICYMAKING STRUCTURE AND REFORMS

HEARING COCHAIR REINSCH: All right. We'll reconvene. I want to indicate before we begin this panel that I understand Congressman Bartlett from Maryland will be submitting a statement for the record, and we'll have that placed at the appropriate place in the hearing record.

Our second panel is going to examine the recent changes in China's energy policymaking structure, and what this may mean for future energy policy objectives.

Dr. Erica Downs is the China Energy Fellow at the Brookings Institution. She earned a Ph.D. and an M.A. in politics from Princeton University, and a B.S. in humanities in international affairs from the School of Foreign Service at Georgetown University.

In addition, she has taught at the Foreign Affairs College in Beijing and worked as an analyst at the RAND Corporation. Her current research focuses on Chinese energy issues.

Edward Cunningham is a research fellow at the Massachusetts Institute of Technology Industrial Performance Center and is completing his Ph.D. in the MIT Department of Political Science.

Mr. Cunningham graduated from Georgetown University and received an A.M. from Harvard's Graduate School of Arts and Sciences.

Thank you to both of you for joining us today. As in with past panels, your full statement will be placed in the record. We'd like you to summarize, each of you, within seven minutes, and we'll begin with Dr. Downs. Please go ahead.

STATEMENT OF DR. ERICA DOWNS THE BROOKINGS INSTITUTION, WASHINGTON, DC

DR. DOWNS: Good morning. I first would like to thank the members of the Commission for the opportunity to testify. It's an honor to participate in this hearing.

My remarks today will focus on the changes to China's energy policymaking structure approved by the National People's Congress in March 2008.

First, I will outline China's old energy policymaking apparatus and why its reform has been a hot topic of debate in China.

Second, I will explain the new changes to China's energy policymaking structure and why those changes are unlikely to

substantially improve energy governance.

And third, I'll discuss some implications for the United States.

I'll begin by talking about China's old energy policymaking structure. China suffers from a disconnect between the increasingly prominent position of energy issues on its domestic and foreign policy agendas and the capacity of the country's institutions to manage the energy sector.

Some Chinese commentators have even argued that the biggest threat to China's energy security is posed by the very institutions responsible for enhancing it.

Consequently, restructuring those institutions has been a subject of intense debate in recent years as the country has grappled with an unexpected surge in energy demand, growing dependence on energy imports, rising global energy prices, and periodic domestic energy supply shortages.

Authority over China's energy sector at the national level is fractured among multiple government agencies, the most important of which is the National Development and Reform Commission. Within the NDRC itself, responsibility for energy is also scattered among several departments.

Prior to March 2008, the key component was the Energy Bureau which had a broad mandate but lacked the authority, tools and manpower to fulfill it.

In 2005, the government added another cook to the kitchen with the establishment of a National Energy Leading Group, a coordinating and advisory body headed by Premier Wen Jiabao. While the Leading Group's creation reflected recognition of the need to strengthen energy sector management, it did not eradicate China's energy governance woes.

China's fragmented energy policymaking structure has impeded energy governance because there is no single institution such as the Ministry of Energy that can coordinate the interests of the various stakeholders. For example, the implementation of energy laws in China is hampered by the fact that those laws often do not specify the government agencies responsible for implementation because of disputes over who's in charge.

Similarly, the fuel tax the NPC approved in 1999 has not been implemented because of the failure of the relevant stakeholders to reach an agreement.

This policy paralysis within the national level energy bureaucracy stands in sharp contrast to the activism of China's state-owned energy companies. These firms are powerful and relatively autonomous actors. Their influence is derived from their full and vice ministerial ranks, the membership of some top executives in the

Central Committee of the Chinese Communist Party, their industry expertise, internationally listed subsidiaries, and profitability, at least until recently in the case of the oil and power firms.

More often than not, it is China's energy companies who initiate major energy projects and policies that are later embraced by the central government such as the West-East Natural Gas Pipeline and the acquisition of foreign energy assets.

These companies also have some capacity to advance corporate interests at the expense of national ones. For example, oil and power generating companies have periodically reduced their output in part to pressure the government to raise state-set prices of refined products and electricity. Similarly, China's oil companies have sometimes ignored guidance from the central government about where they should invest overseas.

This brings me to the second part of my remarks on China's new energy policymaking structure. The recent changes to China's energy policymaking apparatus are the latest in a series of institutional reforms aimed at improving energy governance. In March 2008, the NPC approved two new additions to China's energy bureaucracy: the State Energy Commission, or SEC, and the National Energy Administration, or NEA.

The SEC, a high level discussion and coordination body whose specific functions, organization and staffing have not yet been determined, will replace the National Energy Leading Group, and the daily affairs of the SEC will be handled by the NEA, a vice ministerial component of the NDRC, which is the successor to the Energy Bureau.

The NEA has a broad mandate which includes managing the country's energy industries, drafting plans and policies, and strengthening international energy cooperation.

However, the NEA, like its predecessor, will struggle to fulfill its mandate because it lacks the autonomy, authority, manpower and tools to deal with the country's energy challenges.

Although the NEA's capabilities in each of these areas are greater than those possessed by the NDRC Energy Bureau, they still fall short of what it needs to do its job.

The NEA is especially constrained by the fact that it does not have the political clout to coordinate more powerful stakeholders. It has also been deprived of an important lever of control: the authority to set energy prices. Moreover, the NEA has a skeleton crew of just 112 people.

In sum, the new energy administration is unlikely to substantially improve energy governance. The organizational changes are tantamount to rearranging deck chairs on the Titanic. Although the energy bureaucracy looks a bit different, its limited capacities remain

largely unchanged. Consequently, we can expect to see a continuation of business as usual.

For example, conflicts of interest will impede decision-making. The energy companies will remain important drivers of projects and policies. State-set energy prices will continue to contribute to periodic domestic supply shortfalls, and the NEA, with no authority to adjust energy prices by itself, probably will resort to "second best" administrative measures to try to eradicate those supply shortages.

Finally, by way of conclusion, what does all this mean for the United States? First, U.S. policymakers should recognize that China's energy policymaking apparatus may constrain the Chinese government from doing all that the United States would like it to do, and indeed what Chinese leaders themselves may want to do to enhance international energy security and combat climate change.

If China falls short of our expectations, it may not represent a conscious decision by Beijing to shirk its global responsibilities, but rather the limited capacity of its national energy institutions to bend other actors in China, notably firms and subnational governments, to its will.

Second, U.S. institutions that plan to cooperate with China on energy issues have a plethora of partners to choose from. While the NDRC is often the partner of choice because of its authority and convening power, engagement with other actors can also be productive.

Corporations or sub-national governments may be appropriate partners for some issues.

Finally, U.S. policymakers should recognize that the "China, Inc." model often used to describe the foreign investments of China's oil companies is less coherent than sometimes assumed. Beijing has certainly encouraged the companies to go abroad. It has provided them with varying levels of diplomatic and financial support, and it has occasionally intervened in their decision-making processes.

However, for the most part, when it comes to choosing where and when to invest, the companies are almost always in the driver's seat.

Thank you.

[The statement follows:]

**Prepared Statement of Dr. Erica Downs
China Energy Fellow, The Brookings Institution, Washington, DC**

I first would like to thank the members of the Commission for the opportunity to testify. It is an honor to participate in this hearing.

My remarks today will focus on the changes to China's energy policymaking structure approved by the National People's Congress (NPC) in March 2008.

- First, I will outline China’s previous energy policymaking apparatus and why its reform has been a hot topic of debate in China.
- Second, I will explain the new changes to China’s energy policymaking structure and why those changes are unlikely to substantially improve energy governance.
- Third, I will discuss some implications for the United States.

I. China’s “old” energy policymaking structure

China suffers from a disconnect between the increasingly prominent position of energy issues on its domestic and foreign policy agendas and the capacity of the country’s institutions to manage the energy sector. Some Chinese commentators have even argued that the biggest threat to China’s energy security is posed by the very institutions responsible for enhancing it. Consequently, restructuring China’s energy policymaking apparatus has been a subject of intense debate in recent years as the country has grappled with an unexpected surge in energy demand, growing dependence on energy imports, rising global energy prices and periodic domestic energy supply shortages.

Authority over China’s energy sector at the national level is fractured among more than a dozen government agencies, the most important of which is the National Development and Reform Commission (NDRC). Within the NDRC itself, responsibility for energy is similarly scattered among multiple departments. Prior to the restructuring in March 2008, the key component was the Energy Bureau, which had a broad mandate but lacked the authority, tools and manpower to fulfill it. In 2005, the government added another cook to the kitchen with the establishment of the National Energy Leading Group, an advisory body headed by Premier Wen Jiabao. While the leading group’s creation reflected recognition of the need to strengthen energy sector management, it did not eradicate China’s energy governance woes.

China’s fragmented energy policymaking structure has impeded energy governance because there is no single institution, such as a Ministry of Energy, with the authority to coordinate the interests of the various stakeholders. For example, the implementation of energy laws is hampered by the fact that those laws often do not specify the government agencies responsible for implementation because of disputes over who should be in charge. Similarly, the fuel tax that the NPC approved in 1999 has not been implemented because of the failure of the relevant stakeholders to reach an agreement.

The policy paralysis within the energy bureaucracy stands in sharp contrast to the activism of China’s state-owned energy companies. These firms are powerful and relatively autonomous actors. Their influence is derived from their full and vice ministerial ranks, the membership of some top executives in the Central Committee of the Chinese Communist Party, industry expertise, internationally listed subsidiaries and profitability (at least until recently). More often than not, it is China’s energy firms who initiate major energy projects and policies that are later embraced by the government, such as the West-East Pipeline and the acquisition of foreign energy assets.

The companies also have some capacity to advance corporate interests at the expense of national ones. For example, oil and power generating companies have periodically reduced their output to pressure the government to raise the state-set prices of refined products and electricity, which have not kept pace with increases in the market-determined prices of crude oil and coal. Similarly, China’s national oil companies have ignored guidance from the central government about where they should invest overseas.

II. China’s “new” energy policymaking structure

The recent changes to China's energy policymaking apparatus are the latest in a series of institutional reforms aimed at improving energy governance. In March 2008, the NPC approved two additions to China's energy bureaucracy – the State Energy Commission (SEC) and the National Energy Administration (NEA). The SEC, a high-level discussion and coordination body whose specific functions, organization and staffing have not yet been determined, will replace the National Energy Leading Group. The daily affairs of the SEC will be handled by the NEA, a vice-ministerial component of the NDRC, which is the successor to the NDRC's Energy Bureau. In addition to the Energy Bureau, the NEA is also comprised of other energy offices from the NDRC, the Office of the National Leading Group, and the nuclear power administration of the Commission of Science, Technology and Industry for National Defense. The NEA has a broad mandate, which includes managing the country's energy industries, drafting energy plans and policies, negotiating with international energy agencies and approving foreign energy investments.

The NEA, like its predecessor, will struggle to fulfill its mandate because it lacks the authority, autonomy, manpower and tools to deal with the country's energy challenges. Although the NEA's capabilities in each of these areas are greater than those possessed by the NDRC Energy Bureau, they still fall short of what the NEA needs to do its job.

Authority: The NEA has more political clout than its predecessor, but not enough to mitigate the bureaucratic infighting that undermines energy decision-making. The NEA is a vice-ministerial body, which is a step above that of the Energy Bureau, which was a bureau-level organization. However, the NEA still does not have the authority it needs to coordinate the interests of ministries, commissions and state-owned energy companies. One of the frustrations of officials in the NDRC Energy Bureau was that the energy companies often undercut their authority by circumventing the Bureau to hold face-to-face discussions with China's senior leadership.

The authority of the NEA is somewhat enhanced by the appointment of Zhang Guobao, a Vice-Chairman of the NDRC with full ministerial rank, as head of the NEA. While it was widely expected that Zhang would retire, his new position is a reflection of his substantial energy expertise. Zhang, who has worked at the NDRC since 1983, is a smart and skillful bureaucrat with encyclopedic knowledge of China's energy sector. He has overseen the development of some of the country's major infrastructure projects, including the West-East Pipeline, the transmission of electricity from west to east, the Qinghai-Tibet Railway and the expansion of Beijing Capital International Airport.

Autonomy: The NEA is a creature of the NDRC. Some Chinese media reports speculated that the fact that the NEA's offices will be separate from those of the NDRC and that the NEA will have its own Party Group – which will give the NEA greater autonomy in managing its affairs, including personnel decisions – are signs of the NEA's independence. However, the fact that Zhang Guobao – an NDRC “lifer” – is head of the NEA and its Party Group indicates that the NEA's room to maneuver will be constrained by the NDRC. Moreover, the NEA's independence is limited by the fact that key tools it needs to effectively manage the energy sector are in the hands of the NDRC.

Tools: Arguably the greatest constraint on the NEA's ability to fulfill its mandate is the fact that it does not possess the authority to set energy prices, which remain the purview of the NDRC's Pricing Department. The issue of who would end up with the power to determine energy prices was, in the words of Zhang Guobao, a subject of “constant dispute” during the bureaucratic reorganization. Although the NEA can make suggestions about energy price adjustments and should be consulted by the NDRC on any proposed changes, the shots are still being called by the NDRC (and ultimately the State Council, whose approval is needed for any major energy price changes). The fact that the NDRC retained control over energy prices is hardly surprising. The power to set prices is one of the NDRC's main instruments of macroeconomic control, which it understandably is reluctant to relinquish, especially to a subordinate

component which might be tempted to adjust energy prices in ways that run counter to broader NDRC objectives, such as combating inflation.

The NEA's lack of authority over energy prices makes its task of mitigating the current electricity shortages, which are partly rooted in price controls, especially challenging. Electricity prices are set by the state, while coal prices are determined by the market. The failure of electricity price increases to keep pace with soaring coal prices has contributed to the national power shortage because some electricity producers can't afford coal while others are unwilling to operate at a loss. With no pricing power, the NEA has little choice but to resort to administrative measures to achieve an objective that would be more effectively realized by raising and ultimately liberalizing electricity prices.

Personnel: The central government is still managing the energy sector with a skeleton crew. Contrary to rumors that the NEA's staff would be as large as 200, it ended up with just 112 people. This staff quota is certainly larger than that of the NDRC Energy Bureau, which had only 50 people, but it does not represent a major increase in the number of people directly involved in managing the energy sector at the national level. Moreover, some Chinese media reports have speculated that the NEA may face the problem of "too many generals and not enough soldiers" because at least half of the 112 slots at the NEA are for positions at the deputy department head level and above. The Party organ that determines the functions, internal structure and staff quotas for government institutions probably resisted calls for more personnel out of concern that if it approved a large staff for the NEA, then other government bodies would also press for more manpower at a time when the State Council is trying to streamline the bureaucracy.

In sum, China's new energy administration is unlikely to substantially improve energy governance. The organizational changes are tantamount to rearranging deck chairs on the Titanic. Although the energy bureaucracy looks a bit different, its limited capacities remain largely unchanged. Consequently, we can expect to see a continuation of business as usual: conflicts of interest will impede decision-making; the energy companies will remain important drivers of projects and policies; state-set energy prices will continue to contribute to periodic domestic energy supply shortfalls; and the NEA, with no authority to adjust energy prices, probably will resort to "second best" administrative measures to try to eradicate those shortages.

The modest tinkering to China's energy policymaking apparatus unveiled during the March 2008 NPC meeting reflects the conflicts of interest that stymie energy decision-making. Despite widespread recognition among Chinese officials and energy experts of the need to get the country's energy institutions "right" and the growing chorus of voices calling for the establishment of a Ministry of Energy (MOE), there are powerful ministerial and corporate interests that favor the status quo. The opposition to the creation of a MOE, a hot topic of debate in Chinese energy circles in recent years, was led by the NDRC and the state-owned energy companies. The mere specter of a MOE strikes fear in the heart of the NDRC because it would deprive the NDRC of a substantial portion of its portfolio and important tools of macroeconomic control. The NDRC's aversion is shared by the energy firms who are reluctant to have another political master and afraid that a MOE would limit their direct access to China's leadership. Such opposition helps explain why the government was unable to forge a consensus in favor of more robust changes to China's energy policymaking apparatus.

Implications for the United States

First, US policymakers should recognize that China's fractured energy policymaking apparatus may constrain the Chinese government from doing all that US policymakers would like it to do – and indeed what Chinese leaders themselves might want to do – to enhance international energy security and combat climate change. If China falls short of our expectations it may not reflect a conscious decision by Beijing to shirk its global responsibilities but rather the limited capacity of its national energy institutions to bend

other actors, notably firms and local governments, to its will.

Second, US institutions that plan to cooperate with China on energy issues have a plethora of partners to choose from. While the NDRC is often the partner of choice because of its authority and convening power, engagement with other actors can also be productive. Local governments or corporations may be more appropriate partners for some issues.

Third, US policymakers should recognize that the “China, Inc.” model often used to describe the foreign investments of China’s national oil companies is less coherent than is often assumed. Beijing has certainly encouraged the companies to go abroad, provided them with varying levels of diplomatic and financial support and occasionally intervened in their decision-making. However, when it comes to choosing where to invest, the companies are almost always in the driver’s seat.

HEARING COCHAIR REINSCH: Thank you. Thank you. You get extra points for finishing on time.

Mr. Cunningham.

**STATEMENT OF EDWARD A. CUNNINGHAM, IV
PH.D. CANDIDATE, MASSACHUSETTS INSTITUTE OF
TECHNOLOGY, CAMBRIDGE, MASSACHUSETTS**

MR. CUNNINGHAM: I'd also like to thank the Commission and the chairman for the opportunity to share my views this morning. I've been engaged in the study of China's energy system for about a dozen years, and I look forward to our discussion regarding a topic of such importance to the U.S. and to the global environment.

As the title of this panel indicates, my goal this morning is to focus less on statistics and more on the structure and reform of China's energy regulatory apparatus over time, and in addition, as today's hearing is focused on the relationship between China's energy policy and the environment, in particular, I will tend to provide examples from China's coal and electric power industries rather than its oil industry.

My comments will focus on three major points: the first relating to failure of reform; the second, to success of reform; and the third, to resulting challenges for reform.

First, China's recent drive to establish a National Energy Administration, is but one of many attempts at centralization over the past several decades. This national energy administration if and when it again emerges, will not resolve in the near to medium term the underlying infrastructure that has historically blocked meaningful energy reform.

Second, successful measures by the central government to loosen upstream energy prices and to reform state-owned enterprises have created newly empowered corporate actors that are increasingly

determining the technology and fuel driving China's energy growth. Moreover, the pressures facing these corporations are increasingly commercial in nature.

Third, these price and corporate reforms enable the streamlining of industrial ministries and encourage rapid economic growth, resulting in a weakening of traditional levers of top-down vertical authority by the central government. So these points are all echoing concepts that we heard this morning and also what Dr. Downs has mentioned.

These levers include direct financing, permit and construction approval, penalty enforcement and controlled upstream energy pricing.

In short, the majority of evidence reveals a national energy system governed by a fractured central state that is attempting two things: one, to manage rising disparities between a liberalizing upstream and controlled downstream energy market; and two, to regulate powerful local governments and corporations that are rapidly transforming China's state-owned assets.

China's energy governance is driven by a tension between the need to strengthen state dominance in a strategic sector and the need to support globally competitive corporations in an increasingly market-guided economy.

Energy policy in China therefore is really a battleground of negotiation at this point among powerful actors with very conflicting interests that are evident at all levels.

That battle of interests among local governments and between local and central government are fairly understandable as local economic growth imperatives are by nature competitive and may undermine central mandates to provide public goods.

However, that conflict is equally apparent within the central government itself. As one example, the powerful Pricing Bureau of the NDRC, the National Development and Reform Commission, seeks to strengthen competition by maintaining high numbers of energy firms in industries as diverse as power generation, coal extraction, coal gasification, and more recently nuclear component manufacturing.

In contrast, other central agencies seek to consolidate the number of energy firms operating in China. The State-Owned Assets Supervision and Administration Commission, SASAC, the nominal owner of core energy assets in China, as well as the Ministry of Finance, together aim to maximize returns on assets held by the central government and are encouraging scale and therefore encouraging mergers within the energy sector.

These tensions are not new. Conflicting interests have fueled an alphabet soup of line ministries built and destroyed and national

energy institutions effectively still-born throughout the past four decades.

Significantly, Beijing's first attempt to centralize energy oversight proved short-lived. Between 1953 and 1955, the Ministry of Fossil Fuels combined coal, electricity, and petroleum into one organ.

Fifty years of reform has not resulted in any lasting structure. By 1998, China's energy policy apparatus had undergone four periods of decentralization and recentralization.

While several waves of regulatory separation and merger affected the energy industry throughout the 1970s, the 1980s ushered in the process of removing government from enterprise work in the energy sector and from the business of controlling energy production.

Decentralization and partial deregulation led to the creation of a new class of legally independent corporate actors able to pursue a range of choices regarding energy provision. These corporations, particularly in environmentally sensitive industries such as coal and electric power, are now rapidly proliferating in China, owned by a host of local public and private enterprises. They are also building capacity at a frenzied pace.

For example, upstream in the coal industry, de facto private mines contribute over a third of national output. Downstream, over half of China's installed electric power is produced by hundreds of firms owned by provincial investment corporation, private groups and some foreign players as well.

Commercial pressures facing these firms are considerable, as was mentioned briefly this morning. By the late 1990s and early 2000s, successful central government policies allowing significant price increases in the energy upstream have heightened such pressures. While price volatility continues to be controlled, relative energy prices upstream have largely converged with and in some cases exceeded prices in the developed world.

Delivered coal prices to Chinese power plants are at times more than double the national average in the United States today.

Chinese contracted gas prices are largely setting the benchmark in the region, and local electric power rates for Chinese industry are often one to two cents higher per kilowatt-hour than in the United States.

The mobilization of these corporate resources coincide with a massive reduction in the central state's capacity to monitor their activities. Central government personnel, dedicated funding and institutional structure contracted considerably in the late 1990s. In 1998, the 40 ministries overseeing China's growth were reduced to 29 with many employers transferred to state-owned enterprises, research institutes, quasi-private firms or simply laid off. Those reforms

affected 30,000 central government personnel and laid off more than four million government employees.

At most, a mere 750 individuals within the central government now bear some responsibility that is related to energy policy. Most Chinese experts estimate the real number to range between 240 and 320. As many observers have noted, in contrast, the U.S. EIA alone, an organization dedicated to data analysis and gathering, employs over 600 people.

Beijing has not failed to notice that disparity between state resources and corporate activity, and in recognition of the fractured nature of this governance, the National Energy Leadership Group was established in 2005 to bring together the heads of 13 ministries to lay out a long-term vision. This commission will enjoy ministerial rank remain separate from the National Energy Bureau under the NDRC will be charged with implementation of energy policy as formulated by the Administration.

However, the draft energy law does not detail authority delegation and continued uncertainty is highlighted by the fact that no vice premier has been named to lead the commission.

Yet, this newly established commission, often cited as an indication of regulatory consolidation, is confronted by the disparate interests and overlapping authorities that we've seen plague China historically, and importantly, as well as the new interests of new entities.

At the central level, SASAC claims nominal ownership rights over and bears responsibility for the financial performance, merger, management and disposal of core state-owned assets. SASAC also in most cases now drafts personnel appointments of corporation executives with a vice ministerial rank and below.

Executives with ministerial rank are appointed directly by another entity, the Central Organization Department of the Chinese Communist Party.

The environmental agency, now with enhanced rank as the Ministry of Environmental Protection, enforces environmental standards and compliance. Resource extraction rights, operation management, conflict resolution, all are largely shared by the Ministry of Land and Resources, the Ministry of Water Resources and the State Administration of Coal Mine Safety.

Energy policy research and formulation falls under the auspices of the new National Energy Administration. And of course, energy pricing authority remains within the Pricing Bureau.

Splintered governance will continue. Most evidence points to the fact that the NDRC will not be ceding its pricing powers any time soon, that SASAC's new established authority to demand dividends

from energy corporations will increase its personnel appointment powers, and that the environmental enforcement will, of course, remain within the new strengthened Ministry of Environment.

Finally, my submitted remarks detail recommendations for U.S. policy, but most importantly, in the long-term, it is clear the U.S. has not devoted enough human and financial resources to understanding China's market and its governance system.

By the estimates of some in DOE most familiar with China, the DOE has itself, at the most, only ten full-time employees on the ground that focus on China in some manner. Similar individuals within the State Department estimate the corresponding number of full-time employees to be about eight. An audit of U.S. capacity in this regard would be a major step forward, particularly with an additional focus on regional and ministerial, particularly the vice ministerial level, partnerships. I think we heard a bit about that this morning from Mr. Fulton.

In conclusion, as China's growth begins to transform international markets as vital as energy, understanding these actors shaping China's energy sector has never been more important. Encouraging state regulatory capacity in China rather than fearing it will be paramount. And in the end, while accusations of neo-mercantilism and an overbearing state tend to have dominated our discussions in the U.S., it is Beijing's lack of authority in this critical sector that should be most concerning.

Thank you.

[The statement follows:]

**Prepared Statement of Edward A. Cunningham, IV
Ph.D. Candidate, Massachusetts Institute of Technology,
Cambridge, Massachusetts**

Wednesday, August 13, 2008

Edward A. Cunningham, IV

PhD Candidate, Massachusetts Institute of Technology

Testimony before the U.S.-China Economic and Security Review Commission

Hearing: *China's Energy Policies and Environmental Impacts*

Panel: China's Energy Policymaking Structure and Reforms

I would like to begin by thanking the Commission for the opportunity to share my views. I have been engaged in the study of China's energy system for a dozen years and I look forward to our discussion regarding a topic of such importance to the US and to the global environment. As the title of this panel indicates, my goal this morning is to focus less on statistics and more on the structure and reform of China's energy regulatory apparatus over time. In addition, as today's hearing is focused on the relationship between China's energy policy and the environment, I will tend to privilege examples from China's coal and electric power industries and defer in-depth discussion of China's oil industry to my colleagues.

My comments will focus on three major points – the first relating to failure of reform, the second to success of reform, and the third to resulting challenges for reform. First, China's recent drive to establish a National Energy Commission is but one of many attempts at centralization over the past several decades. Central government entities have vague mandates and disparate interests that result in still-born energy institutions. These institutions historically have failed to produce focused, systemic energy policy. A full energy ministry, if and when it again emerges, will not resolve such tensions in the near to medium term. Second, successful measures by the central government in introducing energy price liberalization and state-owned enterprise (SOE) reform have created newly empowered corporate actors that are increasingly determining the speed and form of China's energy infrastructure, as well as the technology and fuel driving such growth. Moreover, the pressures facing these corporations are increasingly commercial in nature. Third, these price and corporate reforms enabled the streamlining of industrial ministries and encouraged rapid economic growth, resulting in the weakening of traditional levers of "top-down" vertical authority by the central government such as direct financing, permit and construction approval, penalty enforcement, and upstream controlled pricing.

In short, the majority of evidence reveals a national energy system characterized by a fractured central state attempting to: i) mitigate rising disparities between a liberalizing upstream energy market and a controlled downstream energy market; and ii) regulate powerful local governments and corporations that are rapidly transforming state owned energy assets and financing major energy infrastructure decisions. The dilution of command and control has not been lost on the leadership in Beijing. Certain central government agencies have now refocused their efforts on traditional command tools in an effort to maintain some degree of guidance: namely controlled downstream energy prices and senior personnel appointments in industry. China's energy governance, therefore, is driven by a tension between the need to strengthen state dominance in a strategic sector and the need to support globally competitive corporate actors in an increasingly market-guided economy.

Competing Interests, Splintered Institutions

The work of identifying stakeholders has become increasingly difficult in recent years. Energy policy in China today is a battleground of negotiation among powerful actors with conflicting interests that are evident at all levels of analysis.

At the highest level, within the central government itself, the powerful pricing bureau of the National Development and Reform Commission (NDRC) and weaker, emerging regulatory bodies such as the State Electricity Regulatory Commission (SERC) seek to strengthen competition by maintaining higher numbers of energy firms in industries as diverse as power generation, coal extraction, coal gasification, nuclear component manufacturing, and certain downstream activities in the petroleum industry. China's major commercial banks often support such diversification, as it enables the banks to widen their portfolio of risk and wean themselves from a dependence on customers that are "too big to fail". In contrast, central agencies such as the State-owned Assets Supervision and Administration Commission (SASAC) – the nominal owner of core assets in China's economy, including energy assets – and the Ministry of Finance (MoF) together aim to maximize returns on assets owned by the central government by encouraging scale and the consolidation of existing firms.

At the middle level of analysis, conflicts of interest between central and local governments are perhaps more obvious. Sub-national government leaders, eager to maintain or increase economic output and thus advance their political careers, often aid in the financing and underreporting of electric power generation capacity, local coal extraction, integrated railway projects that promote local monopoly, and other forms of energy production expressly forbidden by the central government. While environmental protection is now included in the metric by which promotion is determined, economic growth and social stability far outweigh "green" contributions.

Lastly, at the lowest level of analysis, interests between local government actors diverge as well. Energy investment at this level is perhaps best characterized as "tribal", as many localities remain unwilling to depend on other localities for sources of energy. Provincial and municipal governments, urged on by China's three major oil corporations, are moving ahead to build local natural gas networks in the southern and eastern coasts despite considerable price shock by the NDRC and an historical unwillingness to approve projects at the global price. Major regional large scale projects like the Ertan hydropower station begin life producing under capacity as local governments continue to build and protect locally owned plants to support higher tax revenue, thus dampening demand and lowering efficiency.

In sum, these conflicting interests at all three levels have fueled an institutional evolution of energy oversight that has become an alphabet soup of line ministries built and destroyed and supra-institutions effectively still-born.

Competing interests have resulted in an energy institutional landscape characterized by

overlapping jurisdictions and inconsistent waves of centralization and decentralization. Significantly, Beijing's first attempt to centralize energy oversight proved short-lived. Between 1953 and 1955, the Ministry of Fossil Fuels combined the coal, electricity and petroleum industries into one organ for energy policymaking, allocation, and planning. Fifty years of reform has not resulted in a lasting structure. In 1980, a second attempt at comprehensive administrative centralization created the State Energy Commission, which never received any dedicated staff, an independent base of operations, or funding. Previously existing agencies continued to operate as before, and the Commission dissolved two years later amid a proven inability to obtain the capital necessary to support sufficient energy for the burgeoning national economy. A subsequent Energy Ministry lasted a mere five years, between 1988 and 1993. By 1998, China's energy policy structure had undergone four periods of decentralization and recentralization. In March, 2003, the State Economic Trade Commission was abolished and the majority of its functions transferred to the newly renamed NDRC. Most critical economic regulatory powers, it was then argued, were to be in the hands of this one supra-ministry, yet regulators were overseeing an energy economy more diverse and with a wider set of stakeholders than ever before.¹

Rise of the Corporation

While several waves of separation and merger affected the energy sector throughout the 1970s, the 1980s ushered in the process of removing government from enterprise work and from the business of controlling energy production. Decentralization and partial deregulation led to the creation of a new class of legally independent corporate actors able to pursue a range of choices regarding energy provision. The energy corporation initially served as a vehicle to resolve increasingly blurred rights and claims between central and local government control over energy assets, and also to attract foreign technology and financing to develop domestic resources under tight credit market conditions. Firms such as China Huaneng Group (CHG) and China National Offshore Oil Corporation (CNOOC) were formed to import foreign technology, increase energy investment, and promote international trade. In the nuclear industry, the Ministry of Nuclear Industry transferred its formal administrative capacity to the new China National Nuclear Industry Corporation. Energy corporations – particularly in the environmentally sensitive industries such as coal and electric power – are now rapidly proliferating in China, owned by a host of local public and private entities, and building capacity at a frenzied pace. For example, upstream in the electric power industry, *de facto* private

¹ For a summary of the argument in this testimony please refer to Cunningham, "China's Energy Governance: Perception and Reality", available at: <http://web.mit.edu/newsoffice/2007/china-energy-0625.html>. For a detailed analysis of the evolution of China's energy governance, impact on corporate strategy and resulting public policy challenges, please refer to Cunningham, "New Institutions, New Actors, but Old Tools? Energy Governance in China", Chapter 2, dissertation manuscript.

mines contribute over one-third of total coal production. National production has doubled between 2000 and 2007 to stand at over 2.5 billion tonnes – well over twice the output of the US and over 41 percent of global production. Downstream, China's electric power generation monopoly has been disbanded and carved into five large firms. Perhaps more importantly, over half of China's installed electric power is provided by hundreds of firms owned by provincial investment corporations, private groups, and several foreign players. Installed capacity has also more than doubled from 2000 to 2007 – the 102 GW China installed in 2006 was nearly equal to world installed capacity growth in 2004.

By the late 1990s and early 2000s, successful central government policies supporting significant price increases in the energy upstream had heightened commercial pressures for Chinese energy firms. Prices for coal and, more recently, natural gas contracts, have been most directly influenced. While price *volatility* continues to be controlled, relative energy prices upstream and downstream have largely converged with – and at times exceeded – prices in the developed world. Delivered coal prices to Chinese power plants at times are more than double the national average in the US, Chinese contracted natural gas prices are largely setting the benchmark in the region, and local electric power rates for Chinese industry are often one to two cents higher per kilowatt-hour than in the US. In a survey of the Chinese electric power industry that our MIT China Energy Group just completed, over half the plants in the survey sample (44 of 85 plants) responded to questions about coal allocation and pricing. Of the plants that responded, 55 percent (24 plants) reported that none of their fuel supply was subsidized, while 45 percent (20 plants) reported that at least some fraction of their supply came through state channels at subsidized prices. Interestingly, only six plants reported receiving all of their fuel through subsidized channels. For many of the other plants accessing subsidized coal, these lower-priced fuels accounted for only a fraction – and sometimes a very small fraction – of the plant's total fuel supply. This important shift in pricing policy is often overlooked by observers and has begun to have far reaching effects. As one example, electric power generating firms have, in recent years, invested in larger generating units and advanced boiler and generator technologies that have increased efficiencies considerably.²

Only crude and retail oil product prices remain below world prices and continue to require considerable transfer payments from the central government to the oil majors as imported crude and product are increasingly allowed to enter the domestic market. Such receipts are particularly large for Sinopec, which suffers from a historical asset bias towards refining activities.

² For a more quantitative analysis of technology, fuel and other aspects of China's electric power industry, please refer to Edward Steinfeld, Richard Lester, Edward Cunningham, "Greener Plants, Grayer Skies: A Report from the Front Lines of China's Energy Sector", available at the MIT Industrial Performance Center website: <http://web.mit.edu/ipc/publications/pdf/08-003.pdf>.

The Wizard, Revealed

Finally, the mobilization of corporate resources coincided with a massive reduction in the state's capacity to monitor the activities of these new actors. Central government personnel, dedicated funding, and institutional structure contracted considerably during the critical industrial reform period of the late 1990s. In 1998, the 40 ministries overseeing China's growth were reduced to 29, with many employees transferred to SOEs, research institutes, quasi-private firms, or simply laid off. The reforms affected over 30,000 central government personnel and in total laid off more than 4 million government employees. Moreover, the state did not redeploy its resources to guide energy investments at the firm level.

At most, a mere 750 individuals within the central government bear responsibilities that in some way relate to energy policy. Most Chinese experts estimate the real number to range between 240 and 320, even after the most recent raft of reforms. The vast majority of these people devote only a small fraction of their attention to energy issues. As many observers have noted, in contrast, the US Energy Information Agency (EIA) alone – an organization dedicated mainly to data gathering, analysis, and education – employs over 600 people. The US Department of Energy (DOE) employs nearly 15,000. While one may debate how many employees are involved in part-time energy work at these institutions, the disparity in personnel is striking, particularly in the context of the processes of decentralization, ownership diversification, corporatization, and rapid capacity expansion that characterize China's current energy market.

Nowhere are such challenges of decentralization more evident than in China's electric power industry. The great expansion of electric power that began in the mid 1980s, aided by the corporate reforms mentioned previously, also heralded the relative decline of central funding for such expansion. For example, as St. Francis Xavier University professor Xu Yichong has noted, between the years 1980 and 1994, the average annual growth rates of both power generation and installed capacity crept above eight percent; during roughly the same period the share of central government investment in total power sector investment declined from 91 percent to 30 percent. The central government provided nearly half of power industry investment during 1985-1990. In the following five years, only one-third of investment funds flowed from the central government. In the same period, local sources accounted for 42.9 percent of the total. Financial levers of central government influence have clearly declined.

Construction oversight and environmental compliance have also suffered dramatic setbacks. Illegal power generation capacity has become a major concern for regulators, particularly those responsible for grid safety, environmental protection, and market

supervision. While a myriad of pollutants simply lack reduction targets and are ignored, SO₂ challenges have proven particularly troublesome for regulators. A recent World Bank report outlined how, during the 10th Five Year Plan (2001-5) the central government failed to meet 10 of 13 core targets for air and water pollution. By 2005 total sulfur emissions were over 40 percent higher than the standard set and emissions from industry were up by 50 percent. Despite the passage in 2005 of the National Renewable Energy Law and the high profile shuttering of certain plants by the State Environmental Protection Agency (SEPA), results have been disappointing. In 2006, only four out of China's 31 provincial-level jurisdictions met their annual two percent reduction targets in SO₂. Despite these policies, national SO₂ emissions increased by 463,000 metric tons. While the percentage of flue-gas desulfurization (FGD) equipment being installed in new plants, or retrofitted in older plants, is rapidly increasing, such actions are clearly failing to affect substantially core emissions. The inefficacy of such a policy has less to do with installation and more to do with the fact that while plants may install FGD solutions, they rarely operate the equipment – largely for economic reasons.

Although the cost of running such equipment has been reduced through gains in efficiency and innovation, the reality is that plants are acting rationally given the fractured and incomplete regulatory and financial system created by the reforms previously discussed. On the one hand, decentralized, subsidized capital, in the form of bank loans or provincial investment companies, greatly aids the fixed cost capital purchase of environmental equipment. This explains why plants are so willing to install them and pacify the local environmental protection bureau. On the other hand, direct financing by the central government has essentially ended. Thus, the operation of such equipment has a direct negative impact on the plant's operating costs and, critically, retained earnings. Parasitic power loss is in the range of one to two percent, and operating cost is often in excess of the US\$ 0.0019/kWh (RMB 0.015/kWh) subsidy that FGD-compliant plants receive in the price paid to them by the grid.

Beijing has not failed to notice the disparity between state resources and corporate activity.

In recognition of the fractured nature of such governance, the National Energy Leading Group (NELG) was established in 2005 to bring together the heads of 13 ministries to lay out a long term vision for creating what has now been announced as the National Energy Commission. This Commission will enjoy ministerial rank, remain separate from the National Energy Bureau under the NDRC, and be charged with implementation of energy policy as formulated by the Bureau. However, the cast of characters is ever evolving and a true division of responsibilities remains unclear. The draft Energy Law does not detail authority delegation and continued uncertainty is highlighted by the fact that no vice premier has been named to head the National Energy Commission. It has been stated that

the National Energy Bureau itself will oversee 9 departments with a staff size of 112 people. However various energy-related officials, such as NDRC vice minister Zhang Guobao, have stated that the Bureau “will not seek the right to set energy prices”.³

Finally, the newly established Commission, often cited as an indication of regulatory consolidation, is confronted by the disparate interests and overlapping authorities that have plagued China historically, as well as the interests of new entities. At the central level, SASAC claims nominal ownership rights over, and bears responsibility for, the financial performance, management and disposal of core state-owned assets (including approval rights regarding merger and acquisition approval and other energy asset restructuring). SASAC also, in most cases, drafts personnel appointments of energy corporation executives with a vice ministerial rank and below. Energy executives with ministerial rank are appointed directly by another entity – the Central Organization Department of the Chinese Communist Party (CCP). The environmental agency, now with enhanced ministerial rank as the Ministry of Environmental Protection, enforces environmental standards and compliance by energy firms, while resource extraction rights, operation management, and conflict resolution responsibilities are largely shared by the Ministry of Land and Resources, the Ministry of Water Resources, and the State Administration of Coal Mine Safety. Energy policy research and formulation falls under the auspices of the Energy Bureau – now renamed the National Energy Bureau – while energy pricing authority is exercised by the Pricing Bureau. Both bureaus are under the auspices of the strategic and long term economic planning agency, the NDRC. Most evidence points to the fact that the NDRC will not be ceding its pricing powers anytime soon, that SASAC’s newly established authority to demand dividends from energy corporations will increase its personnel appointment powers, and that environmental enforcement will of course remain in the strengthened environmental ministry.

Implications for the US

US actions designed to support productive energy, and, by definition, environmental change in China require an analytic shift along two dimensions. Effective *short term* action must target the incentives of current decision makers on the ground – the local government and corporate entities building China’s energy future. Effective *long term* actions must begin by recognizing the systemic weaknesses in central state governance and by working towards resolving them in concert with specific central actors.

In the short term, effective actions towards leveraging resources in the US and China will require changes at the sub-national and national levels. At the sub-national level, initiatives should facilitate a considerable ramp up of investment in the identification of

³ These departments include: General Integration, Strategic Planning, Policy, International Cooperation, Science and Technology Energy Savings, New Energy, Coal, Electric Power, Petroleum and Natural Gas.

and interaction with powerful local governments as well as the interests of the often quasi-public, quasi-private enterprises that make many of the ground level energy decisions in China. Precedents exist. AIRNow, a cross-agency US government program, has made progress in the measurement and dissemination of air pollution indices (API) through close collaboration with municipal governments such as Shanghai and the major electric power firms operating there. The benefits of such a shift in focus are clear from the experience of the US itself, as many of the most innovative and effective energy solutions have been pioneered at the state level.

As recent congressional hearings in the US have pointed out, large energy consumer states such as California have dedicated much effort to promote energy efficiency, conservation, and the development of renewable energy technologies such as solar power and advanced energy storage technologies. These states have also linked such advances to the training of provincial regulators in China. In 2005 the state government of California joined forces with the Jiangsu provincial government to pursue such avenues of cooperation. Large energy producing states such as Montana and West Virginia have focused efforts on advanced clean coal technology partnerships with specific corporations such as Shenhua Ltd, China's largest coal producer. States should be encouraged to follow the lead of their business delegation counterparts and link directly with provincial and other local governments in China. Similarly, federal resources could be focused on enabling the many innovative small and medium sized energy enterprises in the US to link with counterparts in China and encourage reverse trade missions back to the US.

In the long term and at the national level, experience suggests that in the absence of a coherent national energy ministry in China, strategic partnerships with specific ministries yield critical results. As an example, building related energy consumption accounts for over one-quarter of China's national energy consumption. The Lawrence Berkeley National Laboratory (LBNL) has achieved important and laudable milestones through a long history of interaction with China, creating environmental building code standards along with China's Ministry of Construction. Such partnerships require increased support and should become the rule, not the exception.

Equally important in the long term, it is clear that the US has not devoted enough human and financial resources to understanding China's energy market and its impact on the global energy market. While the disparity in regulatory capacity between China and the US in the energy sector is increasingly appreciated by observers, what is noted far less frequently is the fact that few of these US resources are dedicated to the study of China's energy system itself. By the estimates of some in the DOE most familiar with China, the

DOE has, at the most, only 10 full time employees on the ground that focus on China in some manner. Similar individuals within the State Department estimate the corresponding number of full time employees to be about eight. International Energy Agency (IEA) membership for China would greatly enhance regional and global energy emergency preparedness and afford greater transparency and understanding relating to China's energy decisions and statistics. Yet the IEA employs one – albeit quite capable – China specialist. I gather that at least a deputy position has now been created. US political resources could be utilized to strengthen the capacity and impact of this important group in an effort to make a clear argument for why membership is in China's national interest and why continued exchange training between statistical arms of the IEA and NDRC are so critical to both sides.

In conclusion, as China's growth begins to transform international markets as vital as energy, understanding the structure governing energy policy and markets in China has never been more important. First, effective US policy towards China requires identifying and interacting with powerful sub-national governments, not focusing exclusively on policy makers in Beijing. Second, strategic policy thinking will require serious consideration of the interests of the quasi-public, quasi-private enterprises SOEs that make many of the ground level decisions in energy and other key sectors. Third, encouraging state regulatory capacity in China, rather than fearing and demonizing it, will prove paramount. While accusations of neo-mercantilism and an over-bearing state tend to have dominated US policy discussions of Chinese energy policy in recent years, it is Beijing's lack of authority in this critical sector that should be most concerning to careful observers of China's long term governance.

Panel II: Discussion, Questions and Answers

HEARING COCHAIR REINSCH: Thank you.

Commissioner Fiedler.

COMMISSIONER FIEDLER: Dr. Downs, I'd like to get you to expand more specifically on oil company behavior and inability of the government to control it, you make reference to overseas investment decisions being made by the companies, not essentially sanctioned by the government. I presume, since they're oil companies, we're talking about Africa, and if we are, could you name me a country where they invested that the government didn't want them to invest in?

I would like to make an observation before you answer the

question, and that is you testified that the companies act on their own.

Correct me if I'm wrong, they need someone in the government to protect them so that when they make a decision, there's someone in some part of the government or the party that is providing them some political protection. Otherwise, we're talking about the companies being stronger than the party, which I have very severe difficulties in believing.

So that they're really not actors, I mean individual independent actors, but they have support somewhere within the government.

DR. DOWNS: Those are very good questions. There are a couple of points I'd like to make in response. I'm going to start with your last observation about the companies' relations with the Chinese Party State. I think you are correct to point out that if China's top leaders don't want a Chinese oil company to do something, I imagine that they could order that company not to do it.

For example, if President Hu Jintao decided that he no longer wanted China National Petroleum Corporation to expand its operations in Sudan and gave that directive, then it would be followed.

I think that's an important point to make also about energy policymaking in general. The remarks that I made today were focusing on what happens at the working level, what happens with the people that are involved in coordinating interests, in figuring out what they're going to do, and trying to implement it. But I think that the top leaders certainly do have the capacity to intervene, both in terms of company investment decisions and also in terms of breaking stalemates between different actors who are trying to coordinate interests.

So I think that is an important point that you make, and I would agree with you that if the senior leadership does not want a company to do something, that it can give that order, and I imagine it would be followed because, as Edward had mentioned in his remarks, that the top leaders of China's energy companies are appointed by the Party's Organization Department and the Ministry of Personnel, and if they want to move up in party ranks, if they want to move on into a position in the Chinese government, they need to balance their corporate interests with serving the interests of the Party State, so they basically need to do a good job running their companies, but they also have to make sure that while running their companies, they don't run afoul of Party State interests.

In terms of decision-making with respect to foreign investments, the point that I was trying to make is that there's no highly coordinated government company strategy for foreign investments, that the companies are not mere puppets of the Chinese government. You don't have the Chinese government saying, hey, I think that Block 32 in Angola is looking especially attractive, why don't you go there?

However, there are a mix of national and corporate motives that are driving these investments. Certainly at the national level, the government is interested in having the companies go abroad, not only to help the companies access oil for Chinese consumers, but also the government has an interest in creating internationally competitive companies.

At the company level, as Edward pointed out, these firms are very much driven by commercial interests. They're oil companies. If you want to stay in the oil business, you need to grow reserves and profits. Certainly investing in already discovered oil fields abroad is one way to do that.

To illustrate the point that I'm making, you asked about Africa. I guess one example that illustrates this interplay between government and company relations would be the case of Angola.

As many of you may know, the China Export Import Bank has made substantial loans to the Angolan government. When the first loan was announced back in 2004, that helped the Chinese oil company, Sinopec, acquire 50 percent stake in Block 18 off shore Angola. BP is the operator of the project and they have the other 50 percent stake. The stake that Sinopec bought had been held by Royal Dutch Shell. Royal Dutch Shell wanted to sell that to an Indian company, but then Sonangol--after the announcement of the Chinese loan came, Sonangol intervened and said, no, we have preemptive rights and we want to sell this to the Chinese instead.

I think that within India, within China, within other capital cities around the world, there's definitely a sense that the Chinese loan helped, you know, was aimed at helping Chinese oil companies establish a footprint in Angola.

However, it's important to note that I don't think the government had Sinopec in mind for the company that was going to go into Angola.

I've heard through interviews in Beijing that the Chinese government was actually quite shocked when Sinopec went in, and they thought another company might go in.

So here's a case where the government has sort of opened the door, they've made these loans, but in terms of who went in and snagged the block, it was Sinopec that moved first.

COMMISSIONER FIEDLER: But what you are describing is they thought another Chinese company would be--

DR. DOWNS: Yes, I think it was clear--

COMMISSIONER FIEDLER: So it wasn't an issue about going into Angola?

DR. DOWNS: Yes. Certainly at the national level, I think there was a sense that there are a lot of investment opportunities in Angola.

We'd like for our companies to be there; we're going to do what we

can to open that door.

But in terms of which company went after which project, that was decided at the corporate level.

HEARING COCHAIR REINSCH: Mr. Cunningham, you don't have a comment?

MR. CUNNINGHAM: I would just quickly jump in to say that if you want an example of a firm as first mover, when the firm moves without the state's backing, I think you look at what CNOOC did with Unocal.

I think if you sit down and really pick that apart, what you'll find is that you had a smaller firm, a newer firm with a new head, that went ahead and was engaging in a transaction that other larger firms had decided to not engage in, and did that with zero, zero passive or proactive support from the central state.

So I think it does happen. And so I think what Dr. Downs said is exactly right--that in one sense you have an increasing disconnect between the knowledge base, the financial mechanisms and resources and, also the networks of these firms compared to the central state. That's my only addition.

COMMISSIONER FIEDLER: Let me, just one quick point that you made. On the Unocal deal question, the real question on a policy basis is did the Chinese government, I mean does the Chinese government now enforce predecision-making on what are clearly sensitive transactions?

In other words, did they learn from that experience to exercise control over their companies? Yes or no?

MR. CUNNINGHAM: Is this to me?

COMMISSIONER FIEDLER: Yes.

MR. CUNNINGHAM: So I think now the situation is that that was sort of one of those trial balloon that was sent up by a firm, definitely recognized by the central government. They themselves didn't move to squash it. I think a lot of it happened even within the board, and within the firm, but I think that there has been, yes, there's been definite recognition, that that's why you see a lot of this reorganization happening. We now are in a situation where China is developing -- because of successful policy -- very competitive, very active firms that are doing a myriad of activities that we are simply behind the ball on. Now there's that recognition. Whether they can actually attempt to realize those regulatory goals is another question.

HEARING COCHAIR REINSCH: Okay. Moving right along, Commissioner Shea.

COMMISSIONER SHEA: I was going to ask the same question that Jeff asked, the relationship between the Chinese national energy companies and the state government, but is there a formal process

now?

I understand your point, Dr. Downs, that if Hu Jintao tells Sinopec that they can't make an investment, the leadership of that company is going to probably go along, but the question is does the central government, the top leadership of the government, of the party, have knowledge about these acquisitions or potential acquisitions in advance?

Is there formal notification or decision-making process? And I think this is the follow-up question that Jeff asked. Maybe you could answer that.

DR. DOWNS: Sure. For foreign energy investments, anything above 30 million and below \$200 million, and this is a very small amount of money in the oil business, needs to be approved by the National Development and Reform Commission. Investments over \$200 million also need approval from the State Council.

I think in the case of, for example, CNOOC's bid for Unocal, I mean obviously the State Council didn't stop CNOOC from making that bid, but I would agree with what Mr. Cunningham said, that CNOOC had the acquiescence but not necessarily the active support of the central government to undertake that investment.

I've also heard anecdotally that there are cases where the companies might go and make an investment first and then come back and inform the government about it later.

COMMISSIONER SHEA: An overseas investment?

DR. DOWNS: Yes, an overseas investment.

COMMISSIONER SHEA: Such as? Just anecdotal but with no specificity.

DR. DOWNS: Yes, I don't have a specific example to give you, but based on interviews that I've done, I've heard that sometimes that happens. So take that as you will.

COMMISSIONER SHEA: Thank you.

HEARING COCHAIR REINSCH: Commissioner Wortzel.

CHAIRMAN WORTZEL: I want to thank both of you for being here today. It looks like a lot of our questions are approaching the same point about the governance system in China.

Dr. Downs, in your testimony, you talked about powerful stakeholders in the Chinese energy system that just sort of operate.

Mr. Cunningham, you talked about powerful local governments that seem to ignore the center.

Now, if I could paraphrase a witness at an earlier hearing here on proliferation, he said that powerful political actors with strong party influence can circumvent government regulations or will with impunity. Is that the kind of network inside the party extra-governmental that we're talking about?

MR. CUNNINGHAM: Do you want to get that first?

DR. DOWNS: May I first add on a comment, a response, to the question that Mr. Shea had asked?

CHAIRMAN WORTZEL: Of course.

DR. DOWNS: One point that I wanted to make that I had forgotten to make in my previous response is that I think one sign that the government is still struggling to keep abreast of the activities of China's oil companies can be found both in the text of the draft energy law and in the official description of what it is that the new National Energy Administration is supposed to do.

If you look at both of these documents, they discuss trying to improve oversight of the foreign investments of China's national oil companies. In the case of the National Energy Administration, it sort of reemphasizes the role of approving investments. It also talks about a role for the NEA to play in negotiating with foreign governments.

It's a pretty vague term. I don't know if they're referring to transnational pipeline projects where there's an obvious role for the government or if they're talking about the government continuing to play a role in negotiating bilateral investment deals where government involvement can often be an asset rather than a liability, and that's going to depend on the country, of course.

Also if you look in the draft energy law, there is talk about wanting to coordinate the investments of the foreign oil companies, and so I think that for officials in China who are eager to have greater control over these companies, this is still something that they're struggling with.

COMMISSIONER FIEDLER: Now his question.

HEARING COCHAIR REINSCH: Are you going to answer Mr. Wortzel's other question or--

DR. DOWNS: The other question. I'm sorry. Could you refresh--that had to do with party power and with powerful actors in the system. Running roughshod over--

CHAIRMAN WORTZEL: Well, acting with impunity. Again, I'll repeat the other witness' statement: that powerful political actors with strong party influence can circumvent government regulations or will with impunity.

Is that the same sort of situation that you're both alluding to?

DR. DOWNS: Do you want to start?

MR. CUNNINGHAM: I'll start. Yes, I would have signaled to people to change the terms of debate. So in one sense, I think we've moved past that luckily, and I think debate has evolved and matured in the United States to the point where that is what we're discussing. We're not discussing a top-down state.

CHAIRMAN WORTZEL: Right.

MR. CUNNINGHAM: Because that's not the case. So with that said, though, those kind of general statements are always a bit difficult. It depends on what part of the value chain you're operating in in the energy system in China, I think.

So the reason that the average 17 percent increase in fuel pricing was so important--and I think it was an important signal--was because it shows you that the reason, that the subsidy has moved due to the independent actions of companies. To get back to Commissioner Mulloy's point about markets and how markets work in China in the energy sector: oil refining companies like Sinopec were continually in the red because the retail price was simply too low--the policy to increase the fuel retail price provides clear evidence that the central government recognizes the fact that these refiners were unwilling to refine product at such low domestic prices--and that's why you had miles long lines at petro stations.

That is a recognition of the power on the ground of these firms. Now, can they do it without impunity? No. Because in the end they need to be bailed out because they're fundamentally commercial actors and they can't operate within the still low pricing system without those subsidies.

So the central government raises retail prices and moves the subsidy. Instead of having the subsidy go directly to the refiner in a delayed fashion through eventual transfers, Beijing moves the subsidy in a sense by increasing the retail price. The consumer absorbs some of that original subsidy. The firms now have an increased incentive to refine, as prices are higher, and the central government will use other channels to supplement the remaining cost to the firm through readjustment of the rates at which Sinopec borrows, things of that sort.

That's a moving target, but I think that's an example of the fact that these firms are very much taking countercentral state actions, consistently, even within China--let alone outside China, in places like Sudan.

DR. DOWNS: I think that Edward has made a great point, and I elaborated in my prepared statement on those examples with firms both in the oil sector and in the electric power sector reducing output in part to put pressure on the central government to increase the state's products for both refined products and electricity prices.

In terms of powerful actors, and how I used that term in my prepared statement, I was focusing primarily on not just the energy companies, but also on other actors in the national level energy bureaucracy who have authority over various parts of the energy sector.

This would include ministries like the Ministry of Railways that has a loud voice in coal policy because it's responsible for transporting

a lot of the coal.

It's going to include the Ministry of Finance which is one of the actors that's a big stakeholder in this decades-long debate over the fuel tax, and also the energy companies, which we just talked about, which hold both ministerial and vice ministerial rank, and more importantly in the case of some companies, the heads of these companies are members of the Central Committee of the Chinese Communist Party.

So this gives them a lot of influence. There are other reasons as well, which I detailed in my statement about where the companies get their power from. So a lot of these actors often, in recent years have been more powerful than the locus of energy management in the government.

For example, if you look now at the National Energy Administration that was created and just went into operation last month that is headed by Zhang Guobao, who is a Vice Chairman of the National Development Reform Commission. He has ministerial rank, but he's not a member of the Central Committee of the Chinese Communist Party, whereas I suspect if you look at some of the ministers with whom he's coordinating, if you look at the heads of some of these companies, they are.

So in terms of backroom negotiations, in terms of perhaps more formal coordination, this is going to pose some difficulties for the National Energy Administration. I also think it's worth reiterating the point that Edward had been talking about earlier, that I think a lot of these problems with coordination, a lot of these problems that the government has with trying to get the companies to do what it wants, are partly rooted in price controls and are also partly rooted in sort of the increasing commercial drivers of these companies.

I think if energy prices were completely liberalized in China, then a lot of these issues might disappear. Then you wouldn't have the oil companies and electric power companies cutting back on production to pressure government to raise prices because those prices won't be set by the government; they'd be set by the market.

Similarly, if you look at the government's efforts, which have not been as successful as the government would like, in terms of trying to get the coal and power companies to come to an agreement on a price at which thermal coal can be sold to power generators, that's another problem that would abate if electricity prices were liberalized.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman.

I have first a question for Dr. Downs and then a question for Mr. Cunningham. Dr. Downs, on page two, paragraph two of your testimony, you again talk about these Chinese state-owned energy

companies, and the point you make is that the NEA doesn't control these companies, leading one to believe, well, maybe the government doesn't control them.

But you say these firms are powerful and relatively autonomous actors. Their influence over the development of China's energy sector is derived from their full and vice ministerial ranks.

What does that mean? What are full and vice ministerial ranks? Are they ranks in the government?

DR. DOWNS: These are ranks in the government. A lot of China's energy companies began life as ministries. For example, China National Petroleum Corporation, which was created in 1988, grew out of the Ministry of Petroleum, and there are other companies that also grew out of energy ministries. And when these ministries were being transformed into companies, the individuals fought very hard to make sure that their companies had ministerial rank--

COMMISSIONER MULLOY: Okay.

DR. DOWNS: --to allow them a voice, a strong voice in policy, in the policymaking process.

COMMISSIONER MULLOY: That's very helpful for us to understand. These are government companies essentially.

DR. DOWNS: They're state-owned companies.

COMMISSIONER MULLOY: Ministerial ranks. They're not like our companies, Exxon or something. The U.S. government doesn't tell them what to do. But these guys are part of the government essentially; right?

DR. DOWNS: Well, they're state-owned companies.

COMMISSIONER MULLOY: Now, then you say they also have membership of the top executives of these companies in the Central Committee of the Chinese Communist Party.

DR. DOWNS: Okay. Okay.

COMMISSIONER MULLOY: So they got government and then they got party rank.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: So they're pretty well plugged in.

DR. DOWNS: Yes.

COMMISSIONER MULLOY: Okay. Now, many people sometimes, three years ago, about this time of the year, there was a big discussion in this town about CNOOC buying Unocal.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: And a lot of people cite that as protectionism in the United States, that somehow there was some concern about that.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: Now, my understanding is that

originally the board of directors of CNOOC voted against that transaction, and then later the State Council got into it some way or another and then the transaction went forward.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: And there was concern in this country not that a Chinese company, private sector company, but the Chinese government was buying influence and impact in our private sector, whereas if Chevron wanted to buy CNOOC--

DR. DOWNS: Okay.

COMMISSIONER MULLOY: --that wouldn't be allowed; would it?

Okay. So I just want to get your under--I think it's very important for Americans to understand these Chinese state-owned companies aren't like we understand companies.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: These are arms of the government; it that your understanding?

DR. DOWNS: These are, as we just discussed, China's national oil companies are state-owned companies. The parent companies are wholly state-owned. And each one of these companies has at least one subsidiary that's listed on international stock markets.

In the case of CNOOC Ltd., it's a subsidiary of CNOOC Group. It's 70 percent owned by the parent. And that's listed on the Hong Kong and New York Stock Exchanges. As you mentioned, in terms of the CNOOC bid for Unocal, I'm not privy obviously to the interactions between the government and the companies, but I imagine this was an investment that the head of CNOOC, Fu Chengyu, ran up the chain, ran it by the NDRC, ran it up the State Council, presumably didn't get their opposition, got some level of acquiescence.

On the shareholder--

COMMISSIONER MULLOY: Wait a minute. I want to be very clear about this.

DR. DOWNS: Yes.

COMMISSIONER MULLOY: My understanding with CNOOC, Ltd., which was the company that's on the Hong Kong Stock Exchange--

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DR. DOWNS: Right.

COMMISSIONER MULLOY: --that was the actual bidder?

DR. DOWNS: That was the bidder.

COMMISSIONER MULLOY: Yes. That they have a board of directors--

DR. DOWNS: Correct.

COMMISSIONER MULLOY: --and that board of directors voted against that transaction. Is that your understanding?

DR. DOWNS: The board of directors delayed the transaction. My understanding is that the reason they--and this is part of the reason why I think that CNOOC lost the bid--is that what happened is that at the end of December 2004, Fu Chengyu started talking to Unocal. I think Unocal was interested in CNOOC's bid, but for some reason, my understanding is that Fu Chengyu did not make his intentions known to his board then, and sort of at the last minute, he showed up with this big document and said, hey, you know, I want to buy Unocal, please sign on the dotted line, and they said, hey, wait, this is a huge transaction, you're buying a company that's equal to half your market capitalization; we need time to stop and think about this; we need time to sit back and see is this a smart decision.

And by the time they finally gave CNOOC the green light, Chevron had moved in and Unocal had accepted an offer from Chevron, and that put CNOOC in the very difficult position of having to break up a corporate merger.

COMMISSIONER MULLOY: If I can just follow up one second? My further understanding on that, on that board of directors, that the former Swiss Ambassador to China was on that board.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: And he resigned in protest.

DR. DOWNS: Okay.

COMMISSIONER MULLOY: Because he said this company as no longer behaving in a commercial fashion.

DR. DOWNS: Okay. Okay.

COMMISSIONER MULLOY: Is that your understanding? Do either of you have that understanding of what happened here?

DR. DOWNS: You are correct in that he resigned. I think that there's probably going to be a gap between the stated reason and the real reason. I seem to recall something about health reasons. That might have been someone else.

But I do think one thing that's interesting about this example, about the conflicts between CNOOC's board and CNOOC executives in the case of the bid for Unocal, and in a number of other examples involving CNOOC is that these are cases where CNOOC, Ltd. has not been able to do everything that it's wanted to do, precisely because it is responsible to someone other than the Chinese government, because it is responsible to these minority shareholders, and there are a number of cases which I've detailed in some of my other work where CNOOC has wanted to do things, where CNOOC, Ltd. and CNOOC parent have wanted to do things and the board of directors has voted them down.

In the case of CNOOC, Ltd.'s bid for Unocal, the board of directors prevented CNOOC, Ltd. from moving as quickly as it wanted.

There was another case that actually stemmed directly from CNOOC,

Ltd.'s unhappy experience in bidding for Unocal, which is that right after CNOOC withdrew in August 2005, CNOOC executives came out and said, hey, you know, we've learned a number of things from our attempt to purchase Unocal and one of the things that we've learned is that we might want to change the way that we do business overseas.

Specifically, what I mean by that is that when CNOOC, Ltd. was trying to get listed on international stock exchanges, it secured from its parent company an agreement where the two of them would not compete in exploration and development, which meant that CNOOC parent could not engage in buying assets overseas, investing in exploration and production of oil overseas.

CNOOC, Ltd. did this because they thought that this would bolster its corporate governance credentials. CNOOC executives were very public about this. One of the things they said they learned from the failed bid for Unocal was that maybe we should copy the other Chinese oil companies, whose parent companies can invest overseas. Maybe that's a better model.

Maybe that's a better model because there is going to be more opaqueness. We don't have to deal with all these shareholders. We don't have to deal with shareholders leaking information about our negotiations to the press. Maybe that will make it easier to deploy the full, you know, to deploy resources of the Chinese state. And so they tried to get the shareholders, the minority shareholders to agree to this, that CNOOC parent could invest overseas. Shareholders said no.

In another case, there's another case involving financial transactions where they wanted CNOOC--

COMMISSIONER MULLOY: I think I better turn back my time to the chair.

DR. DOWNS: Okay.

HEARING COCHAIR REINSCH: Yes. That would be a good idea.

COMMISSIONER MULLOY: Thank you, Dr. Downs.

DR. DOWNS: You're welcome.

HEARING COCHAIR REINSCH: Thank you.

We have one remaining question from Commissioner Fiedler, unless somebody else--

COMMISSIONER MULLOY: I have another follow-up.

HEARING COCHAIR REINSCH: We have two remaining questions then, one from Mr. Fiedler and one from Mr. Mulloy. Mr. Fiedler.

COMMISSIONER FIEDLER: Continuing on this discussion, a factional dispute and corporate, alleged corporate decision-making in China. Can we turn to the power industry a second and certainly the Chinese domestic power industry, which raises capital on the

international markets, I believe the two largest companies are both run by children of Li Peng; right?

It strikes me as over time, I mean now we're talking about children of a serious person at various points in history. It's unclear how serious a person he is now in terms of wielding power behind the scenes.

But it doesn't appear as if their power has been diminished. Do you agree that much of their, that some of their activity is derived on the basis of the power of their personal relationships to their father?

MR. CUNNINGHAM: The largest group is Huaneng. That was run by Li Xiaopeng, Li Peng's son. He has now been moved to the vice governorship I believe of Shanxi Province because he's got, I think, higher goals than remaining in a state-owned enterprise. So he was the head.

Li Xiaopeng's sister, Li Xiaolin, is in command of CPI, China Power International, which is the smallest of the big five. So these are the princelings which we hear so much about. They represent one of the two factions within the Politburo that are vying for power in a way. So to say that they can, for example, the fact that Huaneng is leading GreenGen is an example I think of the importance of that firm in terms of state policies.

The fact that a lot of the assets, pretty productive assets, in the coastal area, is underneath Huaneng's authority, is another example of that.

But I still think, to go back to Commissioner Mulloy's point and sort of feed into what you're saying, the way you want to think about it is more as the state has assets are being used strategically by firms and is often reactive to what those firms are doing, and the firm does provide a considerable amount of knowledge in terms of these new GreenGen-type projects, those types of technology.

COMMISSIONER FIEDLER: The only point I think I'm trying to make actually, and you're making, is that it is impossible to generalize about the behavior of Chinese state companies in a way that we understand behavior of companies.

And I might, if we take completely different industries, the weapons industry, like Polytechnologies and China North, and He Ping running Polytechnologies, and I got to wonder what the dynamic in Beijing was as he was trying to unload a shipment of AK-47s in Zimbabwe repeatedly by going to various other countries to try to unload it.

So we have a very different corporate decision-making dynamic. I would allege in this case that He Ping was more powerful than just about anybody else in that dynamic, certainly anybody in the foreign ministry.

So it's difficult for U.S. policymakers, it seems to me, to make policy vis-à-vis Chinese companies when, in fact, we have a virtually ad hoc dynamic in existence on how these companies make decisions. It depends very much on who's in power both in the party and in the companies.

I think that's a fair generalization, if you will. I don't know that we can apply it to every set of circumstances. It makes policymaking very difficult.

MR. CUNNINGHAM: If I could add just quickly--you're right. I think that's true. I would say that. But that's a static statement in the sense that if you look moving forward, I think the reason that we have this problem of trying to figure out why, in an ad hoc manner, these decisions are made, is because they're fairly new players.

So when you look at the coal industry, when you look at the power industry, what I said originally was they are very disaggregated. Over half of power is not produced by the big five gencos. Over a third of coal not produced by state-owned enterprises effectively.

What we're seeing--think about a pre-Progressive era United States, where you have consolidation occurring. When that consolidation is finished, you're going to have significant corporate actors with much more, I think much more standardized interaction with the state because remember that--geopolitically--I think China's leadership is in a very different place than it ever has been in a modern era.

You do not have one individual that has absolute authority. You do not have these relationships. It's not as relationship based as it was historically because now, as I said, you have two groups. These two groups are very different with different attitudes.

As a result, you're starting to see, I think, much more of a standard institution building within the central state itself. It's no longer going to be the "Mao from above" System. It's just not the case.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Mulloy has one very short question, as does Commissioner Bartholomew.

COMMISSIONER MULLOY: Thank you, again, both of you for being here.

Mr. Cunningham, on page eight of your testimony, you again talk about IEA membership for China. Now, you were here when I asked Ms. Fredriksen her view on that. Is that your clear understanding? Do you have anything you want to add to her answer?

MR. CUNNINGHAM: I'll quickly add just two things. One is I think, as you said, that there is a willingness in the United States to revisit those two issues because there's a clear recognition that China

should be part of the IEA.

The issue, I think, is not on the U.S. side; I think it's on the Chinese side in terms of deciding what's in the Chinese interests to really join the IEA. I don't think we have figured out a way to frame that properly.

COMMISSIONER MULLOY: Okay.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Bartholomew.

VICE CHAIRMAN BARTHOLOMEW: Thanks very much. I'm so sorry that I wasn't here for your testimony which clearly was very interesting.

It's actually a simple question, but you both travel in and out of China to do your research. Have either of you ever had a visa denied?

DR. DOWNS: No, but I had a lot of trouble getting a visa for my trip at the end of June.

VICE CHAIRMAN BARTHOLOMEW: Thank you.

MR. CUNNINGHAM: I've never had it denied, no.

DR. DOWNS: May I add on to the IEA point or are we out of time?

HEARING COCHAIR REINSCH: You have ten seconds.

DR. DOWNS: I agree with what Edward said. I was doing some interviews on this issue in Beijing at the end of June, and I felt that people were all over the map in terms of their understanding of the IEA, whether it would be good for China, whether they thought China should join.

HEARING COCHAIR REINSCH: Thank you. And thank you to this panel. That was very interesting and helpful testimony.

We'll move now on to the third panel, please.

PANEL III: CHINA'S ENVIRONMENTAL POLICY AND ACTIVITIES TO ADDRESS THE ENVIRONMENTAL IMPACTS OF ITS ENERGY USE

HEARING COCHAIR REINSCH: Dr. Aldy, Dr. Levine, and Dr. Schwartz.

Let's begin the third panel, please. This panel will discuss environmental policies in China and activities to address the environmental impacts of energy use.

We're very pleased to have three distinguished guests today. Our first witness is Dr. Joseph Aldy, who is Co-Director of the Harvard Project on International Climate Agreements and a Fellow at Resources for the Future in Washington.

His research addresses questions about climate change policy,

mortality risk evaluation, energy subsidies to low income households, and energy policy.

Our second witness is Dr. Mark Levine who is Director of the Environmental Energy Technology Division and Group Leader of the China Energy Group at Lawrence Berkeley National Laboratory, Berkeley, California.

Over the past two decades, Dr. Levine has been involved in analyzing and promoting energy efficiency in China.

Finally, we have Dr. Jonathan Schwartz, who is Assistant Professor of Political Science and International Relations, State University of New York at New Paltz. His research focuses on state-civil society relations, public health networks, and environmental issues in the People's Republic of China.

Thank you all for participating. We'll proceed in the order in which I introduced you. Your full written statements, will be placed in the record. So we ask each of you to summarize your remarks orally for seven minutes each. Thank you.

Dr. Aldy.

**STATEMENT OF JOSEPH E. ALDY, FELLOW
RESOURCES FOR THE FUTURE, CO-DIRECTOR, HARVARD
PROJECTS ON INTERNATIONAL CLIMATE AGREEMENTS,
WASHINGTON, DC**

DR. ALDY: Thank you, Mr. Chair and cochairs and commissioners, for the opportunity to present testimony here before this Commission about China's energy policies and their environmental impacts.

I'm a Fellow at Resources for the Future, and I serve as the Co-Director of the Harvard Project on International Climate Agreements. RFF is an independent and nonpartisan research institute, and it does not take policy positions, although individual researchers are encouraged to express their individual opinions.

The Harvard Project on International Climate Agreements works to help identify key design elements of a scientifically sound, economically rational and politically pragmatic post-2012 international climate policy.

The views I present today are mine alone and do not reflect the positions of Resources for the Future or Harvard University.

I'd like to focus my opening remarks on three key points:

First, the use of energy and its associated environmental impacts in China reflects truly remarkable economic development over the last three decades.

Second, China's carbon dioxide emissions are growing fast,

posing serious risks to the U.S. and global environment.

And third, we need to design an international climate policy architecture that can effectively engage China and other emerging economies.

Let's turn first to Chinese economic performance. China's economic growth has raised per capita incomes in excess of \$5,000, thereby lifting several hundred million people out of poverty since 1978. This is probably the most successful poverty reduction program in history.

As the country has developed, it has become a major producer of energy-intensive goods. China today manufactures one out of every three tons of steel produced globally, and this phenomenal growth has required substantial investments in the Chinese energy infrastructure.

In the past 20 years, power generation has increased tenfold. In 2006 alone, China installed 105 gigawatts of new capacity, 90 percent of which was coal fired. China has now become the second-largest consumer of petroleum and third-largest net importer in the world.

The growth in energy consumption has dramatically increased China's CO₂ emissions, the second key point I would like to emphasize today. In 1980, China's CO₂ emissions from fossil fuel combustion comprised eight percent of global emissions. In 2007, China was responsible for 23 percent of global CO₂. China's emissions are now some 15 percent higher than U.S. emissions.

In terms of the historic contribution to the atmospheric accumulation of greenhouse gases, China is second in the world with 11 percent of the global share, after the United States at 20 percent.

As we look forward, we should recognize that forecasting Chinese emissions is perhaps more art than science. Consider the forecasts of the Energy Information Administration and the International Energy Agency made in 2000 for CO₂ emissions in China in the year 2010.

China passed these 2010 forecasts in 2003 and 2004 respectively. In 2000, the Intergovernmental Panel on Climate Change published 40 emission scenarios through the year 2100. But they all appear to have underestimated emissions through just the first decade of this century.

Realized 2006 global emissions exceeded even the worst case scenario largely reflecting the growth in China. If China's emissions grow as fast over the next five years as they did over the past five years, then they will be nearly double what our EIA currently forecasts for the United States in the year 2012.

It is possible that China's emissions in 2030 could triple current U.S. emissions. The prospect of such growth in carbon dioxide emissions in China raises critical questions for the effort to tackle global climate change. If emissions in China do not slow and reverse

soon and if the emissions in the United States do not slow and reverse soon, then we will effectively close the doors on the policy goals advocated by some in the scientific and policy communities.

Finally, let's focus on how the dramatic changes since 1992 commend important revisions and innovations to the international climate policy architecture. In 1992, at the Earth Summit in Rio de Janeiro, the U.N. Framework on Climate Change effectively divided the world into two: Annex I countries, the industrialized nations, and non-Annex I countries, basically the developing world.

Since then, China's share of global CO₂ has more than doubled. If China continues to grow at its recent pace, its per capita emissions will be roughly on par with much of Western Europe by 2012. China's current per capita income exceeds that of several Annex I countries at the time they signed the Framework Convention in 1992.

This also suggests that we need to find ways to, quote, "graduate" emerging economies into taking more effort to mitigate climate change.

To frame the consideration of what China could do, let's first consider what China is doing. China's most recent five-year plans set an ambitious goal of lowering the energy intensity of economic output by 20 percent over five years although its progress towards this goal is not impressive.

China's 2007 National Climate Change Program also calls for a variety of actions, from promoting more small-scale hydropower in western regions to coal-bed methane capture to producing biofuels to expanding forest cover.

In total, China estimates that these efforts could lower emissions by 300 million tons of carbon by the year 2010.

The international climate policy regime should become more flexible to incorporate efforts and commitments by emerging economies that may differ from those taken in the Kyoto Protocol.

Given the poor track record in forecasting Chinese CO₂ emissions, it does not seem plausible that China could negotiate a cap on its emissions. Instead, China should focus on policies and measures that can lower the carbon intensity of its development.

The policy commitments China could undertake should start with what China is doing already. Several additional policies could aid this effort. First, China can continue and accelerate the reform of energy subsidies. Reducing subsidies can free up fiscal resources for other uses, promote more efficient allocation of private sector resources, facilitate energy security by reducing fuel else and lower CO₂ emissions.

Second, China could implement a carbon tax. This could provide the incentive for households and firms to invest in more energy

efficient and carbon-lean technologies. Vice Minister Pan Yue of the Ministry for Environmental Protection has called for both subsidy reform and carbon taxes.

Quote: "By introducing an environmental tax, we can achieve the triple win of revenue increases, environmental protection, and fairness in society. As a first step, eliminate subsidies and preferential taxation policies not in favor of environmental protection."

The Vice Minister has suggested that after further research on environmental taxation, China will, quote, "design various carbon tax policies in due course."

These policies may make more sense in China than they would here. First, China has institutional experience with subsidy reform and taxation, but very little experience in the design of environmental policy instruments like cap and trade favored by many in the United States.

Second, a carbon tax and subsidy reform also takes advantage of the strength of the leading ministries in Beijing including the Ministry of Finance and NDRC.

Third, this may also play to the interests of those in Beijing who would like to reassert more control over the provinces.

From the U.S. perspective, Chinese efforts to mitigate their emissions will deliver several important benefits:

First, these policies will lower Chinese CO₂ emissions and help address the risks proposed by climate change.

Second, removing subsidies and imposing carbon taxes will minimize the potential incentive that American firms may face to relocate their manufacturing activities to China.

Third, this leadership by China will show other emerging economies how they can contribute to the global effort to confront climate change.

Finally, taking serious efforts to mitigate carbon dioxide emissions in the United States and China can complement other opportunities for cooperation such as an R&D for carbon capture and storage technologies.

Thank you again for this opportunity to participate in this important discussion on China's energy policies and their environmental impacts.

[The statement follows:]

**Prepared Statement of Joseph E. Aldy, Fellow
Resources for The Future, Co-Director, Harvard Projects on
International Climate Agreements, Washington, DC**

Testimony of

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Joseph E. Aldy
Fellow, Resources for the Future
Co-Director, Harvard Project on International Climate Agreements

Prepared for the
U.S.-China Economic and Security Review Commission

Hearing on China's Energy Policies and Environmental Impacts

Washington, DC
August 13, 2008

Thank you, Co-Chairs and fellow Commissioners, for the opportunity to present testimony before this Commission about China's energy policies and their environmental impacts. I am a Fellow at Resources for the Future (RFF), a 56-year-old research institution, headquartered in Washington, DC, that focuses on energy, environmental, and natural resource issues and I serve as the Co-Director of the Harvard Project on International Climate Agreements.

RFF is both independent and nonpartisan, and shares the results of its economic and policy analyses with members of both parties, environmental and business advocates, academics, members of the press, and interested citizens. RFF neither lobbies nor takes positions on specific legislative or regulatory proposals, although individual researchers are encouraged to express their individual opinions, which may differ from those of other RFF scholars, officers, and directors. The Harvard Project on International Climate Agreements works to help identify key design elements of a scientifically sound, economically rational, and politically pragmatic post-2012 international policy architecture for global climate change. The Harvard Project draws upon leading thinkers from academia, private industry, government, and non-governmental organizations from around the world to construct a small set of promising policy frameworks, and then disseminates and discusses the design elements and frameworks with decision makers. The views I present today are mine alone, and do not reflect the positions of RFF, the Harvard Project on International Climate Agreements, or Harvard University.

The use of energy and its associated environmental impacts in China reflects remarkable economic development over the past three decades. China's economic growth has resulted in per capita income in excess of \$5,000 (on a purchasing power parity basis) thereby lifting several hundred million people out of poverty since 1978 (UNDP 2005), probably the most successful poverty-reduction program in history. As the country has developed, it has become a major producer of energy-intensive goods. China today manufactures one out of every three tons of steel produced globally, and the Chinese domestic market consumes approximately 90 percent of that production (Houser et al.

2008). The emerging middle class in China drives a rapid increase in automobile ownership, as the Chinese car market now exceeds the German and Japanese markets and will likely pass domestic sales in the United States by 2015 (IEA 2007).

This phenomenal economic growth has required substantial investments in the Chinese energy infrastructure. In the past twenty years, power generation has increased ten-fold, and the rate of growth in installed capacity continues to increase: in 2006 alone, China installed 105 gigawatts of new capacity, 90 percent of which was coal-fired (IEA 2007). The amount of coal-fired generating capacity installed in China in 2006 exceeds more than a quarter of all U.S. coal-fired generating capacity (EIA 2007). China has now become the second largest consumer of petroleum, and third largest net importer in the world. Total energy demand has increased substantially as the economy has expanded, although through two distinct phases in recent years. The energy intensity of economic output declined significantly from 1980 through 2001 – the energy to GDP ratio falling approximately 5 percent per year. This trend reversed over the 2001 to 2005 period, with energy intensity increasing nearly 4 percent per year.

The development in China has brought substantial economic gains, but has adversely affected the local and global environment. The daily discussion of air quality in the lead-up to the Beijing Olympics this month illustrates the seriousness of the pollution problem in China and the growing concern Chinese officials share about the environment. Vice-Minister Pan Yue of the Ministry of Environmental Protection has noted that the “global environmental crisis is most prominently revealed in the contradictions between traditional industrial economic growth and environmental protection” (Pan Yue 2007, p. 10).

While American athletes and tourists may experience first-hand elevated smog levels and concentrations of fine particulates during the Olympics, the most pressing effects of Chinese economic activity on the U.S. (and global) environment result from the emissions of carbon dioxide and other greenhouse gases. I will focus on the impact China has on the global climate through past, current, and forecast greenhouse gas emissions. Then I will discuss the prospects for Chinese participation in international efforts to confront global climate change, with attention to ways to integrate recent Chinese domestic policy goals and efforts in a global regime.

China’s Greenhouse Gas Emissions

Current Emissions

China’s rapid development and reliance on coal to power their economy has caused a dramatic increase in carbon dioxide emissions. In 1980, China’s carbon dioxide emissions from fossil fuel combustion comprised 8 percent of global emissions. China’s share increased to 10 percent by 1990, and advanced to 12 percent by 2000. With the accelerated economic growth in this decade, and the reversal of the trend in improving

energy efficiency, China's carbon dioxide emissions have taken off and passed U.S. emissions in 2006. In 2007, China's emissions of 1.83 gigatons of carbon alone comprised 23 percent of global carbon dioxide emissions, and these emissions exceeded U.S. emissions by more than 15 percent in that year (Netherlands Environmental Assessment Agency 2008).

The recent acceleration in China's emissions growth reflects a variety of factors already enumerated above. China's increasing role in international trade has also contributed to the growth in carbon dioxide emissions. The energy- and carbon-intensity of Chinese imports, and their volume, dwarf the emission-intensity of Chinese exports. Chinese scholars have estimated that the embedded energy in net exports exceeded more than a quarter of all energy consumed in 2006 (Jiahua et al. 2007). If the United States accounted for the carbon content of net imports, our emissions could be 10 to 30 percent higher than current estimates (Weber and Matthews 2007), reflecting U.S. specialization in carbon-lean goods for export and imports of carbon-intensive goods. This distinction between the location of where carbon-intensive goods are produced and where they are consumed will likely play a larger role in the design of domestic and international climate policy.

Historic Contribution to Emissions

Climate change does not reflect the flow of emissions in any one year, however; it is the product of the accumulation of greenhouse gases that reside in the atmosphere for hundreds to thousands of years. Many developing countries have pointed to the historic contribution of wealthier countries that achieved their development during the 19th and 20th centuries as a result of burning fossil fuels as a leading rationale for why the developed countries should take the lead in mitigating climate change. Recent analysis of greenhouse gas emissions across the world dating back to 1890 casts some light on this issue. When accounting for all sources of greenhouse gas emissions, the industrialized countries classified as Annex I under the Framework Convention on Climate Change are responsible for 54 percent of the atmospheric accumulation of greenhouse gases and all non-Annex I countries are responsible for the remaining 46 percent (Muller et al. 2007).¹ While nearly one out of five tons of greenhouse gases in the atmosphere reflects economic activity in the United States, China is second in terms of its contribution at 11 percent of the global share. While these historic contributions on a per capita basis differ substantially between developed and developing countries, they show how the damages from climate change – which depend on the accumulation of gross, not per capita, emissions – exist as a by-product of economic activity in a number of large economies in both the industrialized and developing world.

¹ All Annex I countries except for Turkey and Belarus have legally-binding quantitative emission targets inscribed in Annex B of the Kyoto Protocol.

Per Capita Emissions

Developing countries, including China, have focused on the significant variation in per capita emissions around the world. During the 1997 Kyoto Conference, a Chinese negotiator reportedly said “In the developed world, only two people ride in a car, and yet you want us to give up riding on a bus” (Climate Action Network 1997). In 1980, carbon dioxide emissions per capita in the United States exceeded China’s per capita level 14 times over. By 1990, the average American was associated with ten times as much carbon dioxide emissions as the average Chinese. By 2005, this ratio had declined to less than five times, and if China’s emissions continue to grow fast, per capita emissions will converge quickly.

Forecasting Emissions

Will China’s emissions continue to grow fast? Expert forecasters at the Energy Information Administration and the International Energy Agency did not anticipate China’s rapid increase in carbon dioxide emissions. In 2000, the EIA forecasted China’s 2010 carbon dioxide emissions to be 1.15 gigatons of carbon and the IEA forecasted China’s emissions to be 1.32 gigatons of carbon in that year. China passed the EIA forecast in 2003 and the IEA forecast in 2004. The Intergovernmental Panel on Climate Change effort in 2000 to forecast long-term global emissions did not anticipate the fast growth of emissions in China or globally this decade. The IPCC published 40 emissions scenarios through 2100, but they all appear to have underestimated emissions through the first decade of this century: realized 2006 global emissions exceeded even the worst-case scenario (Canadell et al. 2008), largely reflecting the growth in China. It is important to note that even if China’s emissions grow at the slower rates previously forecast by the IPCC, IEA, and EIA, they would now grow from a much higher base than initially expected. For example, the *Stern Review on the Economics of Climate Change* employed the IPCC’s A2 emissions scenario to forecast the long-term damages from climate change. If we use the A2 scenario’s long-term emission growth rate, but grow global emissions from the realized 2006 level (instead of the 1990 level in the IPCC work), then global carbon dioxide emissions would be some 40 percent higher in 2100 than assumed in the *Stern Review*. Forecasting emissions, especially for a country like China, is very difficult, but can have very serious implications for our long-term assessments of climate change.

Several recent analyses have provided emission forecasts for China that account for the most recent experience in the Chinese energy-economy. Researchers at the University of California evaluated historic provincial-level carbon dioxide emission data to forecast exceptionally rapid emissions growth in China (Auffhammer and Carson 2008). Extrapolating their 2010 forecast growth for China to 2012, the close of the Kyoto

Protocol commitment period, shows that Chinese emissions could grow to as much as 3.32 gigatons of carbon. Or drawing from a much simpler analysis, if China's emissions grow as fast over the next five years as they did over the past five years, then they will effectively reach this same forecast level in 2012. To put this figure in context, the Energy Information Administration (2008) forecasts U.S. 2012 fossil fuel carbon dioxide emissions to be 1.68 gigatons of carbon, or almost exactly half of China's emissions in 2012! If China's emissions grow this fast, then its per capita carbon dioxide emissions will exceed the current per capita levels of 15 Annex I nations and be roughly on par with much of Western Europe by 2012.

The variation in forecasts of China's carbon dioxide emissions is represented well by Figure 1, drawn from recent work by Blanford, Richels, and Rutherford. The lower shaded section shows the slower growth forecasts from the International Energy Agency and by the modeling teams participating in the 2006-7 scenarios work under the purview of the U.S. Climate Change Science Program (CCSP). The higher shaded section demonstrates the much faster growth expected in the MERGE model, one of the models that participated in the U.S. CCSP exercise, with its updated assessment of Chinese growth and energy system. In the highest growth case in their model, China's emissions in 2030 could be triple current U.S. emissions.

The prospect of such growth in carbon dioxide emissions in China raises critical questions for the effort to tackle global climate change. A number of scientists have raised concerns about atmospheric concentrations of greenhouse gases exceeding 450 parts per million (and even recently expressed concerns about going beyond 350 parts per million). The current concentration is about 385 parts per million carbon dioxide, and when accounting for all greenhouse gases, the atmospheric concentration is roughly equivalent to 450 parts per million. This suggests that long-term goals to stabilize the atmosphere at these levels may not be feasible without dramatic action. If emissions in China do not slow soon and reverse and if emissions in the United States do not slow and reverse soon, then we will effectively close the doors on some of the policy goals advocated by some in the scientific and policy communities.

The Potential Role for China in International Climate Policy

Graduation

In 1992 at the Earth Summit in Rio de Janeiro, the UN Framework Convention on Climate Change effectively divided the world into two: Annex I countries – the industrialized nations in the OECD and much of the former Soviet bloc – and Non-Annex I countries – everybody else. Much has changed since then, and the emergence of some countries, including China, suggests the need to re-evaluate the division of effort under international climate policy and find ways to “graduate” emerging economies into taking more effort to mitigate climate change. China's current per capita income exceeds that of

several Annex I countries at the time they signed the Framework Convention on Climate Change. If China's emissions grow at the same rate as they have over the past five years, then their per capita emissions will be on par with the median country with target under the Kyoto Protocol in 2012. China has the second largest economy in the world and has made substantial investments in human capital to indicate that it has the resources to alter the carbon-intensity of its development.

This is not to say that China should take on emission targets like Annex I countries, but to note that China and some other emerging economies have the means to do more and should not necessarily be lumped in with the least developed countries. The Government of Bangladesh recently framed this issue well:

“At the same time while the differing national circumstances between developed and developing countries have been acknowledged,..., it must be acknowledged that similar vast differences exist between many of the developing countries, particularly the large ones among them and the Least Developed Countries (LDCs). Such large developing countries with large economies and resource and institutional capability to take mitigation, adaptation and technology-related actions can not and should not be equated with those of LDCs even when all nations are required to lower GHG emission” (UNFCCC. Views Regarding the Work Programme of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention, March 3, 2008).

What Is China Doing Now?

Some may infer that China is not doing much to combat climate change as evidenced by its recent run-up in carbon dioxide emissions and lack of quantitative emission commitment under the Kyoto Protocol. China has set goals and begun to pursue policies that can lower its carbon dioxide emissions. The most recent five-year plan set an ambitious goal of lowering the energy intensity of economic output by 20 percent over five years. While the first several years showed an increasing energy intensity of output, preliminary data for 2007 suggest that China may have reversed the trend again with a modest improvement. China's National Climate Change Programme also calls for a variety of actions, from promoting more small-scale hydropower in western regions to coalbed methane capture to producing biofuels (NDRC 2007). The Programme calls for expanding reforestation efforts to increase forest coverage to 20 percent of land mass, thereby increasing biological sequestration of carbon. In total, China estimates that these efforts would lower emissions by 300 million tons of carbon by 2010.

China has also actively participated in the Clean Development Mechanism (CDM) under the Kyoto Protocol. The CDM allows for the industrialized countries with emission targets under Kyoto to meet their commitments in part by financing projects that lower

greenhouse gas emissions in developing countries. China hosts more than twenty percent of all registered CDM projects, but these tend to be larger than average projects since China is expected to generate more than half of all certified emission reduction credits under the CDM.²

What Can China Do in an International Climate Policy Regime?

China is not a developed country, like the United States and members of the European Union, so international commitments appropriate for the wealthiest economies in the world may not be appropriate for China. China is not like many developing countries, as noted by the Government of Bangladesh, and so it may be appropriate to ask China to do more than the least developed countries of the world. This suggests that the international climate policy regime should become more flexible to incorporate efforts and commitments by emerging economies that may differ from those taken in the Kyoto Protocol.

Commitments do not have to be quantitative emission targets. Given the poor track record in forecasting Chinese carbon dioxide emissions and the fast but potentially volatile growth in emissions expected under continued economic development, it does not seem plausible that China could reasonably negotiate a quantitative cap on its emissions with the rest of the world. Instead, China should focus on policies and measures that can lower the carbon-intensity of its development. Only after further economic growth, institutional development, and experience with mitigation policies, would it be practical to consider an emissions cap for China.

The policy commitments China could undertake should start with what China has already started to do under its National Climate Change Programme. This is consistent with some notions of so-called “pledge and review” approaches to international climate policy (e.g., Pizer 2007). China’s experience with the Clean Development Mechanism suggests that many more opportunities exist for low-cost mitigation. Several policies could help drive substantial, low cost emission abatement. First, China can continue and accelerate the reform of subsidies in the consumption of energy. China’s energy subsidies amounted to about \$11 billion in 2006 (IEA 2007), but may be much higher this year as the Government of China has subsidized petrol during the run-up in crude oil prices (although the government did allow petrol prices to increase recently). Reducing subsidies can free up fiscal resources to address other important social objectives, promote more efficient allocation of private sector resources, facilitate energy security by

² Refer to <http://cdm.unfccc.int/Statistics/Registration/AmountOfReductRegisteredProjPieChart.html> and <http://cdm.unfccc.int/Statistics/Registration/NumOfRegisteredProjByHostPartiesPieChart.html> for more information.

reducing demand for fuels for which China is a net importer, and lower carbon dioxide emissions.

Second, China could implement a carbon tax. This could provide the incentive for households and firms to invest in more energy-efficient and carbon-lean technologies. The revenues could also benefit the government as it attempts to finance more research and development, and consider ways to address the concerns of the lowest-income citizens who would face higher energy prices. These ideas constitute rational economic policy to address the environment, and they may have some salience among environmental leaders in China. Vice-Minister Pan Yue of the Ministry for Environmental Protection has called for both policy instruments: “By introducing [an] environmental tax, we can achieve the ‘triple win’ of revenue increases, environmental protection, and fairness in society. . . .As the first step, eliminate subsidies and preferential taxation policies not in favor of environmental protection” (Pan Yue 2007, p. 329). The Vice-Minister has suggested that after further research on environmental taxation, China will “design various carbon tax policies in due course” (Pan Yue 2007, p. 330).

This fiscal instrument approach to climate change may make more sense in China than it would here or in other developed countries. First, China has institutional experience with subsidy reform and taxation, but very little experience in the design of environmental policy instruments for carbon dioxide emissions, like emission cap-and-trade favored by many in the United States. Second, a carbon tax and subsidy reform also takes advantage of the strength of the leading ministries in Beijing, including the Ministry of Finance and the National Development and Reform Commission. Third, this may also play to the interests of those in Beijing who would like to re-assert more control over the provinces. Centralized tax policy provides a better way to do this than cap-and-trade (Pan Yue 2007).

From the U.S. perspective, Chinese efforts to step forward in the international community and commit to policies that will mitigate their emissions will deliver several important benefits. First, these policies will lower Chinese carbon dioxide emissions and help address the risks posed by climate change. Second, policies that remove subsidies and impose taxes on the carbon content of fuel will minimize the potential incentive that American firms may face to relocate their manufacturing activities to China. This will ensure the level playing field as the United States moves forward with its domestic emission mitigation efforts. Third, this leadership by China will show other emerging economies how they can contribute to the global effort to confront climate change. Finally, taking serious efforts to mitigate carbon dioxide emissions in the United States and China can complement other opportunities for cooperation. This could include coordinated research and development on carbon capture and storage technologies, which could ensure that both countries could continue to use their vast coal resources while sequestering the associated carbon dioxide emissions underground.

References

Auffhammer, Maximilian and Richard T. Carson. 2008. "Forecasting the Path of China's CO₂ Emissions Using Province Level Information." *Journal of Environmental Economics and Management* 47(1): 47-62.

Blanford, Geoffrey J., Richard G. Richels, and Thomas F. Rutherford. 2008. Global CO₂ Stabilization Implications of Revised Growth Projections for China. Working paper, July draft.

Canadell, Pep et al. 2008. Recent Carbon Trends and the Global Carbon Budget: Updated to 2006. Global Carbon Project. June 13, 2008 Version.
http://www.globalcarbonproject.org/global/ppt/GCP_CarbonCycleUpdate.ppt#774,1,
Recent Carbon Trends and the Global Carbon Budget updated to 2006

Climate Action Network. 1997. ECO: Climate Negotiations Newsletter 18(6).

Energy Information Administration (EIA). 2007. Electric Power Annual. Washington, DC: Department of Energy.

Houser, Trevor, Rob Bradley, Britt Childs, Jacob Werksman, and Robert Heilmayr. 2008. Leveling the Carbon Playing Field: International Competition and U.S. Climate Policy Design. Washington, DC: Peterson Institute for International Economics and the World Resources Institute.

International Energy Agency (IEA). 2007. World Energy Outlook 2007: China and India Insights. Paris: International Energy Agency.

Jiahua, Pan, Chen Ying, Zie Laihui, and Zheng Yan. 2007. "Energy Embodied in Goods in International Trade in China: Calculation and Policy Implications." In: *International Climate Change Regime: A Study on Key Issues in China*. China Environmental Science Press.

Muller, Benito, Niklas Hohne, and Christian Ellerman. 2007. Differentiating (Historic) Responsibilities for Climate Change: Summary Report. Oxford Institute for Energy Studies Energy and Environment Paper.
<http://www.oxfordclimatepolicy.org/publications/DifferentiatingResponsibility.pdf>

National Development and Reform Commission (NDRC). 2007. *China's National Climate Change Programme*. Beijing: NDRC.

Netherlands Environmental Assessment Agency. 2008. Global CO2 Emissions: Increase Continued in 2007.

<http://www.mnp.nl/en/publications/2008/GlobalCO2emissionsthrough2007.html>

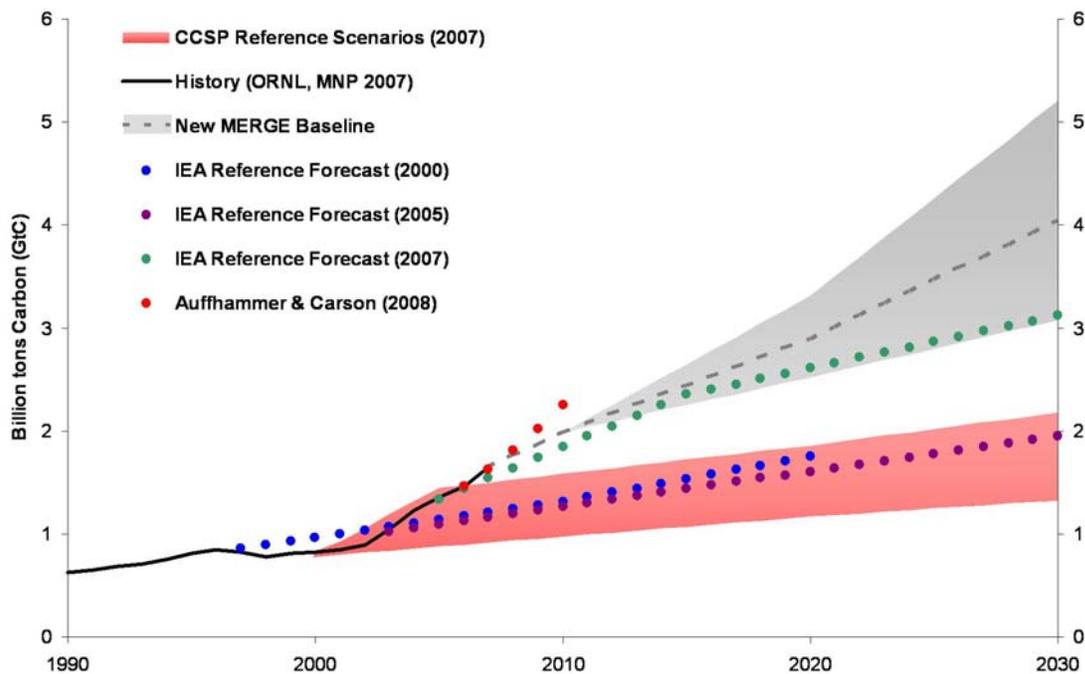
Pizer, William A. 2007. "Practical Global Climate Policy." In: Joseph E. Aldy and Robert N. Stavins, eds. *Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World*. Cambridge: Cambridge University Press.

United Nations Development Programme (UNDP). 2005. China Human Development Report. http://www.undp.org.cn/downloads/nhdr2005/NHDR2005_complete.pdf.

Weber, Christopher L. and H. Scott Matthews. 2007. "Embodied Environmental Emissions in U.S. International Trade, 1997-2004." *Environmental Science and Technology* 41(14): 4875-4881.

Yue, Pan. 2007. Thoughts on Environmental Issues. Beijing: China Environmental Culture Promotion Association.

Figure 1. Fossil Fuel Carbon Dioxide Emissions, China, 1990-2030



Source: Blanford et al. 2008.

HEARING COCHAIR REINSCH: Thank you.
Dr. Levine.

**STATEMENT OF MARK D. LEVINE
STAFF SENIOR SCIENTIST AND CHINA ENERGY GROUP
LEADER, LAWRENCE BERKELEY NATIONAL LABORATORY,
BERKELEY, CALIFORNIA**

DR. LEVINE: Thank you very much. I have seven minutes; is that right?

HEARING COCHAIR REINSCH: Correct.

DR. LEVINE: Okay. I too thank you very much for the invitation to address this panel. I have some things to say that I think are important and urge you to give them quite serious consideration.

I believe there are misunderstandings in both China and the United States surrounding the topic of energy and environment and climate change, and that those misunderstandings cause both countries to miss opportunities for fruitful collaboration. Perhaps the greatest of these misunderstandings on the U.S. side is the failure to recognize that China has in the past, in the period 1980 to 2000, been able to reduce the growth of energy-related CO2 emissions through the design and implementation of aggressive and innovative energy efficiency policies.

I believe China is moving again to reinstate those policies which were more successful than those of any other developing country in our time.

I want to stress two points. The first is that China and the United States - accounting for about 40 percent of total energy-related CO2 emissions and having the largest potential to reduce the growth of emissions - need to work cooperatively to establish a global regime in which these emissions are contained.

My second point is the need for assistance from outside China in reducing greenhouse gas emissions. The Chinese emissions could triple or quadruple over the next 20 years without such assistance or could well double over that same period with such assistance, and those two worlds are profoundly different.

A China with four times the emissions of today in 20 years is a China that has gone so far down the path of a high-energy society that the world's addressing the greenhouse gas problem is made extremely difficult if not impossible.

A China that contains its emissions over this period of time gives us all an opportunity to address this enormously important global problem.

I have three major recommendations to make. The first is that I

urge that the U.S. and China engage in formal discussions of ways of working together to reduce greenhouse gas emissions, and that these discussions have the goal of influencing global negotiations.

Let me assure you that if the U.S. and China can figure out an effective way of addressing these emissions, each country pursuing a path that is appropriate to that country and acceptable to the other, it will have a powerful influence on global negotiations.

And I think such an outcome is possible through discussions. In fact, I will describe in a few minutes one possible outcome that in my mind, at least, could take us a long way.

My second recommendation is that in the near term, in the next ten to 15 to 20 years, the greatest asset that the U.S. can provide and the greatest need that China has is not money, is not the provision of capital, which in fact is happening now under CDM, Clean Development Mechanism, but rather the capability to more effectively deploy energy efficiency policies and technologies that exist within China.

I might call this knowledge transfer. This is not the transfer of intellectual property. It is not the spending of money in China. It's enabling of China to invest its own money in energy efficiency and to have the capabilities to implement energy efficiency policies.

My third recommendation relates to the long term, and here technologies will have to play a critical role. I believe the U.S. and China can work together, along with other countries, to develop these technologies and share in intellectual property that does not presently exist. So you don't have interested parties who are protecting their intellectual property. You have the joint development of intellectual property for the benefit of all of us.

On this issue of providing technical assistance, let me give one quick example. At LBL, starting in the early '90s, we trained the Chinese to analyze appliance efficiency standards. They started with refrigerator efficiency standards. We agreed to give the training if the government of China made a commitment to enact the standards. They didn't tell us what level they would be at. We didn't tell them what level of stringency they should set the standard at.

They simply made a commitment to promulgate standards. It took six months for them to make that commitment. When they informed us that the government had made the commitment, we provided the training. They promised to issue standards in 18 months from the beginning of the training. In 18 months, they came up with standards, which they have done their own way, and at this point have been extremely effective.

In fact, those standards for refrigerators and later for 21 other appliances—for which we also provided training—are estimated to save

100 million tons of CO2 by 2020. That's worth \$2 billion. How much did that training cost? Maybe one or two million dollars. That's my point. That expertise if made available to China and if China is interested and willing to use it--it makes no sense if China doesn't want to do it--has a tremendous impact, and it's the kind of thing that the U.S. can do.

We have great knowledge and skills that can be used in these areas, and it's the kind of knowledge that China wants and is prepared to use.

One last comment, because I see I'm running out of time. There's I think legitimate concern about a world in which we have prices on carbon, which raises the price of our products, and China doesn't. The issue is: what will be the impact of such a situation on trade between China and the United States. I propose a solution to this problem in my written statement. I've not read this anywhere else.

If, say under a cap and trade system the price of CO2 is \$20 a ton, let's get an agreement with China where they have a tax of \$20 a ton on CO2 products that they're exporting. They can collect that tax and reinvest that tax and in policies and programs to reduce CO2 emissions. In this approach, there's no international exchange of money, trade is not impacted, and the proceeds of such a tax in China can provide additional support for reducing CO2 emissions. Everyone, including the environment, is a winner.

Do I think that's a possible agreement? I do think that that's an agreement that could be achieved in the context of broader discussions between China and the U.S. on limiting greenhouse gas emissions where both parties figure out what's in their interest and what's in the mutual interest. We have tremendous areas of mutual interest in this area, in this topic.

Thank you.

[The statement follows:]

**Prepared Statement of Mark D. Levine
Staff Senior Scientist and China Energy Group Leader, Lawrence
Berkeley National Laboratory, Berkeley, California**

Date of Hearing: August 13, 2008

Mark D. Levine

Staff Senior Scientist and China Energy Group Leader,

Lawrence Berkeley National Laboratory¹

¹ The views that Dr. Levine expresses in this statement and his subsequent testimony are his and do not represent the position of Lawrence Berkeley National Laboratory, the

“Testimony before the U.S.-China Economic and Security Review Commission”
Hearing title: “China’s Energy Policies and their Environmental Impacts”

I wish to thank the Commission for giving me the opportunity to participate in this hearing. I consider the topic, “China’s Energy Policies and their Environmental Impacts,” to be one of great importance. I believe there are misunderstandings in both China and the United States surrounding this topic that cause both countries to miss opportunities for fruitful collaboration. Perhaps the greatest of these misunderstandings is the failure to recognize that China has in the past (1980-2000) and is again putting tremendous effort into reducing growth of energy-related CO₂ emissions through the design and implementation of aggressive and innovative energy efficiency policies.

I wish to stress two points: The first is that China and the United States, accounting for nearly 40% of current global energy-related CO₂ emissions and having the largest potential to reduce emissions growth, need to work cooperatively to establish a global regime in which these emissions are contained. The second is the need for assistance from outside for China to successfully limit these emissions. I suggest that China, without assistance in reducing greenhouse gas emissions, could triple or even quadruple emissions over the next 20 to 25 years. With serious assistance from industrialized countries, especially the United States, the increase in emissions could be cut in half. The second outcome makes it possible to conceive of a future in which the worst effects of global climate change are averted; in the first case, such a future is difficult to imagine.

I have three major recommendations for the United States government:

1. The United States and China should engage in formal and regular discussions of ways of working together to reduce greenhouse gas emissions, with the goal of influencing global negotiations. A serious proposal that both the United States and China agree to is likely to be acceptable to both industrialized and developing countries.
2. In the near term, the greatest support that the United States can provide to China (and other developing countries) is to build capacity in those countries to create and implement policies and programs that reduce greenhouse gas emissions. The United States should play a leadership role, creating a program at the level of \$500 million per year (~\$200 million of which is for China). The United States should strongly encourage other industrialized nations to fund such programs as well.
3. In the long term, the solution to climate change will have to rely on technology that is not yet commercialized. The United States government should play a key role in establishing a basis for performing R&D on these technologies with other nations (including China) and the sharing of intellectual property of these future technologies among nations of the world.

institution that employs him or of the U.S. Department of Energy.

I urge the Commission to consider these ideas and recommendations seriously, in light of the statement that I provide below.

Qualifications

Let me first state my qualifications. After receiving a PhD from the University of California, Berkeley, in chemistry, I turned my attention to the study and analysis of energy issues. I have specialized in energy efficiency, including technology, economics, and public policy. I have worked in the energy field full-time since 1972, first for the Ford Foundation (two years), for SRI International (four and one-half years), and finally for Lawrence Berkeley National Laboratory [LBNL] (30 years). In addition to management and research responsibilities at LBNL, I have participated as a senior leader and author of major reports on energy efficiency and energy futures for the U.S. Department of Energy, the World Energy Council, the Agency for International Development, the Environmental Protection Agency, and the Energy Foundation's China Sustainable Energy Program.

Two aspects of my background are of particular relevance to this testimony. The first is my involvement over the last 20 years in the three analyses carried out by the Intergovernmental Panel on Climate Change (IPCC). I served as convening or coordinating lead author for two of these three assessments. The second aspect is my creation and leadership of the China Energy Group at LBNL. Since its formation in 1988, this group has worked collaboratively with Chinese organizations to further energy efficiency policy in China. As a result of leading this group, participating in research projects, and having many discussions with energy policy officials and researchers over these 20 years, I have gained knowledge of China's energy system, its approach to policy and policy implementation, and individuals who are involved in energy decision-making.

LBNL's China Energy Group

I've been asked to describe the China Energy Group at LBNL. The Group came about as a result of a U.S. Department of Energy sponsored conference on China's energy markets held in Nanjing, China in 1988. The leaders of the Energy Research Institute, the Chinese central government's leading research and analysis organization supporting energy policy decision-making, expressed a strong desire to establish ties with energy specialists outside of China. At that time, their contacts were almost entirely within China. After discussions, we drafted a plan for cooperation and collaboration. They submitted the plan to higher authorities in their government and received very rapid approval. On our part, we agreed to do our best to create an ongoing program of collaboration with a strong focus on energy efficiency policy.

With initial funding from the U.S. Department of Energy – later from the U.S. Environmental Protection Agency, then from foundations and private industry – we began a collaboration that has continued for 20 years. LBNL's China Energy Group has built up a staff of seven researcher/analysts and has collaborated closely with scores of research, analysis, and policy-related organizations in China, including bureaus of the

central government. Our most significant achievements are these:

- the introduction of techniques for analyzing appliance efficiency standards, which has led China to analyze and adopt close to 30 appliance standards and form organizations within the Chinese government for a continuing program;
- the creation of a voluntary energy efficiency agreements between China's government and industry – modeled after similar agreements in the Netherlands and the UK – which is now the underlying programmatic approach of the Chinese government to industrial energy efficiency;
- the founding with a partner national laboratory of the Beijing Energy Efficiency Center, which is the leading group in China for analyzing energy efficiency policy and managing large energy efficiency programs funded by international organizations;
- at the behest of the Energy Foundation and working with the Packard Foundation, the creation of the China Sustainable Energy Program (CSEP) at the Energy Foundation, a program that supports energy efficiency and renewable energy policy research for China. The annual budget of CSEP has grown from an initial \$5 million to \$18 million today; and
- the development of state-of-the-art tools and data collection and synthesis to permit analysis of China's energy future.

More information about the China Energy Group at LBNL can be found at <http://china.lbl.gov/>.

Issues

You raise five very important and interesting issues in your letter of invitation. I wish to focus my attention on the fifth of these: “What steps is China taking on a governmental and non-governmental level to address the environmental impacts of its energy use? What role can the United States play in addressing these problems?” I will address the environmental issue that I believe is of the greatest importance: the role of climate change in the relations between the United States and China.

My thesis is that progress toward a solution to the problem of greenhouse gas emissions depends critically on both China and the United States and that deepened bilateral cooperation would greatly increase the likelihood of finding an effective way to move forward. China and the United States produce approximately equal levels of energy-related CO₂ emissions² and together account for almost half of such emissions worldwide. China is projected to account for more than 40% of new energy-related CO₂ emissions globally between the present and 2030, thus being by far the largest future contributor to increased concentrations of CO₂ in the atmosphere. The United States, meanwhile, has the greatest potential of any country in the world to reduce energy-related greenhouse gas emissions, for two reasons: first, because the U.S. per-capita intensity of

² Energy-related CO₂ emissions make up approximately 80% of total of such emissions to the atmosphere.

these emissions is considerably higher than those of other large industrial countries (e.g., 2.5 times that of the European Union and 2.1 times that of Japan); and second, because the United States has the scientific, technical, and economic capability of developing viable alternatives to fossil energy technologies and is likely to be the world leader in any breakthrough technology if one is developed.

It is not enough that China and the United States both take steps to reduce CO₂ emissions. *It is essential that the two countries do this cooperatively.* As long as China does little to reduce growth of greenhouse gas emissions or appears to be doing little, it will be politically difficult for the United States to sign a binding international treaty that commits to a serious cap on emissions. And as long as the United States either does little or appears to be doing little, it's impossible to imagine China committing to any international treaty that limits its own emissions. This is a vicious circle in which neither country will act boldly unless the other acts first, and neither appears willing to act first.

Agreement on Factual Information and Generally Agreed Viewpoints

In my view it is very desirable that a relatively short list be crafted that contains commonly accepted information that senior government officials of both China and the United States would accept as accurate, balanced and fair in depicting the historical, current, and anticipated future situation of the two countries regarding greenhouse gas emissions. Below are 10 items that could form the basis of a common understanding.

Both countries

1. The United States is responsible for 28% and China 8.5% of total cumulative emissions of CO₂ from energy consumption ^a

China

2. From 1980 to 2000, China limited the growth rate of energy demand and concomitant CO₂ emissions to less than half that of GDP. ^b
3. From 2001 to 2006, China's energy demand and energy-related CO₂ emissions grew faster than the 10% annual growth of GDP. This led to an increase in China's emissions from 12.7% of global emissions (2001) to 18.4% (2006). ^c
4. In 2006, China instituted a national program to reduce energy intensity (energy demand per unit of GDP) by 20% by 2010. The program started slowly but is now approaching its annual target. ^d
5. Over the next 25 years, China will be the world's largest annual emitter of CO₂ by a considerable margin. ^e

United States

6. From 1975 to the present, the United States reduced the growth in the magnitude of its energy-related CO₂ emissions more than any other large industrialized country in the world. GDP per capita grew almost 200% while energy consumption (and CO₂ emissions) per capita remained constant. ^f

7. Notwithstanding these reductions in growth of CO₂ emissions, U.S. CO₂ emissions per capita are 2.5 times greater than those of the European Union countries and 2.1 times those of Japan.^g
8. Annual growth of energy-related CO₂ emissions in the United States in the coming decades is expected to be in the range of 0.5 to 1.0 percent unless new policies are enacted to cut CO₂ emissions.^h
9. The United States is actively developing advanced technology to cut CO₂ emissions through low carbon energy supply and energy efficiency technologies.ⁱ

United States and China

10. Neither China nor the United States have agreed to binding commitments on greenhouse gas emissions. China is a signatory to the Kyoto protocol, but the protocol contains no binding commitment for developing countries. The United States has not ratified the Kyoto protocol.

Notes

^a The most important measure of contributions of energy use to greenhouse gases in the atmosphere is the cumulative emissions of CO₂. This is because of the long residence times of CO₂ in the atmosphere (>100 years); thus contributions many years ago affect the global greenhouse as much as emissions today.

In describing contributions of a country, it is useful to present this in terms of per capita emissions, in the same way that GDP/capita, not GDP, is a measure of the economic well-being of a country. China's cumulative per capita emissions of energy-related CO₂ are less than 8% of those of the United States.

^b This is generally seen as a remarkable achievement, as virtually all countries undergoing very rapid economic development – China had 9-10% annual GDP growth over those two decades – experience energy growth that is *faster* than GDP growth. China's reduction in energy demand growth was the consequence of explicit policies carried out in China. If energy had grown just at the rate of GDP, China's emissions of CO₂ would be more than twice as great as today's emissions.

^c It is noteworthy that in 2006 the energy intensity decreased by 1.3% (i.e., energy grew 1.3% less rapidly than GDP) and by 3.7% in 2007, with greater intensity declines projected in 2008.

^d This is virtually identical to a goal of reducing the intensity of CO₂ emissions by 20%.

^e For example, the International Energy Agency in its 2008 World Energy

Outlook anticipates that 40% or more of energy-related CO₂ emissions at a global level will be produced in China between now and 2030.

^f The reduction in growth of emissions is relative to a baseline in which CO₂ emissions grow at the same rate as GDP. For industrialized countries, emissions are unlikely to grow at this baseline rate because many activities and products have saturated their markets: for example, not many people are purchasing their first car, virtually all homes have refrigerators and most are not seeking to have a second. However, it is useful to use a baseline that has CO₂ emissions growing at the rate of growth of GDP when making comparisons among countries.

^g EU and Japan are not far behind the United States in GDP/capita. However, these nations have much less land per capita and have much higher population densities. High population density reduces travel demand and results in smaller per capita living space, thus causing lower energy demand. Policies in the countries promoting efficient energy use vary among the countries as well.

^h The Energy Information Administration's base case projects U.S. per capita CO₂ emissions declining by 0.2% per year between 2006 and 2030. The EIA base case projects total energy-related CO₂ emissions growing by less than 0.6% per year during the period. See <http://www.eia.doe.gov/oiaf/forecasting.html>.

ⁱ Any new international climate treaty is likely to include some means of sharing advanced technologies for GHG mitigation that are developed by the United States and other countries.

A Matter of Perspective: Predominant Viewpoints of China and the United States

Perspectives on responsibility for curbing greenhouse gas emissions and the impacts of doing so are very different when viewed from the Chinese and United States sides.

I will mostly address the two perspectives of China's emissions—as these may be somewhat less well known in this country. For our purposes, we need to consider the past, present, and anticipated future.

United States perspectives

Many in the United States look at China's emissions, note how rapidly they have grown in the past five years, and are aware of the forecasts that show that a large proportion of the world's expected increase in energy-related carbon dioxide emissions will come from China. For those who are concerned about global climate change and its possible serious and adverse impacts, emissions from China are a cause of grave concern.

Many Americans express the concern that emissions reductions applied to this country could increase the cost of our producing goods and services, thus placing us at a competitive disadvantage with any country that does not do the same. As a result, there

are strong sentiments in many quarters in the United States that we should not agree to a cap on our emissions if China does not do the same, especially in light of China's large trade surplus with the United States.

Chinese perspectives

The view from China is very different. Chinese note that per capita income, energy consumption and CO₂ emissions are much lower in China than in the United States. They emphasize the disproportionate contribution of the United States to the global greenhouse gas problem, pointing out that the United States, with a population one-quarter the size of China's, is responsible for putting far more CO₂ in the atmosphere than has China. This point is made to indicate the inequity inherent in focusing on current emissions while the problem is caused by emissions over long periods of time.

These views provide a philosophical underpinning that supports China's major concern looking forward. China believes that it will need more energy for development—much more. Chinese officials observe that the industrialized countries have already been through the energy-intensive phase of their development, but China is in the midst of its own. The possibility of gaining a competitive trade advantage through a new climate treaty is much less significant to the Chinese than the possible roadblocks to achieving social development goals that could be brought by a commitment to binding targets.

Reconciliation (or Identification of the Key Differences)

It is important to understand how both sides see the problem. Considering these viewpoints leads me to believe that there are the two major impediments to agreement: the Chinese view that a binding commitment on CO₂ emissions could stifle their development; and the U.S. view that because of its large trade deficit with China, any adoption of a carbon dioxide cap without a comparable commitment by China could drive the two nations' trade balance out of control.

There are of course many other issues that are of domestic importance to an agreement to limit greenhouse gas emissions, but these are the two that the United States and China need to work out together for them to jointly take a leadership position in their spheres of influence--industrialized and developing countries, respectively.

Forging Agreements

Continuing discussions between high-level teams from both countries are needed to discuss ways of overcoming the existing impasse in both countries. The leaders of the teams should be policy makers above the level of the climate change negotiators. These discussions should become formal. They need to be carried out on a regular schedule. Today they are informal and do not occur regularly. They should not be construed as bilateral negotiating sessions. The two countries can set the rules for their discussions. Ideally, they would keep key decision-makers in the U.N. process informed of developments in their discussions. However, if keeping information about the discussions private to the two governments increases the likelihood of progress, then the two countries may choose to maintain confidentiality. The goal is for China and the United States to reach a consensus that can serve as a model for the EU and developing

nations.

Now to the difficult issue: what would such an agreement look like, at least in outline form? While there are many complex issues, I believe that reducing the discussion to the minimum number of critical ones is most helpful in moving forward. In addition to satisfying the U.S. and Chinese teams, the negotiation must produce an agreement that is appealing to the international community engaged in climate change negotiations. This means in effect:

For the international community:

- The agreement must contain binding commitments in some form and they must take effect in the near term.³

For China:

- If there are binding commitments, they must not threaten China's growth and internal development goals;
- The agreement must include giving China access to knowledge, tools, and technology that lowers the cost of reducing emissions;

For the United States:

- The terms should not exacerbate the U.S. trade deficit with China;
- The United States must be convinced that it can meet the commitment to greenhouse gas reduction at economic costs that are acceptable to its population

With the exception of the last bullet, which is well beyond the scope of China/U.S. relations, there are various ways that these objectives can be met. Considering the second bullet, a formula that could work in China is a commitment that industrial emissions would grow slower than industrial value added—for example, 80% as fast—over the next decade, after which time a new formula could be agreed upon. The advantage of this approach is that it places no constraint on its consumer economy, which China views as necessary to meet its development objectives. A further advantage is that it addresses the sector that is responsible for 70% of all energy-related emissions; it thus addresses the activities in China that are by far the largest contributor to greenhouse gas emissions.

There are other formulas that could be used for China as well. Most involve adoption of an emissions target that increases as GDP increases, thus assuring China that growth need not be impacted so long as proper measures are taken to reduce growth of greenhouse gases. Like the industrial emissions approach, the formula could involve a commitment

³ The nature of the binding commitments can be very different for the two countries. For the United States it might be an absolute limit of greenhouse gas emissions in a given year, if the approach being pursued by other industrialized nations is adopted. For China, it might be a limit that increases as economic activity increases, thus complying with the next bullet.

that GHG emissions grow at a rate lower than that of GDP (e.g., 80% as fast) with the provision of technical support, capacity building, and/or funds to facilitate reductions in greenhouse gas emissions. Achieving better results could trigger greater levels of assistance.

It is important to understand the nature of the assistance that is needed and appropriate. There are many misconceptions about this topic.

I believe that there are two primary needs. In the short term – the next one to two decades – China’s primary need is in technical assistance and knowledge transfer. This is often called capacity building. To illustrate short-term needs, I use our work as an example. LBNL provided in-depth training to China in the design, analysis, and implementation of appliance energy efficiency standards, starting in the early 1990’s. We did this after receiving assurances that the Chinese government would promulgate standards if they gained the expertise to do so. As they promised, they issued efficiency standards for refrigerators eighteen months after the training began. This training continued for almost a decade, as the Chinese learned the many different techniques to assess energy efficiency in many residential and commercial appliances and heating and cooling equipment. Today, China has standards for twenty-two different household products. The government has created permanent institutions to develop and promulgate these standards and check compliance with them. The standards are expected to reduce CO₂ emissions by more than 100 million metric tons by 2020. Valued at \$20/ton, this is \$2 billion.

This demonstrates the tremendous leveraging that can result from modest investments in capacity-building projects. It is an example of how technical assistance can have a large impact on China’s CO₂ emissions. The cost is very small fraction of the benefits from emission reductions. The assistance develops the capacity for the Chinese to pursue energy efficiency but does not pay for it. Chinese consumers pay the higher cost of more efficient appliances; they also receive the direct economic benefits of lower energy bills.

In my view, an appropriate-sized program for the United States to support is on the order of \$500 million per year for all major developing countries, of which China’s share might be \$200 million per year. A program at this level, with comparable contributions from other industrialized countries, has the potential to reduce the growth in annual energy-related CO₂ emissions in China by 50% over a twenty year period, if China participates actively.⁴ Substantial support from other countries could increase these impacts in proportion to the magnitude of the program.

The second need is for the longer term, where new low-carbon technologies will be essential if energy-related CO₂ emissions are to be reduced to low levels. For the most part, such technology does not exist today and the intellectual property for these technologies does not belong to anyone (i.e., does not exist). There is a need for

⁴ I describe this proposal in more detail in a separate paper. I can make this available to the Commission on request.

programs to support joint development of such technologies, using the technical and financial resources of many countries. It is also essential that new procedures be developed that permits the sharing of licenses and royalties from these technologies. There are substantial advantages to the United States and China working together (along with other nations) to carry out R&D on low-carbon technologies. If the governments of both countries support the research, they can establish the rules for the sharing of intellectual property. A more complicated problem concerns the other developing countries which do not possess the large R&D capabilities of China (or India) but will need access to these technologies to reduce their emissions. The sharing arrangements need to be extended to these other countries as well, and terms for this sharing are needed.

A new approach is needed for sharing intellectual property for low carbon energy technology, ideally under the auspices of the climate change convention. Because this is a subject that is of paramount importance to China, a bilateral agreement between the two countries on collaborative R&D and the sharing of intellectual property on low-carbon energy technology could be an excellent model for a global approach to the problem.

This leaves the issue of trade. There are different ways that this issue can be dealt with. I will describe one. For this purpose, I assume that the signatories to a climate change treaty will agree to a cap on emissions that establishes a price for carbon credits. This is the system that the EU has adopted and that California and other U.S. states are developing. The EU system with a cap that constrains emissions has resulted in the past in CO₂ credits of about \$20 or \$30 per metric ton. To avoid impacts on trade in a case where limits on Chinese emissions in early years would produce only small increases in the price of its products for export, China would agree to a tax on exports equal to the cost of a carbon credit (dollars per metric ton). To avoid this being too cumbersome, it would apply only to products that are energy- (and therefore carbon-) intensive in their manufacture. Under this proposal, China would collect the tax and would be required to apply it to its program of reducing CO₂ emissions.

A program such as this would eliminate the trade advantage that China might gain by not having commitments as tight as industrial countries. It would have the further benefit of assuring resources in China that would be used to address greenhouse gas emissions.

An international commission would be needed to oversee the uses of the tax in China (and presumably other developing countries, if the approach is extended to them) as well as the provision of resources from the United States and other industrialized countries to support greenhouse gas abatement in developing countries.

Issues

I expect that the approach described above, if taken seriously considered, will raise issues in various quarters. I address two of the most likely objections.

If the United States agrees to a cap on absolute quantity of emissions, why should China be permitted a cap that depends on economic growth?

In the United States economic growth and energy use over a period of a decade or longer

are relatively predictable. Absent a multi-year recession (such as that experienced by Japan), annual economic growth is unlikely to be below 1.5% or above 3% over a period of a decade or more. Growth in annual energy demand and energy-related CO₂ emissions, without new policies, is likely to be in the range of 0.5 to 1.0%. Forecasts in this range apply to most industrialized countries, for which most consumer products such as refrigerators and cars have already approached saturation. In short, it is possible to understand at a general level what is entailed in achieving certain targets for greenhouse gas emissions over a period of one to two decades.

For a rapidly developing country such as China, growth in energy demand and resulting CO₂ emissions can have much greater variations. The Chinese economy grew at annual rate of 9 to 10% from 1980 to 2000; during this period energy demand grew at an annual rate of 4 to 5%. In only one year during this period did the increase in energy demand growth exceed even 60% of that of GDP. From 2001 to 2005, GDP in China continued its growth at 10% per year or greater. One might have predicted that energy demand in China would have grown at a rate lower than 5% per year, as it had done over the previous 20 years. Indeed, forecasters did predict this. But energy demand grew even faster than GDP during the period, averaging almost 12%/year.

There are reasons that, in retrospect, explain this very rapid growth in energy demand. It's not necessary to go into them here. The important point for our discussion is that it is extremely difficult in China, in its present stage of economic development, to predict with any accuracy the energy demand growth over a 10 or 20 year period. This is one reason that China would not—and should not—accept a binding cap that is expressed in absolute terms, unless such a cap were well in excess of the higher range of expected emissions. But if a cap were set so high, it would be meaningless.

There are of course philosophical reasons why it is not appropriate to set absolute caps on a developing country that is in the stage of building infrastructure – houses, roads, medical facilities – to serve its population. But I wish to avoid philosophy in this discussion, as such matters often pull Chinese and Americans further apart instead of creating common ground on limiting greenhouse gas emissions. I believe the basic considerations, such as whether China should have an absolute or relative cap on emissions, can be made separate from philosophical views for the reasons that I advance above.

China and other developing countries will have the largest emissions in the future. If we allow them to have a cap that increases as their economies grow, how will it ever be possible to achieve acceptable levels of emissions?

Many people believe that China will continue increasing its energy demand and spewing CO₂ into the environment forever, or at least for a very long time. This is, I believe, a fundamental misconception. China is in the middle stage of building its infrastructure – housing, commercial buildings, roads, hospitals, schools, and the like. It is at a relatively early stage of increasing the mobility of its population. Large quantities of energy are required to accomplish these tasks.

This period is likely to last for 15 to 20 years, possibly as long as 25, depending on

whether China continues at its breakneck speed of construction and whether large numbers of rural dwellers continue migrating into urban areas. At the end of this construction period, China's economy will be much like developed countries of today. Energy demand growth will decline markedly, just as it has in the industrialized world today. Scarcity of traditional energy sources may slow energy demand growth even further in this time horizon.

The key questions are these: What will be the nature of China's energy system in 15 to 20 years? How much will energy demand and CO₂ emissions have grown? How dependent on fossil fuels will China be? What will be its overall contribution to global CO₂ emissions? Will the energy system in China's future be sustainable or will it lurch from crisis?

These are crucial questions not only for China but for all of us. One can envision a world in which China's energy and CO₂ emissions grow more than fourfold in 20 years, thus catching up with and overtaking large industrialized nations (except the United States and Canada) in per capita emissions. One can also imagine a China in 20 years in which CO₂ emissions have grown less than twofold as a result of implementing advanced energy technologies and furthering of policies to cut energy demand growth.

Assuming that global climate change is a serious matter, as I do, I have little doubt that the first case would result in very serious impacts on the global environment. The second case is much more tolerable. If accompanied by aggressive reductions of greenhouse gas emissions in industrialized countries and the aggressive development of low-carbon energy technology, the world could be well on the way to cutting emissions in half by 2050, an important objective, for example, my understanding of the analysis conducted by the Intergovernmental Panel on Climate Change.

The point here is the one I emphasize throughout this statement: If we succeed in working cooperatively with China to reduce CO₂ emissions, the world stands a far greater chance of reducing the threat of global climate change. If we do not, it's difficult to see how China will do it all alone. This is a choice that two great nations – who contribute by far the largest CO₂ emissions to the atmosphere – have to make. I hope this committee recognizes the extraordinary benefits that can come from cooperation between the United States and China in the area of mitigation of CO₂ emissions and the serious threats to our future if the two countries fail to find and pursue a common purpose in this arena

HEARING COCHAIR REINSCH: Thank you.
Dr. Schwartz.

**STATEMENT OF JONATHAN SCHWARTZ, Ph.D.
ASSOCIATE PROFESSOR, STATE UNIVERSITY OF NEW YORK,
NEW PALTZ, NEW YORK**

DR. SCHWARTZ: Yes, thank you for the opportunity to present on this topic.

I will make three main points in this testimony. First, China can be viewed as a high state capacity country. Two, China remains fixated on rapid economic growth as a key source of continuing party legitimacy to rule. And three, in order for the United States to contribute to strengthening China's environmental protection, it should consider the following three steps:

One, the U.S. should enhance China's environmental protection capacity. Two, the U.S. should encourage and support China's environmental civil society. And three, the United States should lead by example.

While I address each of these points in detail in the written testimony, here I only briefly touch on each point. My research focuses on state capacity and its role in effective implementation of China's environmental policies, laws and regulations.

I find that China enjoys high state capacity and that state capacity does play a role in effective policy implementation. However, I also find that state capacity while necessary is insufficient to achieve effective implementation. Also important is commitment.

Essentially, a state may enjoy high state capacity but choose not to employ its capacity to achieve a particular goal. This is logical given that even with high state capacity, no state can achieve all of its goals. It must prioritize.

This is the crux of the challenge: China has the potential to utilize its state capacity to more effectively address its environmental challenges, but it does not choose to do so.

A quick discussion of potential. China's environmental laws and regulations are impressive by less developed country standards and in some cases by developed country standards. We know for example that China's fuel efficiency requirements for 2008 are ten percent more stringent than ours.

Environmental laws and regulations are promulgated at the center and passed down the political hierarchy from the center to the provinces and on down. At each subordinate level of government, there's an Environmental Protection Bureau charged with implementing the laws and regulations. These bureaus are tied to the Ministry of Environmental Protection in terms of information and support; however, these Environmental Protection Bureaus, or EPBs, are more closely tied to their two sources of funding, local governments, and the fees and fines they collect from local factories.

Since the main focus of local governments is on creating jobs, increasing tax revenue and obtaining promotions (which depends on

the recommendations of those higher up the hierarchy, and they focus on economic issues largely) it is unlikely that local Environmental Protection Bureaus will wish to upset local governments by actively enforcing laws that might impede economic growth.

Also, since Environmental Protection Bureaus obtain revenue from fees and fines collected from local factories, aggressive enforcement might result in local factory closures and by extension lost revenue.

The State Environmental Protection Administration promotion to ministry status doesn't change this basic reality. Nor does it change the ministry's status relative to other ministries. It remains equal to them at best, but as a non-revenue generating ministry, it is in fact less influential.

At the central government level, growing awareness and concern about China's rapidly deteriorating environment and its long-term economic and social consequences are largely offset by near-term pressure for rapid economic growth. The Communist Party heavily depends on maintaining economic growth as a central source of legitimacy.

The leadership and the public in general believe that overly enthusiastic enforcement of environmental regulations and laws will slow the economy and raise public dissatisfaction, a threat to the party.

Any slowing of growth might break an unwritten contract that exists between the party and the public. The party promises to keep the economy booming and in return the public promises to stay out of politics.

Still, the central government is aware that annually, it costs China between eight and 13 percent of its GDP to address the environmental damage caused by its economic growth model, a number that seems likely only to increase. This is a serious conundrum for the party state.

What is the role for the United States? First, the U.S. should argue that environmentally sound development needn't come at the expense of economic growth. To do so, the U.S. should prioritize pollution abatement technology transfers. Highly subsidized or preferably free, the technologies and know-how, and I stress know-how, as well as did Dr. Levine; pollution measurement technologies; examples of effective laws, regulations and enforcement mechanisms--these should be made available throughout the government environment hierarchy but also through to the factory level.

This initiative will strengthen China's enforcement capacity while supporting U.S. environment industries.

The second action the U.S. can take is to encourage China's

environmental civil society. China's environmental non-governmental organizations, a component of civil society, are quite constrained by the state. Most engage in local clean-up or education initiatives or provide support for central government environment laws and policies that local governments lack sufficient resources to implement or would simply prefer to ignore.

Despite these limits, ENGOs play an important role. They offer an outlet for social activism while raising public awareness. They provide a means to challenge local industries to adhere to existing laws and regulations, and they encourage the state to strengthen its commitment to environmental protection.

Over time, many of the ENGOs have tested the limits of political space. Such action is inherently dangerous and can lead to closure of the organization or jail time for its members. Since these organizations make a positive contribution to environmental protection in China, it is beneficial to the U.S. to support and encourage them.

Support and encouragement can come in many forms. In addition to direct and indirect funding for activities and training of China's environment community, we can enhance global public attention.

Global public attention and support for the environmental community raises its profile and constrains the state from taking action against it.

The final action the U.S. should do is lead by example. While lecturing and conducting interviews in China on a regular basis, I repeatedly encounter Chinese who question why China should not follow the Western "pollute now and clean up later" model of development.

The fact that the Chinese are far poorer than Americans and are polluting far less on a per capita basis limits the U.S.' moral authority when challenging China to do better. If we demonstrate our commitment to sustainable growth by leading by example, we strengthen our position and significantly assuage Chinese concerns that the U.S. is cynically using environmentalism as a means to impede China's economic and political rise.

I'd like to conclude, by drawing on the 2008 Beijing Olympics--how can we not mention this as exemplifying that the Chinese government has the necessary state capacity to implement long-term complex projects. With the Olympic Games, China identified a priority, which is successful Games, and took often drastic action to achieve success at the expense of tens of millions of people.

The Olympics are viewed by the leadership in highly nationalistic terms with success providing a boost to party legitimacy to rule. As a result, the incentive to achieve a successful result was a sufficient catalyst for the party and state to move into action.

While unreasonable to expect a similar level of commitment to environmentally sound development, movement in this direction is clearly desirable.

The U.S. should work to enhance China's environmental state capacity while encouraging increased commitment to environmentally sound development. It can do so through a combination of technology and expertise transfers, support for and public encouragement of civil society, and by leading by example.

Thank you.

[The statement follows:]

**Prepared Statement of Jonathan Schwartz, Ph.D.
Associate Professor, State University of New York
New Paltz, New York**

“Sixteen of the world's 20 most polluted cities are in China, 70 percent of the country's lakes and rivers are polluted, and half the population lacks clean drinking water. The constant smoggy haze over northern China diminishes crop yields. By 2030, the nation will face a water shortage equal to the amount it consumes today; factories in the northwest have already been forced out of business because there just isn't any water. Even Chinese government economists estimate that environmental troubles shave 10 percent off the country's gross domestic product each year” (John Pomfret, the Washington Post). This description of China's environmental challenges usefully frames the pressing nature of the issues I will discuss today.

My written testimony is divided into two sections. First, I describe the methodology and general conclusions deriving from my research into State Capacity and environmental policy implementation in China. I then apply the results of the research to the Commission's questions.

Throughout, I supplement and update my State Capacity research with data collected during the 2007-08 academic year I spent in China as a Fulbright scholar. During this period I taught an environment and development course to advanced undergraduates and lectured on the environment in a number of venues around the PRC.

State Capacity and its impact on Environmental Policy Implementation

A broadly accepted definition of state capacity is: *The capacities of states to implement official goals, especially over the actual or potential opposition of powerful social groups or in the face of recalcitrant economic circumstances* (Skocpol, 1985: 9). While a useful general definition, I operationalize State Capacity with three measurable components - human capital, fiscal strength and reach/responsiveness.

Human Capital: The technical and managerial skill level of individuals within the state and its component parts.

Reach/Responsiveness: The degree to which the state is successful in extending its ideology, socio-political structures, and administrative apparatus throughout society (both geographically and into the socio-economic structures of civil society), the responsiveness of these structures and apparatus to the local needs of the society.

Fiscal Strength: The financial capacity of the state or of a given component of the state. This capacity is a function of both current and reasonably feasible revenue streams as well as demands on that revenue.

A state enjoying high human capital, reach/responsiveness and fiscal strength enjoys high capacity and will therefore be more likely to successfully implement a policy (Schwartz, 2001).

To test this assertion I conducted a comparative statistical analysis focusing on the jurisdictions responsible for environmental policy enforcement in China – the provinces. I conducted a quantitative analysis of ten provinces: Liaoning, Heilongjiang, Shandong, Henan, Hubei, Hunan, Guangdong, Jiangsu, Yunan, and Guangxi, with the goal of evaluating the impact of relative state capacity on effective environmental policy enforcement.

Relying on operationalizations for each of the components of state capacity, I identified four relatively high capacity and six relatively low capacity provinces. The high capacity provinces are: Liaoning, Heilongjiang, Jiangsu, and Guangdong.

If capacity indeed influences enforcement, it is reasonable to expect the high capacity provinces to be those where enforcement is relatively effective. I identified relative effectiveness using statistical data available on environmental protection efforts by each of the provinces coupled with the opinions of environment specialists within government, and the Chinese NGO and academic communities. The result was a clear correlation between provinces enjoying high capacity and the effectiveness of their enforcement efforts.

To trace the mechanism through which State Capacity correlates with environmental policy implementation, I conducted a qualitative analysis in one sample province – Jiangsu. With the goal of illustrating a causal relationship, this qualitative analysis drew on interviews with environment officials and site visits to chemical and cement plants. The results of the qualitative analysis lent further support to the original conclusion (Schwartz 2003). State capacity causally influences compliance with environmental policies. As a result, it is reasonable to argue that investing in capacity building in China will have a positive impact on environmental conditions in the country.

However, the research also illustrates that state capacity alone is insufficient to ensure improvements in the environment. In order to better understand the impact of additional contributing factors, we must become familiar with China's environmental protection institutions and initiatives.

Challenges to Environmental Protection in China

Although China has developed a strong and increasingly detailed environmental protection regime, the government bureaucracy charged with implementation suffers from structural weaknesses. The key agency responsible for environmental protection in China is the State Environmental Protection Agency (SEPA) – now the Ministry of Environmental Protection (MEP).

With its March 2008 elevation to Ministry status, the MEP is theoretically equal in rank to its other ministry counterparts. However, as an equal ranking ministry MEP cannot enforce environmental directives over the wishes of these other ministries. Indeed, in reality, most ministries (and provinces, since they too enjoy ranks equivalent to ministries) remain more powerful than the MEP, a result of the continuing bias favouring economic growth over environmental protection, and revenue generating ministries over those that are revenue negative.

Even within the environmental protection bureaucracy, the MEP does not dominate. The MEP plays an advisory and managerial role vis-à-vis all lower level environmental protection bureaus (EPBs). EPBs monitor

factory pollution output, maintain records and collect fees and fines. Although EPBs are required to fulfil MEP directives, unlike in many Western countries, the MEP does not control the budgets or the operations of the EPBs. Funding for EPBs derives from relevant levels of government (provincial governments fund provincial EPBs and municipal governments fund municipal EPBs etc.). While EPBs are responsible for implementing central government/MEP environmental protection policies, they are also responsible to their funding government.

Not surprisingly, sub-national EPB officials are more focussed on the priorities of their funding agency than on those of the often distant and invariably financially insignificant MEP. Local EPB effectiveness is therefore influenced by the nature of their relationships with local government leaders and departments.

Undoubtedly, officials would prefer a clean environment. They are also aware that frequent refusal to obey directives from above contributes to weakening the integrity of the existing political system, a system that justifies their own power and status. They are also influenced by their individual interests.

Officials are appointed by their bureaucratic superiors. Superiors also play a major role in allocating highly sought after investment and trade opportunities. Thus, both the future careers of officials and their region's access to economic benefits are influenced by the satisfaction of their superiors with their cooperativeness and reliability. Successfully implementing directives from above illustrates cooperativeness and reliability and increases the likelihood of promotions.

The ability to carry out directives from above, however, is constrained by the resources available. Lacking sufficient resources to implement all directives from above, sub-national government decision makers must prioritise among the directives they receive, taking into consideration budgetary limitations and what they deem their superiors would view as the top priority policies. The greater the importance ascribed to a particular policy, the greater the likelihood sub-national governments will invest real efforts in its implementation. Since the stated goal of the central government is to achieve a Harmonious Society (since 2004, this is described as striving to achieve ongoing rapid economic development with a more equitable division of the fruits of development as a means to avoid the potential for social volatility), sub-national governments naturally focus on economic growth, job creation and raising revenue rather than on protecting the environment.

Sub-national government decision makers must also consider local interests. Citizens, local factories and businesses place intense pressure on these governments to enable ongoing economic activities, regardless of the pollution generated. A major priority of government officials is to feed, clothe and assure employment for their citizens. Thus, when faced with the choice of enforcing environmental policies that may constrain economic growth, or enabling continued, often polluting economic growth, it is the latter option that tends to prevail.

This is a dilemma faced at each level of the government hierarchy. The greater the bureaucratic (and geographic) distance of governments from the centre (a main source of pressure for environmental protection) and the more closely tied governments are to local industry, the greater the pressure to minimise enforcement of environmental protection policies and focus instead on economic growth. The pressure to minimise any constraints on economic growth derives from above and from below.

The constraints on enforcement of environmental protection policies are most severe at the lowest level of the environmental protection bureaucracy – the county. Largely due to local government emphasis on economic development, at this level funding and staffing are often insufficient and the quality of staff is poor. Unfortunately, it is at the county level where pollution problems are most grave, the result of flourishing township and village enterprises.

In short, the environment protection bureaucracy is constrained in its effectiveness in large part because the

incentive to commit to environmental protection is lacking. The existence of high state capacity alone is insufficient to ensure compliance with existing laws and regulations or the development of more robust pollution responses. State capacity measures the *potential* to act - the assessed unit may enjoy fiscal strength, human capital, autonomy and reach/responsiveness at levels conducive to effective enforcement, but may not utilize that potential if no incentive to do so exists.

Based on the above analysis, I draw the following main conclusions. First, State Capacity as I define it does impact the effectiveness of policy implementation – the greater the State’s Capacity, the more likely environmental policies will be effectively implemented. Second, State Capacity alone is not sufficient to ensure effective implementation. A contributing variable is commitment. If the public and the leadership are committed to environmental protection as a high priority, the likelihood of effective implementation rises. Thus, in order to ensure effective environmental policy implementation, it is essential to invest both in capacity building and in strengthening public and government commitment. I draw on these conclusions in my responses to the questions raised by the Commission.

1. Who are the stakeholders in determining China’s environmental policy? Now that China’s State Environmental Protection Agency has been raised to a ministerial level, how will the Ministry of Environmental Protection’s new status affect China’s approach to environmental policies and U.S. bilateral cooperation on the environment?

Key stakeholders include MEP and ministries focusing on environment related issues, government leaders down the bureaucratic chain of command, local Environmental Protection Bureau officials, industry owners and civil society (the latter is discussed in detail in question five).

The change in MEP status is unlikely to have a noticeable impact on its powers and influence. Worth noting is the fact that, even with its newly elevated status, the MEP is a small ministry – perhaps 2,600 officials (of which only 300 are based in Beijing) for a country of 1.3 billion and an environment under significant stress. Contrast these numbers to the USEPA, with 17,000 employees (not including outside contractors) for a population of 350 million.

In addition, as a bureaucratically equal ministry, the MEP cannot force other ministries to adhere to its recommendations. Indeed, most environmentally related issues cross bureaucratic lines (e.g. responsibility for forests lies with many ministries, including the MEP and the forestry ministry, among others) requiring cooperation and compromise among various ministries. The result – constraints on MEP power.

The structure and funding of the environmental protection bureaucracy further constrains the power and influence of the MEP and its subordinate units. Funding for local environmental protection bureaus (EPBs) derives from local governments as well as from fines and fees paid by polluting factories. Local government officials (Party officials) depend on their superiors for promotion and advancement. Promotion and advancement are largely driven by maintaining stability, increasing local tax revenue and achieving high employment. Penalizing local factories contributes negatively to all of these goals. Therefore, there is little incentive for local governments to support efficient and effective EPB work. In turn, local EPB workers – the enforcers of environmental regulations and laws - have little incentive to be overly enthusiastic in effective enforcement since their superiors are unenthusiastic and because too good a job of enforcement may harm local industries – one of the main revenue sources for the EPBs.

Finally, existing fine and fee structures are such that industries generally find it more cost-effective to pay pollution fines and fees than to invest in the pollution abatement technologies necessary to meet mandated pollution discharge standards.

For example, China is the largest producer and consumer of cement in the world. The technologies for

clean cement production are not complicated (e.g. baghouses and electrostatic stack scrubbers). However, because of the outdated technologies used to produce cement in the vast majority of Chinese cement plants (such as vertical kilns) and intense competition, profit margins are small and the added cost of pollution abatement is considered unaffordable. The local government wishes to maintain jobs and tax revenue to keep the public (and higher levels of government) happy; local EPB officials wish to avoid angering their superiors and wish to protect revenue sources; and, local industry wants to maximize production and earnings while minimizing expenditures. The result is collaboration among these three groups to “talk the talk while avoiding the necessity of walking the walk”.

To some extent a similar situation exists at the central government level. Central government leaders are clearly growing increasingly aware and concerned about the environmental challenges China faces. This arises from international pressure, visits abroad and access to the vast information on environmental degradation and its impacts that is provided by MEP and other sources. The result is a growing willingness at the central level to take high profile initiatives to illustrate a commitment to environmental protection as a priority (including numerous declarations by president Hu Jintao and premier Wen Jiabao).

MEP vice-minister Pan Yue is among the most outspoken and articulate examples of this kind of initiative. He has spoken in numerous public forums – both domestic and international – on the nature of the environmental challenges China faces and the action China must take to resolve the challenges. His outspokenness has made Pan Yue very popular with the international environmental community. However, again reflecting the relative importance of economic growth, by so often speaking publicly and critically, Pan Yue has become something of a liability, and has seen his influence decline.

Given the recognized popularity of environmental issues in the international community, China’s leadership is likely to continue to offer supportive words regarding environmental issues while being less willing to take real action. This is well exemplified by the Green GDP initiative. China’s leadership took the initiative to develop a “true” measure of GDP growth by including the environmental costs of development. However, the Green GDP tool was quietly shelved when it was realized how embarrassing the results were. The demise of the Green GDP initiative reflects the ongoing contradiction between lofty environmentally supportive rhetoric and pragmatic economic considerations. I discuss the potential US role later in the testimony.

2. How are China’s patterns of energy consumption linked to rising environmental problems in the country? What are the most pressing environmental problems, and what are the effects of those problems on China’s economic growth, public health, and environmental sustainability?

China relies on coal for eighty percent of its energy needs. Coal in China ranges from relatively clean to highly sulfuric in content. While China is currently drawing heavily on its high quality, relatively clean coal, because of growing energy demand, we should expect a change. China is rapidly burning through its reserves of clean coal (Bituminous) and will soon become more dependent on lower energy and higher sulfur content coal (lignite). Thus, both rising demand for coal and its declining quality will result in increased pollution loads (soot, sulfur, CO₂) over the coming 15-20 years (depending on estimates). In addition, because China’s production efficiency is low, the demand for resources per unit of productivity is far greater than is sustainable. And, because the state highly subsidizes energy, there is little incentive to develop efficiencies.

Based on MEP data:

1. Production in Japan is seven times more efficient than in China; in the US it is six times more efficient and in India it is three times more efficient.
2. China’s labor efficiency is less than 10% the global average, yet her emissions are 10 times higher.

3. Over the past 50 years, China has lost half of its arable land
4. 1/3 of China suffers acid rain
5. 300 million rural people have no access to clean drinking water
6. 1/3 of urban residents breathe heavily polluted air

Drawing on these data, China's current growth model is clearly unsustainable. As the MEP itself estimates, China is already being forced to expend between 8-13 percent of its GDP on addressing environmental damage caused by its economic growth model (this number can only increase).

The public health consequences of unrestrained development are worthy of special attention. Clearly, growing shortages of clean water and air are key challenges to China's ongoing economic development. Insufficient clean water negatively impacts agricultural production, and industry (particularly problematic in China's arid north). Public health suffers as the public is forced to rely on polluted water for bathing, cleaning and drinking. Public health is further impacted by stunningly polluted air. This double threat to economic growth, productivity and quality of life is rising at a time when the traditional public health system that in past provided all citizens with coverage has been allowed to collapse. The old health care system was predicated on providing basic preventive care to all citizens either through their work units (urban areas) or communes (rural areas). However, with the passing of the planned economy, the Chinese health care system shifted to an emphasis on Western-style curative care. Curative care is far more expensive, is less efficient in dealing with broader health challenges, and fails to reach the majority of China's rural, and to a lesser extent, urban populations.

Although recently efforts have been made by the central governments to alter this reality, by and large the situation is one where health challenges are rapidly increasing, while solutions are becoming increasingly costly or simply unavailable to the majority of Chinese citizens (Schwartz and Evans, 2007). Clearly, China's economic growth, environmental sustainability and public health are negatively impacted by these developments.

3. What are the transnational environmental effects of China's energy consumption? For example, how will China's planned hydropower development of the upper regions of the Mekong River affect the environment of downstream nations that rely on the river for water supplies? How is the United States' environment affected by China's energy use?

I do not address this question.

4. What tools are available for enforcing environmental standards in China, and how effective are they? How might these tools be expanded to improve compliance? What role can the United States play in assisting the enforcement of environmental regulations in China?

A review of China's environment laws and regulations indicates that China has developed an impressive array of tools to address environmental challenges. In many cases China surpasses WHO and US standards (e.g. for automobile emissions and fuel efficiency where 2008 requirements in China exceed equivalent US requirements by 10 percent). However, the main challenge lies in implementation. As noted, while China has developed solid environmental laws and regulations and the Chinese central government has tremendous coercive power (high state capacity), it lacks a sufficient commitment to implementation.

A key driver behind the general failure to commit to environmental protection is the view among most officials that the Communist Party depends almost completely on maintaining economic growth and the opportunity for prosperity for all its people as a central source of legitimacy to rule (the other main source is nationalism as finds reflection in the rhetoric surrounding the Olympics, the Taiwan question and Tibet).

A sort of unwritten contract exists between the Party and the public – the Party promises to keep the economy booming and in return, the public promises to stay out of politics. The leadership (and the public in general) believe that overly enthusiastic enforcement of environmental regulations and laws will slow the economy and raise public dissatisfaction – a threat to the Party’s ongoing rule.

The leadership’s goal of economic growth and development is shared by the population in general. Accepted thinking among leaders and the general population is that China should follow in the footsteps of developed countries in what is described by some theoreticians as an environmental Kuznets curve. The environmental Kuznets curve describes a relationship where, as economic growth rises so too do pollution levels. However, at a certain per-capita level of income, environmental conditions begin to improve as an increasingly prosperous public demands a better environment (some theorists argue that at a per capita income of \$1,400 we can expect increased access to clean drinking water and at \$3,200 we can expect a decline in smoke and soot. Note that in 2007, Chinese per capital income was \$2,360).

Numerous discussions with academics and students indicate that (even if unfamiliar with the theory) this view is widely held. It is comforting to imagine that the Environmental Kuznets curve appropriately describes China’s development path and that in time all will be well with China’s (and the global) environment (i.e. China will focus on economic growth, and eventually it will go back and clean up its mess). Unfortunately there is reason to question the validity of the Kuznets model. For example, the United States is a highly developed and wealthy country, and yet we produce the most greenhouse gas emissions per capita of any country in the world (China has recently gained the dubious honor of surpassing the US as the planet’s largest *total* producer of greenhouse gases). Furthermore, even were predictions based on the Kuznets model accurate, the impact on the environment of 1.3 billion people striving to reach the top of the bell curve will likely result in irreversible ecological damage.

Of course, it is widely accepted among the public that, even were the public to reject the image drawn by the Kuznets model, government officials are far too focused on economic development to be responsive to citizens expressing environmental concerns.

This assumption of government insensitivity is largely borne out, though there are occasional exceptions. Just in the past there have been a number of examples of protests forcing the government to back down from planned, environmentally damaging, development. In one case in 2007, residents of Xiamen (Fujian province) stopped development of a large (Taiwanese) chemical plant that threatened the health of city residents. In early 2008, Shanghai residents successfully blocked construction of a proposed extension to the Maglev train – a high visibility, high status project. However, notable in both these high profile successes is the relative prosperity of the protesting citizens and the urban context. As Pan Yue notes, major pollution accidents and environmental crises are regularly occurring across the country with very little notice or action being taken.

As this discussion illustrates, China does not lack environmental protection institutions (though they could benefit from expansion and improvement), nor does it lack a regulatory framework (though this too could be expanded and strengthened). Also notable is that China enjoys high state capacity – the *potential* to effectively implement policies. What China lacks, and the key to success, is a *commitment* to enforcing existing environmental laws and regulations.

Perhaps the most important initiative that the Chinese and US governments can take is to strengthen China’s commitment to enforcement. This can only be done by convincing the Chinese leadership and industry that environmentally sound development will not come at the expense of economic growth (and by extension to the detriment of the Party’s legitimacy to rule).

To convince the Chinese leadership, the US should prioritize pollution abatement technology transfers. Highly subsidized or preferably free, these technologies (e.g. pollution measurement technologies and

examples of effective laws, regulations and enforcement mechanisms) should be made available throughout the government bureaucracy as well as at the factory level.

An example of a factory level initiative can be found in programs developed by both the Canadian and UK government development agencies. These programs provided funds and expertise to install pilot pollution abatement facilities at the factory level in various provinces (using imported technologies). The goal of the programs was to illustrate the economic and environmental benefits of pollution abatement technologies, while providing factory owners with incentives to include environmental considerations in their business plans.

Perhaps most difficult is the question of leadership on pollution abatement. While giving lectures and attending meetings on environment-related topics in China I have repeatedly been confronted with Chinese audiences that question the US position and inquire why it does not lead by example. The fact that China is far poorer than the United States, and is polluting less on a per capita basis, limits the US's moral authority when challenging China to do better. Illustrating our commitment to sustainable growth by leading by example and transferring relevant technologies will assuage Chinese concerns that the US is cynically using environmentalism as a means to impede China's economic and political rise.

China has the basic infrastructure necessary to begin effective enforcement of environmental policies. What it lacks is the incentive to commit to further strengthening and actually enforcing its environmental policies. The US can encourage China by transferring technology and expertise, illustrating our strong commitment to environmentally sound growth and pressing the Chinese to reject the "pollute now, pay later" approach to environment and development.

The US role can be summarized as follows: a) encourage the concept of environmentally sound development; b) contribute resources to catalyze environmentally sound development; and, c) lead by example towards environmentally sound development.

As I will discuss below, the US should also encourage China's environmental civil society, and cooperation between international environmental civil society and its Chinese counterparts.

5. What steps is China taking on a governmental and non-governmental level to address the environmental impacts of its energy use? What role can the United States play in addressing these problems?

I have already addressed the Chinese government's role. Here I briefly touch on the potential role of non-governmental organizations. There exists an extensive literature focussing on China's growing civil society. While there are differences of opinion on where Chinese civil society is going, there is consensus among scholars that at the forefront of China's civil society movement are China's environmental NGOs (ENGOS).

In general, China's NGOs are carefully monitored and scrutinized. NGOs largely focus on supporting government initiatives (in health care, education, and environmental protection among others). While relatively free to act, ENGOS remain quite constrained as well. Most are engaged in local clean-up initiatives, education, or support for government laws and policies that local governments lack sufficient resources to implement or simply would prefer to ignore. Despite these limits, ENGOS have an important role to play. They offer an outlet for social activism while raising public awareness. They provide a means to challenge local industries to adhere to existing laws and regulations and they encourage the state to continue to expand its focus on environmental protection.

Over time, many ENGOS have tested the limits of the political space available. Such action is inherently dangerous and can lead to closure of the organization and/or jail time for organization members. Since

these organizations should be viewed as making a positive contribution to environmental protection in China (e.g. engaging the public and building and strengthening state incentive to protect the environment) it is beneficial to the US to support and encourage these organizations.

Support and encouragement can come in many forms. Direct and indirect funding for activities and training of China's environment community is the most obvious option. Another important form of support is global public attention. Any environmental organization that tests the political limits on behavior faces the threat of government sanction. However, global public attention and support for such organizations raises their profile and constrains the Chinese state from taking action against these groups with impunity.

Conclusion

The international community has grown increasingly aware of, and concerned with China's steadily deteriorating environment. The impact of this deterioration is felt not only by China, but by the international community as a whole. With growing international awareness have come initiatives to press China to invest in the environment and to assist China in its environmental protection efforts.

Since the aid available will never suffice to overcome the numerous challenges China faces, donors are constantly searching for efficiencies - tools that enable them to identify the strengths and weaknesses of potential aid recipients. The state capacity model enables donors to more efficiently direct the limited aid available. Does a province (or other unit of government) possess the capacity to effectively utilize the aid being proffered? Where are the weaknesses and strengths of the potential recipient? However, the existence of high state capacity does not ensure a willingness to utilize that capacity to achieve a particular goal. There must also be a clear commitment, in this case, to environmentally sound development.

As illustrated by preparations for the 2008 Beijing Olympics, the Chinese government has the capacity to identify a priority (e.g. successful games) and take often drastic action to achieve success (e.g. slash coal production to avoid embarrassing coal mine disasters; move or close polluting industries in Beijing and surrounding provinces; temporarily halt construction in Beijing; drastically curtail transportation in Beijing; and, divert drinking water from as far away as Shanxi province to ensure sufficient supplies during the games. All of these are measures that affected tens of millions of individuals). The Olympics are viewed by the leadership in highly nationalistic terms, with success providing a boost to Party legitimacy to rule. As a result, the incentive to achieve a successful result is sufficient to catalyze the Party and State to action. While perhaps unreasonable to expect a similar level of commitment to environmentally sound development, movement in this direction is clearly desirable.

The US should work to enhance capacity while encouraging a high level of commitment to environmentally sound development in China. It can do so through a combination of technology and expertise transfers, support for and public encouragement of civil society and by leading by example.

Panel III: Discussion, Questions and Answers

HEARING COCHAIR REINSCH: Thank you.
Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman. I want to thank each of you for being here and for the very thoughtful testimony that each of you submitted, which is very helpful when you're not an expert in these areas. It was enormously helpful.

Dr. Aldy, on page five and six of your testimony, you talk about

China not being a typical developing country as fitting within the Annex II of the Kyoto, that they should have higher obligations than a typical developing country.

I would agree with that. A country that we're running a \$250 billion trade deficit with and a lot of in advanced technology products is not a typical developing country and that through its \$2 trillion of foreign assets has put 200 billion in a sovereign wealth fund, making purchases here, that's not a normal developing country.

Dr. Schwartz, on page seven of your testimony, you talk about why they don't put as much emphasis on controlling environment--because the whole growth of the economy is part of the legitimacy of the party's hold on power in China.

And Dr. Levine, on page one and page eight of your testimony, you tell us that we should put a \$500 million fund together of which maybe 200 million should be directed to China for environmental programs of one sort or another.

I'm just trying to understand this. How would you convince the American taxpayer that we should be borrowing money from China to lend back to China or to give back to China to control pollution abatement in China when they could do that easily if they really wanted to do it?

It's really hard for me to get why we should be spending our resources. So that would be helpful, just to kick that idea around for a few minutes, because I think it will be a big one in the coming political debate on these issues. So maybe I could start with Dr. Levine, and then Mr. Aldy, and then Dr. Schwartz.

DR. LEVINE: Okay. I want to thank Commissioner Mulloy for the question because I think that is a tough question, and convincing people of that is not easy. Let me make an effort.

The \$200 million that I talk to does not go to China. It is almost entirely spent in this country. We're not providing money to China. I don't think China needs money. I don't think they even want our money. I do think, as a parenthetical comment, that the issue of the amount of dollars that the Chinese have amassed is a separate issue that needs to be dealt with at a macroeconomic level, and I don't want to go into that.

I don't think the money that China has amassed from trade surpluses can be used in China for the purposes that I've talked about.

I've had discussions with Chinese about this, and I think that the use of their foreign exchanges presents a very different issue from the environment and climate change discussions we are having.

The \$200 million per year that I am recommending enables China to spend many tens of billions of dollars productively in achieving a goal that is in our mutual interest, reducing greenhouse gas emissions.

It is the single least expensive action by the U.S. government that our government can make to reduce greenhouse gas emissions because it's essentially the lubricant that permits China to spend its money and make its policy decisions, but it's the hardest money to come by.

It's so-called "soft money" that nobody provides. I know that because I'm in the business of actually doing this sort of thing, and getting a dollar of this kind of money is harder than getting \$10,000 of investment money. But China doesn't need more investment money and it doesn't do us any good to provide it except as a commercial investment opportunity.

So I guess my point to the American taxpayer is if you care about greenhouse gas emissions and reducing them, and also if you want to work cooperatively with China in an area where we share great interests, this is a very tiny amount of money that can accomplish a great deal of good.

COMMISSIONER MULLOY: I have to turn back my time to the chair, but maybe we'll have an opportunity to get the rest of the panel to answer on that later. Thank you.

HEARING COCHAIR REINSCH: Thank you.
Commissioner Wortzel.

CHAIRMAN WORTZEL: Dr. Levine, I was going to go to the exact same point so you're going to get a chance to talk more about it because I appreciate your clarification. I read both pages one and eight of your testimony, and I said to myself, okay, \$1.8 trillion in foreign reserves, able to shut down maybe thousands of industries for the Olympics and still have the money to pay a lot of those workers so they don't go rioting on the streets, why are the American taxpayer going to give you \$200 million to China?

So I appreciate your clarification. If you want to clarify that in your written testimony before we publish it, it would probably be useful. I yield the time back to you if you want to respond to Commissioner Mulloy.

DR. LEVINE: There are a lot of different ways of looking at this. That \$200 million will save us spending billions of dollars that we're otherwise going to spend subsidizing investment in China. Through our investments in the World Bank, in CDM, Clean Development Mechanism, you're going to see large capital flows to China that I don't think China needs and I don't think are justified. Whereas a small amount of money can have a large impact. In my own experience, I was able to convince Chinese policymakers of the value of appliance standards. Once they learned what appliance standards were all about, and once they found out that with the proper expertise, they could develop and implement the standards, they were happy to do it.

But I appreciate both of your points because I think making that clear to members of Congress and to those people who represent the American taxpayer is very, very difficult. It's a subtle distinction. People think of money as money, and money that supports China is the same as money that would go to China, when, in fact, I think the point can be made and understood that this is, number one, money that does not go to China; it's expertise that will go to China that enables the two of us to work together to achieve common objectives.

Thank you.

DR. SCHWARTZ: Can I add to that briefly?

HEARING COCHAIR REINSCH: Yes.

DR. SCHWARTZ: Very briefly. In my experience with looking at environmental laws and regulations that were developed by the Chinese, the thing that stood out to me was how much more slim, not as thick, as the laws you might find on this side of the Pacific Ocean, and what arose from that was a clear example of the fact that the Chinese don't have the expertise to put together complex laws at the micro level dealing with pollution coming out of cement plants.

They don't know how to develop the in's and out's, something that we have a tremendous amount of expertise in. So if we can transfer expertise and that costs money for training, I think that that's only a benefit to them and to us. It's not a zero sum game. If the environment is improving, we all benefit so we should view it as a transfer of expertise.

HEARING COCHAIR REINSCH: Thank you.

Commissioner--

VICE CHAIRMAN BARTHOLOMEW: Dr. Aldy still has comments.

HEARING COCHAIR REINSCH: Dr. Aldy.

DR. ALDY: I would be pleased to add to that because I think this is a very important issue, not just for U.S.-China relations, but also when we think about the international climate policy regime, because there's a lot of debate going on now on financing technology transfer, effectively the developed countries financing the investment in lower carbon technologies in the developing world.

I think there's a concern here if we continue to treat all non-Annex I countries the same. There's a risk of continuing the precedent that the only abatement that will occur in developing countries will be as a byproduct of investment from the rich world. Over time, we will not be able to finance all the abatement that will be necessary in China, India, Brazil, et cetera.

That's why I think it's important for us to establish a rule by which when you're wealthy enough, you have to start doing more, and one thing we could do here when we talk about technology transfer is

to start thinking about, well, how do we condition that transfer of technology to developing countries.

We'll only transfer these technologies if, for example, you follow Dr. Levine's recommendation, that you start implementing a lot of different standards that will improve the energy efficiency of your economy. Perhaps you can make it even more aggressive and say you're not going to get any finance or subsidy of technologies until you actually implement, say, a carbon tax so that we don't run the risk that we're financing the investment of your energy-intensive industries that then get a competitive edge against our industries in America that may be facing more burdensome domestic regulations.

So I think it's very important that we start thinking about how we effectively diversify the kinds of actions and commitments that are expected of developing countries before we start allocating a lot of resources to finance the transfer of technologies.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Fiedler.

COMMISSIONER FIEDLER: I have two quick questions. One to Dr. Schwartz, but anyone can join in. You state that civil society or environmental groups, NGOs, are constrained, which strikes me as an understatement.

I want to get a sense for you optimism or pessimism on that in light of the Chinese government's clamp down on the Sichuan mothers whose children died in the earthquake because of faulty buildings, which is in my view somewhat analogous to environmental damage; right. I mean so they don't let them protest. They don't let them speak, and they're unnecessarily, in my view, frightened of the implications of those people speaking.

So environmental degradation is wreaking actually probably greater havoc than the Sichuan quake has, I mean if you started to add it all up. I don't see the space for environmental groups that other people see. Am I wrong somewhere here?

DR. SCHWARTZ: Thank you for the question. The Sichuan quake was especially embarrassing for local government. Any grouping, any group of citizens who get together in an uncontrolled way and begin to act out can be viewed, especially at the local level of government, as a potential threat.

Environmental NGOs, not only in China but also in Eastern Europe, tend to be a separate example of civil society. They tend to be viewed by governments as nonpolitical and thus not as threats. Environmental NGOs tend to not become involved in, as I was describing the ENGOs in China, they don't become involved in pushing the government to invest in new laws or develop new regulations or criticize the government on the lack of laws, but rather it tends to

work to encourage enforcement of existing laws or to organize clean-up campaigns in local neighborhoods, things that are viewed as relatively benign and only beneficial.

The Sichuan mothers are critical of the government, challenging the government on its past actions in a way that's far more embarrassing. So the distinction there is between environmental NGOs that are viewed as actually supporting central government initiatives and supporting noncontroversial issues.

COMMISSIONER FIEDLER: I would argue with the noncontroversial issues in the following way, and I'll link it to your statements, Dr. Levine, and others, on knowledge versus commitment. I take the point very seriously, and therefore question at what point and how do you measure commitment before you transfer the knowledge?

Because we have little evidence on the local government's part of a commitment to environmental clean-up or prevention. And by the way, Dr. Schwartz, I would say to you that it is inevitable that environmental groups question the commitment of a local government and therefore run smack dab against the state and sort of prohibited political activity ultimately.

One could argue, and I do, that free trade union organizations who are primarily concerned about affecting the behavior of employers are not a political threat. That is not shared by anybody in the Chinese government or frankly by anybody in the United States government vis-à-vis China or the United States, which is a separate argument.

I question how much wishful thinking is engaged in all of this process. What are the real measures that we should take as policymakers of the Chinese commitment?

DR. SCHWARTZ: I think he was referring to you.

DR. LEVINE: Reportedly there were some 50,000 demonstrations in China on environmental matters in the course of just one year. So at the local level there really is concern in China about the environment.

On this question of commitment, I want to say two things. One is I don't agree entirely with one of the speakers in that we can't go to China and say you have to do this, you have to do a carbon tax or whatever it is. I've been working with the Chinese for 20 years, and what you figure out is where there's a commonality of interests. In my case, because it's energy efficiency, there's a commonality of interests in almost everything we talk about because the Chinese government really wants energy efficiency to happen at the national level. At the provincial and local levels, if you talk to the right people who have the right authority, you find the same thing.

Before I provide any technical support, I get a commitment. They know that if they don't meet the commitment, that they won't get any more support. It's pretty simple. So in my 20 years of working with China in this area, they've never, ever broken a commitment.

Now, I've worked with people who look like they were going to break commitments, and we talk to their bosses, and end up finding ways for them to succeed. It's important for them to live up to commitments made seriously. It has to do with the nature of the dealing with China.

You can't get them to do what they don't want to do. You've got to find out an area where there is this commonality of interests. Fortunately, on limiting greenhouse gas emissions, although they won't say it in terms of public negotiations, their interests and ours coincide.

And there, once you get a commitment to "old friends," they don't break their word. And they never have with me.

HEARING COCHAIR REINSCH: Thank you.

Commissioner Bartholomew.

VICE CHAIRMAN BARTHOLOMEW: Thank you very much and thank you to all of our witnesses. It's interesting and the interplay between you all is always interesting.

It is this issue of capacity and commitment, if China is interested and willing. Dr. Levine, if you have been as successful as you say you have been, you should be doing tutorials for the U.S. Trade Representative who has gotten countless commitments from the Chinese government, by which they haven't abided. So perhaps we should invest \$200 million in having him doing training of U.S. trade negotiators.

We have just seen with the Olympics what the Chinese government can do in mobilizing a nation, increase nationalism, 150,000 at least security personnel on the streets of Beijing, and an estimate of 1.7 million Neighborhood Watch volunteers.

If the Chinese government wants to make these changes, it's really hard to believe that they can't. But we're faced with issues like coal-fired power plants that have scrubbers that are dismantled or turned off. I'm not sure of the technical term for that, but there are things out there. How do we find this commonality of interests? What could be more common than the quality of the air we breathe and the quality of the water we drink?

And with that missing, I am at a loss. So I'd be interested in more comments about how we find that and how we work together.

DR. SCHWARTZ: I had the very frustrating experience of teaching an advanced course in Xi'an in the spring titled "The Politics of Environment and Development." And my goal was to engage in a debate in a seminar with students on what can be done, what are the

challenges, Pan Yue's arguments, the Vice Minister of the Ministry of Environment, what can the Chinese do?

The general reaction of the students was we don't really care. We know the environment is not great, but I want a job, and I want a nice apartment and a car, and I personally was in no position to argue with them on that, which takes me back to how do we strengthen the commitment at the lowest level?

There's a general understanding that there's a problem, but there's also an understanding that we'll clean it up later. This is the pollute now/clean up later option, and it's destructive because even if the day comes when they have the wealth, and they do have a lot of wealth, to clean up their environmental mess, it's 1.3 billion people. The amount of pollution that they're producing is not sustainable.

They may reach that point where they can clean it up, but it will be too late to avoid egregious impact. So, yes, we have to find that point, and the micro-level kind of engagement in technology transfers or training and work at the factory level providing pilot examples of environmentally sound and energy efficient pollution abatement technologies. These are the kinds of things that are small, but can spread.

VICE CHAIRMAN BARTHOLOMEW: Dr. Aldy.

DR. ALDY: Yes. I think it's important for us to look for those common areas of interest, as you noted, Commissioner Bartholomew.

I think based on our visit in March, it was interesting in how often in talking about climate change policy, the issue of energy security came up, which is obviously a very salient issue here also. Because we are the two biggest consumers of oil in the world, there's a lot of interest in trying to think about what are the commonalities on energy security and climate.

I think we have to be careful though because there are some things that China can do on energy security that's actually bad for the climate. That is if they decide to use some of their coal for producing liquid fuels that has a much more adverse impact on the climate than burning crude oil as petroleum product.

So I think there are opportunities for us to look there. I think there are certainly opportunities for us to try to help them improve how they address their air quality and their air pollution because they do recognize it's an important issue.

I would say one thing in the context of thinking about tax policy and why I advocate for carbon taxes is because they're seriously thinking about that, whether it's Pan Yue, whether it's researchers who have been directed at the Energy Research Institute, they are evaluating carbon taxes. They're also looking at energy taxes and subsidy reforms.

I think part of it is to try to see what is on their policy agenda that can have an impact here, and how do you think about designing the right incentives in an international agreement. Not to tell them what to do per se, but to create the right incentive for them to say we're going to do this because it makes sense.

One thing that's going to be very important when we think about common interests and we think about commitments, because I have to admit I'm not as optimistic about their commitments because I look at their goal in the Five Year Plan of improving energy intensity, and it's been going in the wrong direction, but they look at the United States and say you said in 1992 in the Framework Convention, you were going to stabilize your emissions at 1990 levels starting in the year 2000.

You went to Kyoto and you negotiated a target for the 2008 to 2012 period, and then you never ratified the agreement. And so I don't expect China to come forward and do much on climate change and mitigating their emissions until they see leadership from the United States.

I agree completely with Dr. Schwartz on that, that we need to take some action, but I think this is the kind of thing where we can start walking sort of together with this and try to find ways where we can cooperate both on the policy front and in the development of technologies where I think it's going to be difficult to develop them, but carbon capture and storage technologies are going to be critical because we burn a lot of coal and they burn a lot of coal. It may make more sense for us to cooperate on the development of that technology, more so than say thinking about technology transfer policies.

VICE CHAIRMAN BARTHOLOMEW: Dr. Aldy, while I'm not a fan of what has happened in the past eight years in particular of what this country has and hasn't done in terms of the environment, I think we still have to ask, though, whether what the Chinese are saying about what we have or haven't done is an excuse or an explanation?

Thank you.

HEARING COCHAIR REINSCH: All right. Commissioner Videnieks.

COMMISSIONER VIDENIEKS: Good morning, gentlemen. Dr. Schwartz, you mentioned that the environmental cost to PRC is roughly eight to 13 percent of GDP. Is it eight to 13 percent cost before or after assessment of PRC GDP growth? How am I to understand it?

DR. SCHWARTZ: So you're saying is it eight to 13 percent of the 11 percent growth? I don't think this is clear—the point is that China's environmental damage is estimated to cost 8-13 percent of China's GDP growth each year.

COMMISSIONER VIDENIEKS: Growth. I thought it was GDP. Okay. I'm sorry.

I agree totally with your point that U.S. should lead by example. In today's Washington Post, Robert J. Samuelson wrote that would not be a painless or inexpensive process or effort on our part. So that's something probably politically not too easy to achieve.

The other thing was, Dr. Levine, you mentioned that increased efficiency would be a laudable goal. Frequently, lately, people have stated that energy intensity due to the industrialized countries transferring certain production methods, energy-intensive production methods to China, that that in itself is creating increased pollution and in some ways should be recognized by the West and industrialized countries when they assess or talk about the increase in PRC pollution.

The fact that we're transferring cement, steel, and other industries to PRC, which are energy intensive and therefore pollution intensive, obviously efficiency factors into it.

Maybe all three of you could comment on that. The question is should we, how should we account for the transfer, the shift, the global shift of certain industries to PRC?

DR. ALDY: I think this last question, commissioner, is very important. Some Chinese scholars have estimated that a quarter of their energy consumption in 2006 was in manufacturing goods that they exported, and there's some recent estimates that would show that if for the United States, if we adjusted our accounting of our carbon dioxide emissions for the carbon intensity of our net imports, our emissions would be some ten to 30 percent higher.

This is an issue that is not lost on the Chinese. They have actually talked about the need to actually move from a production model for accounting for emissions, so where do the emissions occur of carbon dioxide in the world, to a consumption model, and that actually ought to be the basis for commitments. And that's the argument they had made in part to also say here's why we shouldn't be doing as much, we're actually making all the world's dirty manufactured goods that you need when you make automobiles or when you actually put up buildings with cement and steel, et cetera.

The flip side of that obviously is a concern of how do we protect our energy intensive industries, especially as we move forward and pursue domestic policies in the United States. A lot of the discussion on adjustments at the border in the United States is because of our so-called China problem.

I should note as a parenthetical though that in France they refer to this as their U.S. problem because they're concerned about the EU moving forward with their climate change policies while the U.S. is not at present time.

But I think this is going to be something that's going to be one of the more contentious elements in the international debate, and whether or not you see unilateral actions, say some of what was considered in the Lieberman-Warner bill and other bills dropped in this session of Congress, whether it comes into how we do the accounting in the international regime, or how we think about whether or not we do a multilateral approach to effectively try to prevent this emissions leakage.

I mean this is very important, not just from the fact that we lose perhaps jobs in the manufacturing sector and economic activity. It undermines the environmental policies that we're trying to pursue here. And so I think it's very important from both an economic and environmental position and not have climate policies drive more relocation of activity to China or other countries that don't have policy commitments and policy actions in place.

So I think that's an area that is going to require a lot of additional research and analysis and will be part of a very difficult debate both in the Congress when they consider domestic policy and in international negotiations.

COMMISSIONER VIDENIEKS: Thank you.

HEARING COCHAIR REINSCH: Do the others want to comment as well or not?

DR. LEVINE: Yes. I think this issue of trade could end up being a very stubborn one that will set back discussion. I think, first of all, it's going to turn out that when careful analysis is done, that trade contributes less to CO2 than people presently think. We'll be coming out with a paper that will suggest that there have been some methodological problems.

Secondly, it's an issue that cuts both ways. From the U.S. perspective, all this stuff coming in from China that has embodied carbon is bad and we should do something about it. From the Chinese perspective, they're making these products for the American consumer; why does it count against China?

It turns out that there is so little of this coming into the U.S., that when all is said and done, it actually isn't going to matter, and I'd be happy to write you a little paper to convince you of that, that it's a second or third-order effect.

But politically, it's a first-order effect, and so what we'll have is a situation where the disagreements about the effect on carbon limits on trade, which can and should be resolved – will stand in the way of getting an agreement on limiting greenhouse gas emissions.

In another topic, I made a statement about China meeting commitments based on my experiences. I appreciate Commissioner Bartholomew's question. If I were advising trade representatives, it

probably wouldn't do much good except I could tell them the agreements that don't make sense probably aren't going to work out.

I've had discussions with Elizabeth Economy. Liz works on environment and is aware of all the problems of getting China to do things, and I work on energy efficiency, and I'm aware of all the things China can do. It's a situation where on environment per se, while the national government would like to do a lot, the locals for reasons that you've heard from many of your witnesses, really thwart them.

On energy efficiency, on the other hand, an agreement is much easier because they want to do it and they need the tools to make it happen.

HEARING COCHAIR REINSCH: Okay. The last question from Commissioner Slane.

HEARING COCHAIR SLANE: What frustrates me is that they have seemed to study a lot of our technology. For example, there's an IGCC plant, Tampa Power and Electric that I went down and visited. The Department of Energy set it up, and they told me that they've had hundreds and hundreds of Chinese scientists come through there, environmental people.

I've also talked to American Electric Power who is part of the Asia-Pacific Partnership. They've had hundreds of Chinese scientists and clearly what I'm being told is IGCC solves a lot of their problems, but yet they don't seem to, they're so fragmented, they don't seem to have any kind of cohesive focused policy to do anything about it.

The problem just continues to get worse, and while you may dispute this, Dr. Levine--one of the things that we heard in China was you have to help us financially. We want GE's technology which is IGCC, we want their technology. So it's frustrating trying to figure out how can we help them?

DR. LEVINE: I don't dispute your statements at all. If you offer to give me something, I'm going to take it. And if I can convince you to give me more, I'll try to do that, and so these are things that China does want.

The question is what do they need, not what do they want, and what will do the most good? In terms of your first question, you've heard from others, Chinese energy policy is very fragmented, and in fact we can't think of them as a monolith in the energy area at all because different actors do different things.

If you're in China and you have enough money, you can build an IGCC facility, but it takes a huge amount of money to do that. In fact, so much money that I've been told that the IGCC facilities we're building in the U.S. are not state-of-the-art because this is a huge undertaking, and I think the world hopes that China can get it together and invest in the best IGCC facility that be built because we'd all learn

from it.

And we've all had a hard time making that happen. There really isn't in any country the right kind of expertise in any country to be sure of success in constructing a state-of-the-art IPCC facility. It's not like building a power plant. It's more like building a chemical factory. And so it's been very difficult. On the subject of Chinese efforts to carry out advanced technology projects, you're absolutely right. The Chinese government is very successful in some undertakings--they can make things happen--and in other areas, the government is very ineffectual.

HEARING COCHAIR REINSCH: All right. Thank you very much to all three of you. We appreciate it. Interesting testimony.

With that, we will stand in recess until 1:30 when we'll convene the afternoon panels.

[Whereupon, at 12:30 p.m., the hearing recessed, to reconvene at 1:30 p.m., this same day.]

A F T E R N O O N S E S S I O N

PANEL IV: THE EFFECTS OF CHINA'S GREENHOUSE GAS EMISSIONS, AND CHINA'S APPROACH TO GLOBAL CLIMATE CHANGE

HEARING COCHAIR SLANE: We're back in session. Welcome back to our hearing on China energy policies and their environmental impacts.

Our fourth panel will address the effects of China's greenhouse gas emissions and China's approach to global climate change. We're pleased to hear from two distinguished scholars on this issue: Dr. Joanna I. Lewis and Dr. Dan Jaffe.

Dr. Joanna I. Lewis is an Assistant Professor of Science, Technology and International Affairs at Georgetown University's Edmund A. Walsh School of Foreign Service, previously at Pew Center on Global Climate Change. She conducted research and analysis on international climate change policy issues, facilitates dialogues with governments and stakeholders, and tracks energy and climate policy abroad.

Dr. Dan Jaffe is a Professor of Atmospheric and Environmental Chemistry at the University of Washington-Bothell. He is also an adjunct professor at the Department of Atmospheric Science at the University of Washington in Seattle.

His areas of expertise are in global and regional atmospheric pollution, especially mercury, carbon monoxide, ozone, nitrate oxides, aerosols and other metals, and in long-range transport of air pollution in the Arctic and Pacific regions.

We would like to thank each of you for coming and we look forward to your remarks. We'll begin with Dr. Lewis.

**STATEMENT OF JOANNA I. LEWIS, PH.D.
ASSISTANT PROFESSOR OF SCIENCE, TECHNOLOGY AND
INTERNATIONAL AFFAIRS, EDMUND A. WALSH SCHOOL OF
FOREIGN SERVICE, GEORGETOWN UNIVERSITY
WASHINGTON, DC**

DR. LEWIS: Thank you. Members of the Commission, good afternoon, and thank you for the invitation to participate in this panel to discuss China's approach to global climate change.

I've worked in China for several years in several different ways on energy and climate issues. I closely follow the U.N. negotiations and I've also worked on the ground on energy efficiency and renewable energy policy design and implementation.

I'd like to begin today with a few key points. First, the Chinese leadership is very concerned about climate change. Currently, however, they are more concerned about sustaining strong economic growth and enhancing energy security and these things are inherently linked to stability.

Increasingly, they are concerned about local environmental quality issues, and therefore the best climate change approach for China will simultaneously address energy security, local pollution and the economy.

Second, China is already doing a lot to reduce its own emissions. It has an aggressive suite of policies and measures in place including those targeting energy efficiency and renewable energy which could have substantial implications for domestic greenhouse gas reductions.

The implementation of many of these policies has proven challenging, however, and it is increasingly difficult for the central government to establish the correct incentives at the local level to ensure effective policy implementation.

Third, China will need help in achieving significant emission reductions and an enhanced U.S.-China relationship focused on climate change and energy will be crucial.

China needs international assistance and not just in the form of the financial and technology assistance that they publicly demand. They need technical assistance with data collection, with establishing accurate domestic systems to quantify and monitor greenhouse gas emissions, and with modeling and projecting their future emissions growth.

Such baseline information is crucial to informing any domestic climate change policies as well as to setting any international climate change commitments.

Fourth, there are technical as well as political reasons, not just political reasons, that China is unlikely to agree to greenhouse gas emissions by committing to an absolute emissions reduction target. Committing to quantifiable emissions limits is challenging for a country that has little prescience into its future emissions pathway, as recent emissions trend well outside the bound of expert modeling projections have illustrated.

It will be more technically and politically feasible for China to commit to policies that will then lead to absolute emissions reductions or perhaps to intensity targets that are indexed to economic growth.

And fifth, U.S. leadership on climate change is essential to engaging China. U.S. leadership is critical both in its domestic climate policy as well as in the international negotiations and in developing and demonstrating technology that will be critical for greenhouse gas mitigation around the world.

One example of a technology where U.S. leadership will be crucial is carbon capture and storage technology applied to coal power plants. Ultimately, China is the one place where this technology may be the most needed, but it also may be the most challenging environment in which to deploy it.

This morning you've heard a lot about China's energy policies and their environmental impacts, and I have elaborated on several of these in my written testimony, but I think I'll take the time now to briefly elaborate on China's approach to global climate change and how the U.S. and the international community could engage China on this important topic.

China's position in the international negotiations has rarely deviated from the rest of the developing world which is currently articulated by the Group of 77 which is a group of 130 developing countries, formerly 77. The consistent position of this negotiating bloc has been to emphasize the historical responsibility that the industrialized world brings to the climate change problem and the disparity between per capita emissions that persist between the developed and developing world.

In recent years, China's alliance with the G-77 position has not waned, and in fact, I think we've seen its willingness to step out of this pack declining even further as its fear of being singled out grows due to increasing economic growth and energy use.

Despite the EU's willingness to commit to post-2012 emissions reduction targets, the absence of international commitments by the United States, the world's largest industrialized country, does provide the best excuse for China to not accept commitments.

And even as China's emissions surpass those of the U.S. on an annual basis, it will be decades before Chinese emissions surpass U.S. emissions on a cumulative basis, measured as an historic contribution of emissions to the atmosphere, and since greenhouse gases do stay in the atmosphere for a century or more, it is this build up of gases over time that is important.

China's current per capita greenhouse gas emissions would have to quintuple to roughly equal those of the United States. So consequently, if the United States were to take on credible international climate change commitments, China would face renewed pressure to revisit its delayed tactics.

Another key dynamic that could shift in the near term is that of the G-77 developing country negotiating bloc. We already are seeing countries within the G-77 beginning to diverge somewhat in their positions in the climate negotiations which could leave China in a somewhat more isolated negotiating position.

China has been consistent in its position that as a developing

country it should not have to take on any binding international commitments to reduce its emissions. However, I want to point out that some of China's hesitancy to do this stems from reasonable concerns about energy data quality and transparency.

In developing countries where resource constraints result in limited data quality, inventories of greenhouse gas emissions are notoriously inexact. And the uncertainty associated with national inventories makes it very difficult to implement greenhouse gas reduction commitments that rely on these inventories and estimated annual improvements at the national level, particularly in these countries.

So having in place a national system will be a crucial step in enabling the adoption or enforcement of any binding emissions reduction policies whether enacted nationally or internationally.

A central challenge to addressing global climate change will be arriving at multilateral agreements that include adequate effort by all of the major economies to reduce and moderate their greenhouse gas emissions. To date, this effort has relied on a particular form of commitment which is this economy-wide emissions target.

Such limits were voluntary initially for developed countries under the UNFCCC, and later binding under the Kyoto Protocol, and developing countries will continue to reject this type of commitment; therefore, I think it's important to explore other commitment types that may be more appropriate for developing countries.

For China to increase its international commitment to climate action, its overarching concerns will need to be addressed. These include, because of its reliance on coal, the large incremental cost it faces in moving toward higher efficiency coal technology and in capturing the emissions from these plants; concerns about energy data quality and transparency that are at the root of its hesitancy to commit to quantifiable targets; and current limitations on the use of foreign investment and foreign technology to achieve its domestic development goals.

Recognizing the unique challenges that China faces in addressing climate change can inform what it will be willing and able to undertake within a multilateral climate agreement, and in the Chinese context, it might make sense to examine intensity targets, sectoral agreements, and policy commitments and crediting. Targeted international assistance will also be an important component of any international climate agreement.

I will stop there, and I'm happy to expand on these or any other points in your questions. Thank you.

[The statement follows:]

**Prepared Statement of Joanna I. Lewis, Ph.D.
Assistant Professor of Science, Technology and International
Affairs, Edmund A. Walsh School of Foreign Service
Georgetown University, Washington, DC**

**Joanna I. Lewis, Ph.D.
Assistant Professor of Science, Technology and International Affairs
Edmund A. Walsh School of Foreign Service
Georgetown University**

**Testimony before the U.S.-China Economic and Security Review Commission
Hearing on “China's Energy Policies and Their Environmental Impacts”
Panel on *The Effects of China's Greenhouse Gas Emissions, and China's Approach to
Global Climate Change*
August 13, 2008**

Members of the Commission: good afternoon, and thank you for the invitation to participate in this panel to discuss China's approach to global climate change.

I would like to begin with a few key points:

1. The Chinese leadership is concerned about climate change. Currently, however, they are more concerned about sustaining strong economic growth, and enhancing energy security. Increasingly, they are concerned about local environmental quality issues. Therefore, the best climate change approach for China will simultaneously address energy security, local pollution, and the economy.

2. China is already doing a lot to reduce its own emissions. It has an aggressive suite of policies and measures in place, including those targeting energy efficiency and renewable energy, which could have substantial implications for domestic greenhouse gas reductions. Implementation of many of these policies has proven challenging, however, as it is increasingly difficult for the central government to establish the correct incentives at the local level to ensure effective policy implementation.

3. China will need help in achieving significant emissions reductions, and an enhanced U.S.-China relationship focused on climate change and energy will be crucial. China needs international assistance, and not just in the form of the financial assistance and technology assistance they publicly demand. It needs technical assistance with data collection, with establishing accurate domestic systems to quantify and monitor emissions, and with modeling and projecting future emissions growth. Such baseline information is crucial to informing any domestic climate change policies, as well as to setting any international climate change commitments.

4. There are technical—not just political—reasons that China is unlikely to agree to cap its greenhouse emissions by committing to an absolute emissions reduction target. Committing to quantifiable emissions limits is challenging for a country that has little prescience into its future emissions pathway, as recent emissions trends well outside the bounds of expert modeling projections have illustrated. It will be more technically and politically feasible for China to commit to policies that will lead to absolute emission reductions; or to intensity targets, indexed to economic growth.

5. U.S. leadership on climate change is essential to engaging China. U.S. leadership is critical in its domestic climate policy, in the international negotiations, and in developing and demonstrating technology that will be critical for greenhouse gas mitigation around the world. One example of a technology where U.S. leadership will be crucial is carbon capture and storage technology applied to coal power plants. Ultimately, China is the one place where this technology may be most needed, but it may be the most challenging environment in which to deploy it.

Introduction

China's role in an international climate change solution cannot be overstated. Now the world's largest emitter of greenhouse gases, China has become the focus of scrutiny as climate change has become ever more important as a global issue. Increased international attention to the issue is reflected in China's domestic policy circles as well, primarily through institutional restructuring aimed at better government coordination on climate-related policy activities. China released its first national climate change plan last year, composed of measures being taken across the economy that may help slow China's greenhouse gas emissions growth. Yet, China faces substantial challenges in mitigating its increasing contribution to global greenhouse gas emissions, which will require a much higher level of effort than what may be achieved by measures already in place. Understanding the nature of these challenges in the Chinese context helps us to clarify China's negotiating position in international forums, and can provide insights into how the international community might best engage China to address global climate change.

Climate's Competing Priorities

China's climate strategy remains centered on its energy development strategy, as driven by its overall economic development goals. Although attention to climate change has recently increased among China's leadership, climate change has not surpassed economic development as a policy priority. Yet, the causes of climate change, namely greenhouse gas emissions from fossil fuels and land use, are inherently linked to economic development in the Chinese context. Continued growth in the prosperity of the Chinese population is viewed as fundamental to maintaining political stability, and progress to date in this regard has been impressive. China's economic growth over the past two decades, marked by its quadrupling in Gross Domestic Product (GDP) from 1980 to 2000, has been credited with pulling roughly 50 million people out of poverty.

The relationship between economic growth and energy utilization matters greatly, not only from an emissions perspective, but from an energy security perspective as well. Although China quadrupled its GDP between 1980 and 2000, it did so while merely doubling the amount of energy it consumed over that period, marking a dramatic achievement in energy intensity gains not paralleled in any other country at a similar stage of industrialization. This allowed China's energy intensity (ratio of energy consumption to GDP) and consequently the emissions intensity (ratio of carbon dioxide [CO₂]-equivalent emissions to GDP) of its economy to decline. Without this reduction in the energy intensity of the economy, China would have used more than three times the energy that it did during this period.

Between 2002 and 2005, however, this trend reversed, and energy growth surpassed economic growth for the first time in decades. This reversal has had dramatic emissions implications, with China's greenhouse gas emissions growing very rapidly since 2002. In 2007, it is estimated that China's emissions were up 8 percent from the previous year, which would make China the largest national emitter by far on an annual basis, surpassing U.S. emissions that year by 14 percent.¹ Currently, China emits 35 percent more CO₂ per dollar of output than the United States, and 100 percent more than the European Union. China's increase in energy-related emissions in the past few years has been driven primarily by industrial energy use, fueled by an increased percentage of coal in the overall energy mix. Industry consumes about 70 percent of China's energy, and China's industrial base supplies much of the world. For example, China today produces about 35 percent of the world's steel and 28 percent of aluminum, up from 12 percent and 8 percent, respectively, a decade ago.²

China relies on coal for over two-thirds of its energy needs, including approximately 80 percent of its electricity needs. Currently, more coal power plants are installed in China than in the United States and India combined. China's coal power use is expected to more than double in size by 2030, representing an additional carbon commitment of about 86

¹ Netherlands Environmental Assessment Agency (MNP), "China contributing two thirds to increase in CO₂ emissions." Press release; June 13, 2008.
<http://www.mnp.nl/en/service/pressreleases/2008/20080613ChinacontributingtwothirdstoincreaseinCO2emissions.html>

² Trevor Houser, "China's Energy Consumption and Opportunities for U.S.-China Cooperation to Address the Effects of China's Energy Use," testimony before the U.S.-China Economic and Security Review Commission, June 14, 2007,
http://www.uscc.gov/hearings/2007hearings/written_testimonies/07_06_14_15wrts/07_06_14_houser_statement.php.

billion tons.³ Although China is also expanding its utilization of nuclear power and non-hydroelectric renewables, these sources comprise 2 percent and 0.7 percent of China's electricity generation, respectively, whereas hydroelectricity contributes about 16 percent.⁴

China's overall economic development statistics reveal that, despite the emergence of modern cities and a growing middle class, China is still largely a developing country. Although rapid economic growth has made China the fourth-largest economy in the world, its GDP per capita is still below the world average. More than one-half of China's population lives in rural areas where GDP per capita lags that of urban areas. The gap between the best available technologies worldwide and what exists in China is still large, although advanced energy technology is increasingly available and in many cases being developed indigenously. China's per capita greenhouse gas emissions are below the world average and almost one-fifth those of the United States.

All of these factors shape the climate challenge faced by China's leadership. It is increasingly difficult for China to rein in its greenhouse gas emissions growth as investment surges continue in heavy industry. Changing China's emissions trajectory will require either a substantial shift away from coal or massive investments in capturing the CO₂ emissions from coal-based energy sources. Simultaneously, China must increase the efficiency with which it uses energy resources to minimize the environmental impacts of meeting the further economic development needs of its population.

Climate Action in China

China released its *National Climate Change Program* report on June 4, 2007.⁵ Referred to as China's climate change plan, the report has provided a comprehensive synthesis of the policies that China currently has in place that are serving to moderate its greenhouse gas emissions growth and to help the country adapt to climate impacts. The majority of the policies and programs mentioned in the plan are not climate change policies per se, but policies implemented throughout the economy, and particularly in the energy sector, that have the effect of reducing greenhouse gas emissions. Many of these policies have been enacted to help the country meet its broader economic development strategies, and, if implemented effectively, will also serve as policies to mitigate China's greenhouse gas emissions. Three of these key policy areas are energy efficiency, renewable energy, and

³ Energy Information Administration (EIA), U.S. Department of Energy, "International Energy Outlook 2007," May 2007, chap. 5, <http://www.eia.doe.gov/oiaf/ieo/index.html>.

⁴ *China Energy Statistical Yearbook 2006* (Beijing: China Statistics Press, 2007); REN21, "Renewables Global Status Report 2006 Update," 2006, http://ren21.org/pdf/RE_GSR_2006_Update.pdf.

⁵ Chinese National Development and Reform Commission, "China's National Climate Change Programme," June 2007, <http://en.ndrc.gov.cn/newsrelease/P020070604561191006823.pdf>.

industrial policy.

Energy Efficiency

With the hope of achieving energy intensity improvements between 2000 and 2020 similar to those of the previous two decades, China has a broad national goal of quadrupling economic growth while doubling energy consumption. Beijing's eleventh five-year plan includes a near-term goal of reducing national energy intensity 20 percent below 2005 levels by 2010. Implementation of such centrally-administered government targets has proven challenging, particularly at the local level. In an attempt to improve local accountability, the NDRC is allocating the target among provinces and industrial sectors, and energy efficiency improvement is now among the criteria used to evaluate the job performance of local officials. These elevated implementation efforts appear to be having some impact. Following increases in energy intensity each year from 2003 to 2005, the trend was reversed in 2006, although the intensity decline achieved was short of the goal for that year.

Supplementary programs have been established to encourage specific actors to help meet this national intensity goal, including a program established in 2006 to improve energy efficiency in China's largest enterprises.⁶ Another government effort targets the elimination of a number of small, inefficient power plants, totaling around 8 percent of China's total generating capacity, by 2010. Similar plant closings are planned across the industrial sector, including inefficient cement, aluminum, ferro-alloy, coking, calcium carbide and steel plants.

In addition, the 1997 Energy Conservation Law initiated a range of programs to increase energy efficiency in buildings, industry and consumer goods. China has efficiency standards and labeling programs in place for many key energy-consuming appliances and is adopting energy standards for buildings in regions with high heating and cooling demands. In the transport sector, China's fuel economy standards for its rapidly growing passenger vehicle fleet are more stringent than those in Australia, Canada and the United States, although less stringent than those in the European Union and Japan, and the average fuel economy of new vehicles is projected to reach 36.7 miles per gallon in 2008.⁷

Renewable Energy

Under the National Renewable Energy Law adopted in 2005, China has set a target of

⁶ Lynn Price and Xuejun Wang, "Constraining Energy Consumption of China's Largest Industrial Enterprises Through Top-1000 Energy-Consuming Enterprise Program," Lawrence Berkeley National Laboratory, June 2007, <http://ies.lbl.gov/iespubs/LBNL-62874.pdf>.

⁷ An Feng and Amanda Sauer, "Comparison of Passenger Vehicle Fuel Economy and GHG Emission Standards Around the World," Pew Center on Global Climate Change, December 2004, http://www.pewclimate.org/global-warming-in-depth/all_reports/fuel_economy.

producing 16 percent of its primary energy from renewable sources by 2020, up from about 7 percent at present. For the electricity sector, the target is 20 percent of the capacity from renewables by 2020, which will require substantial increases in the use of wind power, biomass power, and hydropower. This law offers financial incentives, such as a national fund to foster renewable energy development and discounted lending and tax preferences for renewable energy projects. Although the increase in wind power in particular has been impressive in recent years, this energy source is still dwarfed by large-scale hydropower. Hydropower capacity is projected to more than double by 2020, requiring the equivalent of a new dam the size of the Three Gorges Project every two years.

Policies to promote renewable energy also include mandates and incentives to support the development of domestic technologies and industries, for instance, by requiring the use of domestically manufactured components. Chinese manufacturers are now producing about 40 percent of the wind turbines being sold in China and 3 percent of the wind turbines being sold globally. Tax and other incentives have targeted the solar photovoltaic (PV) industry, stimulating a six-fold growth in PV production from 2004 to 2005. China is now the largest manufacturer of solar PVs in the world, accounting for 35 percent of the global market.⁸

Industrial Policies

The recent surge in energy consumption by heavy industry in China has caused the government to implement measures to discourage growth in energy-intensive industries compared with sectors that are less energy intensive. In November 2006, the Ministry of Finance increased export taxes on energy-intensive industries. This includes a 15 percent export tax on copper, nickel, aluminum and other metals, a 10 percent tax on steel primary products; and a 5 percent tax on petroleum, coal and coke. Simultaneously, import tariffs on 26 energy and resource products, including coal, petroleum, aluminum and other mineral resources, were reduced. Whereas the increased export tariffs are meant to discourage the relocation of energy-intensive industries to China for export markets, the reduced import tariffs are meant to promote the utilization of energy-intensive products produced elsewhere.

Framing China's Negotiating Position

China's position in the international climate negotiations has rarely deviated from the rest

⁸ "Solarbuzz Reports World Solar Photovoltaic Market Growth of 62 Percent in 2007." Solar Daily, March 18, 2008.
http://www.solardaily.com/reports/Solarbuzz_Reports_World_Solar_Photovoltaic_Market_Growth_Of_62_Percent_In_2007_999.html

of the developing world, as collectively articulated by the Group of 77 (G-77), a group of 130 (formerly 77) developing countries. Recently, the financial incentives for emissions reductions provided by the Kyoto Protocol's Clean Development Mechanism (CDM) has also helped shape China's views on the international regime.

G-77 Solidarity

Developing country solidarity has long been used as a strategy to influence the climate change negotiations, despite the growing economic differentiation within the developing world, and often disparate climate policy interests, within the developing world. Aware of their limited weight of acting in isolation, developing countries attempt to build common positions in the framework of the G-77, the largest intergovernmental organization of developing states in the United Nations. China has historically associated itself with the G-77, despite not having the problem of limited weight in acting alone. The consistent position of the G77 has been to emphasize the historical responsibility that the industrialized world brings to the climate change problem and the disparity between per capita emissions that persists between the developed and developing world.

In recent years, China's alliance with the G-77 has not waned. In fact, its willingness to step out of the pack has declined even further as its fear of being singled out grows due to increasing economic growth and energy use. Despite the EU's willingness to commit to post-2012 emissions reduction targets, the absence of international commitments by the United States, the world's largest industrialized-country emitter, provides the best excuse for China to not have to adopt commitments. Even as China's emissions surpass those of the U.S. on an annual basis, it will be decades before Chinese emissions surpass U.S. emissions on a cumulative basis, measured as historic contribution of emissions to the atmosphere. Greenhouse gases stay in the atmosphere for a century or more, so it is really the buildup of gases over time that is important from a scientific perspective. As previously mentioned, China's current per capita greenhouse gas emissions would have to quintuple to equal those of the United States.

Consequently, if the United States were to take on credible international climate change commitments, China would face renewed pressure to revisit its delay tactics. Another key dynamic that could shift in the near term is the G77 negotiating block. Countries within the G77 are beginning to diverge somewhat in their positions, which could leave China in a more isolated negotiating position. Some tropical forest countries have stated a willingness to take on voluntary avoided-deforestation targets in return for compensation;⁹ historically, voluntary international targets of any form have not been part of the G-77 position.

⁹ "Reducing Emissions From Deforestation in Developing Countries: Approaches to Stimulate Action," January 30, 2007, http://unfccc.int/files/methods_and_science/lulucf/application/pdf/bolivia.pdf (submission of views of 17 parties to the 11th Conference of the Parties to the UNFCCC).

Capitalizing on the Clean Development Mechanism

China has ratified the primary international accords on climate change—the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol—but as a developing country, China has no binding emissions limits under either accord. It is, however, an active participant in the CDM established under the Protocol, which grants emissions credits for verified reductions in developing countries, which can be used by developed countries toward meeting their Kyoto targets.

China has been consistent in its position that, as a developing country, it will not take on any binding international commitments to reduce its greenhouse gas emissions.¹⁰ Some of China's hesitancy to make international commitments stems from reasonable concerns about energy data quality and transparency. In developing countries, where resource constraints result in limited data quality, inventories of national greenhouse gas emissions are notoriously inexact.¹¹ The uncertainty associated with national inventories makes it very difficult to implement greenhouse gas reduction commitments that rely on baseline inventories and estimated annual improvements at the national level, particularly in developing countries. Having in place a national emissions inventory system will likely be a crucial step in enabling the adoption and enforcement of any binding emissions reduction policies, whether enacted nationally or internationally.

Another reason for China's hesitancy stems from broader concerns about the role of international actors in China. China was initially skeptical about the introduction of the Kyoto mechanisms under the UNFCCC, not only viewing the CDM as a way for developed countries to avoid their own responsibilities to reduce emissions, but also expressing concern about the potential for foreign exploitation of rights to ownership of emission credits. China has long resisted foreign involvement in various sectors and activities, particularly industries deemed to have an impact on national economic security.

Despite these restrictions, China has emerged as the leading CDM host country, with about 1.2 billion tons of CO₂-equivalent credits scheduled to be issued by the end of the

¹⁰ "China to Watch Others on Climate Change Action," Reuters, June 15, 2005, <http://www.enn.com/today.html?Id=7959>; P. Parameswaran, "Rich Nations Must Honor Climate Change Pledge: Developing Countries," Agence France-Presse, September 25, 2007, <http://sg.news.yahoo.com/afp/20070925/tts-un-climate-warming-developing-c1b2fc3.html>.

¹¹ See U.S. General Accounting Office, "Selected Nations' Reports on Greenhouse Gas Emissions Varied in Their Adherence to Standards," GAO-04-98, December 2003, <http://www.gao.gov/new.items/d0498.pdf>; David G. Streets et al., "Recent Reductions in China's Greenhouse Gas Emissions," *Science*, November 30, 2001, pp. 1835-1837; Subodh Sharma, Sumana Bhattacharya, and Amit Garg, "Greenhouse Gas Emissions From India: A Perspective," *Current Science*, February 10, 2006, <http://www.ias.ac.in/currsci/feb102006/326.pdf>.

Kyoto Protocol's first commitment period in 2012.¹² This means that over half (52 percent) of total emissions reductions under the CDM are taking place in China. At a price of \$10 per ton, sales of the 1.2 billion tons of reductions currently in the pipeline would represent a total investment in China of about \$12 billion.

Options to Advance International Negotiations

A central challenge in addressing global climate change will be arriving at multilateral arrangements that include adequate effort by all major economies to moderate and reduce their greenhouse gas emissions. The multilateral climate effort to date has relied on a particular form of emissions commitment, economy-wide emissions limits. Such limits for developed countries were voluntary within the UNFCCC, and later binding under the Kyoto Protocol. Developing countries have historically resisted emission limits, however, and will likely continue to do so in any discussion or negotiation of the post-2012 climate effort. Consequently, there is a need to explore alternative approaches to engage large developing countries, such as China, in real mitigation activities in the forthcoming climate change negotiations.

For China to increase its international commitment to climate change action, its overarching concerns will need to be addressed. These include, because of its reliance on coal, the large incremental cost it faces in moving toward higher-efficiency coal technology and in capturing the emissions from these plants; concerns about energy data quality and transparency that are at the root of its hesitancy to commit to quantifiable targets; and current limitations on the use of foreign investment and foreign technology to achieve its domestic development goals. Recognizing the unique challenges that China faces in addressing climate change can inform what it will be willing and able to undertake within a multilateral climate agreement. In the Chinese context, it may make sense to examine intensity targets, sectoral agreements, and policy commitments and crediting. Targeted international assistance will also be an important component of any international climate agreement.

Intensity versus Absolute Targets

Developing countries, including China, view absolute greenhouse gas targets, such as those under the Kyoto Protocol, as a cap on their economic growth. Intensity-based targets, whether measured as energy intensity or greenhouse gas intensity, are based on a ratio of the amount of energy or greenhouse gas emissions per unit of economic output. Because such a target is inherently indexed to the economic growth of a country, meeting this target does not directly require a decrease in economic production to meet it. This type of target is therefore more palatable to developing countries that oppose caps on their economic growth on equity principles. Meeting this type of target requires countries to understand the core drivers of their emissions within their economy, while

¹² "UNEP Risoe CDM/JI Pipeline Analysis and Database," September 2007, <http://cdmpipeline.org/index.htm>.

incentivizing more efficient energy consumption and eventually a decoupling of energy use from economic growth.

The main limitation of an intensity-based target is that, although it can lower an emissions growth trajectory below the projected business-as-usual level, it is unlikely to result in an absolute decrease in emissions. While the intensity of China's carbon emissions (ratio of energy-related CO₂ emissions to GDP) declined 67 percent between 1980 and 2000, its absolute emissions increased by 126 percent over this period.¹³ Yet, if China's emissions intensity had remained fixed where it was in 1980, its emissions would be more than double what they are today.

Sectoral versus National Focus

Uncertainty is associated with all estimates of emission reduction, particularly in many developing countries in which the accuracy of national greenhouse gas emissions inventories are often constrained by limited capacity for data collection and estimation. The uncertainty associated with national inventories makes it very difficult to implement greenhouse gas reduction commitments that rely on baseline inventories and aggregated annual improvements at the national level. More exact estimates can be achieved, however, when estimating emissions from a smaller number of sources, such as within one sector of the economy where the sources of emissions are known and well documented. Consequently, understanding of emissions sources within a particular sector, such as the electricity sector or the cement-manufacturing sector, could form the basis for targeted mitigation efforts within that sector, even in the absence of a broader understanding of emissions sources and trends.

Sectoral agreements have been proposed as a way of structuring multilateral commitments to adopt targets or standards around one or more sectors, possibly including both developed and developing countries, potentially in concert with other commitment types such as economy-wide targets. International sectoral agreements could provide a means of coordinating key industrial producers to develop climate change goals and a forum for information sharing around best practices and technological innovations. Reduction targets or efficiency standards agreed among countries at the sectoral level could target mitigation efforts towards key greenhouse gas-generating activities and help to prevent competitive imbalances, particularly in energy-intensive industries that trade globally.¹⁴ China plays an important role in many such industries. Globally, China now

¹³ EIA, "International Energy Annual 2004," <http://www.eia.doe.gov/iea/>; G. Marland, T. A. Boden, and R. J. Andres, "Global, Regional, and National Fossil Fuel CO₂ Emissions," Carbon Dioxide Information Analysis Center, 2007, http://cdiac.ornl.gov/trends/emis/meth_reg.htm.

¹⁴ Daniel Bodansky, "International Sectoral Agreements in a Post-2012 Climate Framework" (working paper, Pew Center on Global Climate Change, May 2007), <http://www.pewclimate.org/docUploads/International%20Sectoral%20Agreements%20in%20>

accounts for 48 percent of global cement production, 49 percent of global flat glass production, 35 percent of global steel production, and 28 percent of global aluminum production.¹⁵ A major challenge to implementing sectoral agreements is integrating developing countries, which typically use less efficient technology and thus will bear a higher cost in meeting any sector-wide standards. In addition, if some sectors are targeted for mitigation while others are left unregulated, there may be an incentive for emissions to “leak” from one sector to another to the extent cross-sectoral substitutions are feasible.

Policy Commitments versus Project Activities

Currently, 820 discrete CDM projects have been proposed in China that, if approved and implemented, could amount to 1.2 billion tons of CO₂-equivalent emissions reductions by 2012. Yet, China’s single national target to achieve a 20 percent reduction in energy intensity by 2010 could reduce its CO₂ emissions by about 1.5 billion tons. Consequently, this policy and others in China, such as those articulated in China’s national climate change plan, could form the basis of policy-based commitments made under the UNFCCC. Such commitments could achieve more emissions reductions in the developing world than project-based crediting mechanisms, such as the CDM, and potentially reduce the transactions costs associated with project-by-project verification. Policy commitments as part of a multilateral climate agreement could allow developing country governments to identify ways that emissions mitigation fits or advances national priorities, such as economic growth, energy security and public health, and would help to achieve broad participation in an international effort to reduce greenhouse gas emissions.¹⁶ The stringency of policy-based commitments could evolve over time, perhaps beginning as voluntary actions reported internationally in fulfillment of existing UNFCCC commitments, and then be taken as new commitments negotiated as part of a post-2012 agreement.¹⁷

The World Bank, in developing its Investment Framework for Clean Energy and Development, concluded that an expanded carbon market backed by a global climate policy framework would be a principal source of finance for substantially de-carbonizing

[a%20Post-2012%20Climate%20Framework.pdf](#).

¹⁵ Daniel H. Rosen and Trevor Houser, “China Energy: A Guide for the Perplexed,” May 2007,

<http://www.petersoninstitute.org/publications/papers/rosen0507.pdf>.

¹⁶ Harald Winkler et al., “Sustainable Development Policies and Measures: Starting From Development to Tackle Climate Change,” in *Building on the Kyoto Protocol: Options for Protecting the Climate*, ed. Kevin A. Baumert (Washington, D.C.: World Resources Institute, 2002), pp. 61–87, http://pdf.wri.org/opc_chapter3.pdf.

¹⁷ Joanna Lewis and Elliot Diringer, “Policy-Based Commitments in a Post-2012 Climate Framework” (working paper, Pew Center on Global Climate Change, May 2007),

<http://www.pewclimate.org/docUploads/Policy-Based%20Commitments%20in%20a%20Post-2012%20Climate%20Framework.pdf>.

electricity generation in the developing world.¹⁸ In a post-2012 framework that includes new emissions targets for developed countries, the strongest incentive for developing countries to take on policy commitments may then be the prospect of generating marketable emissions credits. Crediting as now structured under the CDM is on a project-by-project basis. If a future framework were to incorporate policy commitments, allowing crediting on the basis of those commitments could channel investment to industry- or sector-wide strategies that could deliver reductions on a far broader scale.¹⁹ Yet, policy-based crediting would face the same fundamental issues that arise in project-based crediting: how to establish that actions to be credited are “additional,” not “business as usual,” and how to verify actual emissions reductions.²⁰

International Assistance

An important part of any multilateral climate deal will likely include a commitment from developed countries to increase developing country access to advanced technologies, and to provide incentives and financial assistance for their mitigation and adaptation activities. China’s own climate change plan has clearly identified its priority areas for international collaboration to include cooperation on advanced coal technologies, energy-efficient building technologies, clean vehicle technology and advanced industrial technologies. China has placed a particularly heavy emphasis on technology transfer in the international climate negotiations, recently proposing the establishment of a Technology Development and Transfer Board to oversee and implement technology-transfer related activities, as well as a Multilateral Technology Acquisition Fund to support the transfer of technologies to developing countries through the buying out of intellectual property rights.

The United States and China in particular share a common interest in determining a way to continue their reliance on coal while moving toward more efficient coal-combustion and gasification technologies and capturing and storing the emissions from coal power plants. With coal fueling almost 80 percent of electricity generation and two-thirds of primary energy consumption, it is going to remain a core part of China’s energy future for decades to come. Carbon capture and storage may be the only means for China to

¹⁸ World Bank, “An Investment Framework for Clean Energy and Development: A Progress Report,” September 1, 2006, [http://siteresources.worldbank.org/DEVCOMMINT/Documentation/21046509/DC2006-0012\(E\)-CleanEnergy.pdf](http://siteresources.worldbank.org/DEVCOMMINT/Documentation/21046509/DC2006-0012(E)-CleanEnergy.pdf).

¹⁹ See Joseluis Samaniego and Christiana Figueres, “Evolving to a Sector Based Clean Development Mechanism,” in *Building on the Kyoto Protocol: Options for Protecting the Climate*, eds. Kevin A. Baumert et al. (Washington, D.C.: World Resources Institute, 2002), http://pdf.wri.org/opc_chapter4.pdf.

²⁰ See Clean Development Mechanism Executive Board, UNFCCC, “Tool for the Demonstration and Assessment of Additionality,” EB 29, February 2007, http://cdm.unfccc.int/methodologies/PAMethodologies/AdditionalityTools/Additionality_tool.pdf.

continue to rely on coal in a carbon-constrained world. While China may be the place where this technology is most needed, it may be the most difficult environment in which to deploy it. Key challenges include the large incremental cost and the energy penalty of running the capture equipment, which can result in up to a 30 percent reduction in plant efficiency.²¹ For a country that is already building one to two new coal power plants per week, the energy penalty associated with running capture technology would mean even more plants must be built to meet the same electricity demand.

China is also wary of pressures to demonstrate a technology that is not yet being used commercially in the developed world. This is therefore a critical area for U.S. technological leadership. The U.S. and China have a shared interest in continuing to use coal while capturing and storing its emissions, and the U.S. possesses the financial and technical capacity to make this unproven technology viable. Increased bilateral assistance in this area can complement and even facilitate multilateral climate negotiations.

Engaging China on Climate

China must play a central role in any global solution to address climate change. Yet, it is also home to 1.3 billion inhabitants that desire the modern energy services and consumption habits enjoyed by much of the developed world. Recent institutional changes and renewed attention to implementing aggressive energy efficiency policies demonstrate the Chinese government's increasing awareness of the problems posed by climate change, and its interest in altering China's current energy development trajectory. China will face increasing international pressure in the coming months to devote more attention to climate change, both due to its emergence as the largest global emitter, and as international attention to climate change is elevated by government leaders and heads of state in high-profile forums around the world. Yet, the government will not likely be able to significantly alter its current energy development trajectory without meaningful international engagement during the next one to two decades, a period during which China's energy infrastructure investment decisions will have direct implications for the future stability of the global climate system.

There is new urgency, as well as opportunity, for each of the major economies to jointly examine and address linkages among their own economic development, their energy security, and their role in global climate change. Effective engagement with Beijing will only be possible if the major emitting developed countries lead by example, and serious U.S. engagement will likely be a precondition to China's engagement in any international climate effort. Meanwhile, understanding the challenges that China faces in reducing its own greenhouse gas emissions in the years ahead, particularly in decarbonizing its energy sector, is the first step to engaging China on climate cooperation.

²¹ Edward S. Rubin, Chao Chen, Anand B. Rao. "Cost and performance of fossil fuel power plants with CO₂ capture and storage." *Energy Policy*, Volume 35, Issue 9, September 2007, Pages 4444-4454.

For additional references, please refer to Lewis, Joanna I. "China's Strategic Priorities in International Climate Negotiations." *The Washington Quarterly* 31:1, pp. 155-174. Available at: http://www.twq.com/08winter/docs/08winter_lewis.pdf

HEARING COCHAIR SLANE: Thanks, Dr. Lewis. Dr. Jaffe.

STATEMENT OF DAN JAFFE, PROFESSOR OF ATMOSPHERIC AND ENVIRONMENTAL CHEMISTRY, UNIVERSITY OF WASHINGTON-BOTHELL, BOTHELL, WASHINGTON

DR. JAFFE: Thank you for the opportunity to testify before the Commission today.

My name is Dan Jaffe. I am a Professor of Environmental Science at the University of Washington. I have studied global pollution for more than 20 years. I have reviewed the questions for today's hearing and hope my testimony will shed some light.

The first point, over the past several decades, China has become a major economic power and at the same time has become one of the largest emitters of air pollutants. For some pollutants, China's emissions have now surpassed U.S. emissions. This is certainly true for sulfur dioxide and carbon dioxide.

In other cases, such as nitrogen oxides, U.S. emissions are still larger, but Chinese emissions are increasingly rapidly.

The emissions are due, largely to coal combustion, but not only coal combustion. Increasing emissions from motor vehicles and other industrial sources are also quite important in there, and they'll all increasing rapidly.

These large emissions are responsible for very poor air quality and significant health impacts within Chinese cities. A recent World Bank report estimated there are approximately 700,000 premature deaths annually and an economic impact of nearly four percent on GDP in China due to air pollution, and just as an aside, this goes back to the question that Commissioner Bartholomew mentioned earlier about where are leverage points, and I think those health impacts are a very important leverage point that we can cooperate on.

Of course, we've all heard about many reports on the impacts of poor air quality on the Olympics. We really should distinguish between the short-term effects on athletes at the Olympics, but going back to the long-term effects on 700,000 Chinese citizens a year,

700,000 premature deaths a year.

Given the continuing rapid economic growth in China, we expect these emissions to continue to increase. Depending on the level of emission controlled and the specific pollutant, emissions will likely increase by 50 to 200 percent by 2020. But the good news is that China could keep the growth in emissions to modest levels or even see some decreases for certain pollutants if advanced control technologies are employed.

Of course, if this is not done, these large emission increases will be a major assault on the global environment.

But it's also important to recognize that China's per capita emissions are still a fraction of what they are in the United States. The average Chinese citizen wants nothing more than what we already have: a high standard of living based on high energy consumption.

My research group at the University of Washington first detected the transport of Asian pollutions to the United States in 1997. Since then we have identified dozens of episodes of this transport, and this result has been confirmed by numerous other university and federal scientists.

My research group also operates the only continuous mountaintop observatory in the western United States, which routinely detects pollutants originating in Asia. The Commission asked about how we identify these? We use a number of tools to identify the source region for these pollutants including surface and aircraft observations, which give us a "chemical fingerprint," meteorological data, satellite observations and chemical transport models.

Currently, a number of scientific groups are trying to understand the influence that Asian emissions have on U.S. air quality. This is a complex issue due to daily, seasonal and annual variations in meteorology and there are large uncertainties.

It should be noted that on most days, the contribution to local air quality from Asian sources is relatively small, but on a few days per year, the Asian contribution can be a large fraction of the regulatory standard.

There are three main pollutants of concern: ozone, particulate matter, and mercury. For ozone, a respiratory irritant, the average contribution from Asian emissions to the eight-hour primary standard is in the range of three to ten percent for the western United States.

While this contribution is relatively modest, it will certainly increase in the future, and when added to local pollution, it can push some areas over the air quality standard.

On a few days, we have seen even higher ozone enhancements due to Asian emissions, up to 35 percent of the eight-hour ozone standard.

For fine particulate matter, or PM2.5, which has a significant respiratory and cardiovascular impacts, the Asian contribution is two to five percent of the annual standard including dust and industrial pollution. But on a few days per year, the impact can be quite large.

In the most extreme case, which occurred in April 2001, Asian dust contributed approximately 50 percent of the particulate matter on a few days and resulted in concentrations that exceeded the daily PM2.5 primary standard at several cities in the western United States and actually also the eastern United States as well.

For mercury, a potent neurotoxin, the best way to understand the Asian contribution is to consider how much mercury deposition occurs in both wet and dry forms. The Asian industrial contribution is approximately ten to 30 percent of the total deposition across the United States, with the highest contributions in Alaska and the western U.S.

For all of these estimates, there are large uncertainties. I should also mention that there is influence on Europe from exported United States pollution, and the Europeans are quite interested in that. There are a number of differences in that, but I don't want to exclude that issue or not mention it.

Finally, we turn to the question of what can the United States do to assist China in its quest to develop more sustainably? For this question, there are two parts to my response: one focused on the traditional air pollutants such as particulate matter, ozone, sulfur dioxide, nitrogen oxides, and the second on the greenhouse gases.

For the traditional air pollutants, high efficiency control technologies are available. The U.S. can encourage rapid implementation of these technologies providing technical assistance, as much as we've heard through most of the morning sessions.

This could be a win-win scenario for U.S. industries involved in control technologies. Another approach is to help Chinese policymakers understand the economic benefits of a clean environment. For example, the U.S. could support joint research or symposia with China to understand the significant economic and social benefits of clean air, going back to that 700,000 premature deaths per year.

I believe it is also essential that we continue to support U.S.-based research on this issue, both as a means to understand the air quality impacts within the U.S. and also as a means of monitoring Chinese compliance with future negotiated agreements.

On greenhouse gas emissions, we have a very different set of issues. Here current technologies are not adequate. Global leadership on the issue is lacking. China's per capita emissions of carbon dioxide are approximately one-fifth of those in the United States; therefore, it

is not reasonable for both economic and equity reasons to expect that China will control its greenhouse gas emissions unilaterally.

Given that the U.S. is the largest per capita emitter of greenhouse gases and the largest global economy, it is paramount that we show leadership on this issue by reducing our own reliance on fossil fuels, developing alternative energy, making energy conservation a hallmark of our economy, developing carbon sequestration, providing assistance to the developing nations to implement these strategies and participating fully in international negotiations on greenhouse gas reductions.

I believe these strategies are not only essential for stabilizing our climate, but will also improve our national economy in the long run.

This concludes my written testimony. Again, I want to thank the Commission for allowing me to present my testimony today, and I would be happy to answer any questions.

[The statement follows:]

Prepared Statement of Dan Jaffe, Professor of Atmospheric and Environmental Chemistry, University of Washington-Bothell, Bothell, Washington

Testimony of Dan Jaffe, Professor, University of Washington, before the US-China Economic and Security Review Commission, Washington D.C. August 13, 2008.

Thank you for the opportunity to testify before the commission today.

My name is Dan Jaffe, I am a professor of Environmental Science at the University of Washington. I have studied global pollution for more than 20 years. I have reviewed the questions for today's hearing and I hope my testimony will shed some light on these issues.

First point, over the past several decades, China has become a major economic power and at the same time has become one of the largest emitters of air pollutants. For some pollutants China's emissions have now surpassed US emissions. This is certainly true for sulfur dioxide and carbon dioxide. In other cases, such as nitrogen oxides, US emissions are still larger, but Chinese emissions are increasing rapidly. The emissions are largely due to coal combustion, but emissions from motor vehicles and other sources are also increasing rapidly. These large emissions are responsible for poor air quality and significant health impacts within Chinese cities. A recent World Bank report estimated that there are approximately 700,000 premature deaths annually with an economic impact of nearly 4% on GDP in China due to air pollution.¹ And of course we've all heard many reports about the impacts of poor air quality on the Olympics.

¹World Bank (2007) Cost of Pollution in China, Economic Estimates of Physical Damages. World Bank, Washington, DC.

Given the continuing rapid economic growth in China, we expect these emissions to continue to increase. Depending on the level of emission controls used and the particular pollutant, emissions will likely increase 50-200% by 2020². But the good news is that China could keep the growth in emissions to modest levels or even see slight decreases for some pollutants, if advanced control technologies are employed. If this is not done, these large emission increases will be a major assault on the global environment.

But it is also important to recognize that China's per capita emissions are still a fraction of what they are in the United States. The average Chinese citizen wants nothing more than what we already have: a high standard of living based on high energy consumption.

My research group at the University of Washington first detected the transport of Asian pollution to the United States in 1997³. Since then we have identified dozens of episodes of such transport and this result has been confirmed by numerous other university and federal scientists. My research group also operates the only continuous mountain top observatory in the western US which routinely detects pollutants originating in Asia⁴. We use a number of tools to identify the source region for these pollutants including surface and aircraft observations to give us a "chemical fingerprint", meteorological data, satellite observations and chemical transport models.

² See for example:

Wang, X., Mauzerall, D. L., Hu, Y., Russell, A. G., Larson, E. D., Woo, J. H., et al. (2005). high-resolution emission inventory for eastern China in 2000 and three scenarios for 2020. *Atmos. Environ.*, 39(32), 5917-5933.

Chen, C. H., Wang, B. Y., Fu, Q. Y., Green, C., & Streets, D. (2006). Reductions in emissions of local air pollutants and co-benefits of Chinese energy policy: a Shanghai case study. *Energy Policy*, 34(6), 754-762.

³ See:

Jaffe, D. A., Anderson, T., Covert, D. S., Kotchenruther, R., Trost, B., Danielson, J., et al. (1999). Transport of Asian Air Pollution to North America. *Geophys. Res. Lett.*, 26, 711-714.

⁴ Our observatory is located on the summit of Mt. Bachelor in central Oregon. Data from the site are available in realtime at <http://research.uwb.edu/jaffegroup>. Published results from the Mt. Bachelor Observatory include:

Jaffe, D. A., Prestbo, E., Swartzendruber, P., Weiss-Penzias, P., Kato, N., Takami, A., et al. (2005b). Export of Atmospheric Mercury from Asia. *Atmos. Environ.*, 39(17), 3029-3038.

Weiss-Penzias, P., Jaffe, D. A., Swartzendruber, P., Dennison, J. B., Chand, D., Hafner, W., et al. (2006). Observations of Asian air pollution in the free troposphere at Mt. Bachelor Observatory in the spring of 2004. *J. Geophys. Res.*, 111(D 10), D10304.

Swartzendruber, P., Jaffe, D. A., Prestbo, E. M., Weiss-Penzias, P., Selin, N. E., Park, R., et al. (2006). Observations of reactive gaseous mercury in the free troposphere at the Mount Bachelor Observatory. *J. Geophys. Res.*, 111(D24301).

Weiss-Penzias, P., Jaffe, D. A., Swartzendruber, P., Hafner, W., Chand, D., & Presto, E. (2007). Quantifying atmospheric mercury emissions from biomass burning and East Asian industrial regions based on ratios with carbon monoxide in pollution plumes at the Mount Bachelor Observatory. *Atmos. Environ.*, 41(21), 4366-4376.

Currently a number of scientific groups are trying to understand the influence Asian emissions have on US air quality. This is a complex issue due to daily, seasonal and annual variations in meteorology and there are large uncertainties.⁵ It should be noted that on most days, the contribution to local air quality from Asian sources is relatively small, but on a few days per year the Asian contribution can be a large fraction of the regulatory standard. There are three main pollutants of concern: ozone, particulate matter and mercury. For ozone, a respiratory irritant, the average contribution from Asian emissions to the 8-hour primary standard is in the range of 3-10% for the western U.S. While this contribution is relatively modest, it will certainly increase in the future and, when added to local pollution, it can push some areas over the air quality standard. On a few days, we have seen even higher ozone enhancements due to Asian emissions, up to 37% of the standard.⁶ For fine particulate matter, or PM_{2.5}, which has significant respiratory and

⁵ See:

- Reidmiller, D. R., D. A. Jaffe, D. Chand, S. Strode, P. C. Swartzendruber, G. M. Wolfe and J. A. Thornton: Interannual variability of long-range transport as seen at the Mt. Bachelor Observatory. Submitted to *Atmos. Chem. Phys. Discuss.*, July 2008.
- Zhang, L., Jacob, D., Boersma, K. F., Jaffe, D. A., Olson, J. R., Bowman, K. W., et al. (2008). Transpacific transport of ozone pollution and the effect of recent Asian emission increases on air quality in North America: an integrated analysis using satellite, aircraft, ozonesonde, and surface observations. *Atmos. Chem. Phys. Discuss.*, 8, 8143-8191.

⁶ For ozone, particulate matter and mercury, estimating the contribution to local air quality from distant sources is a complex process. To do this we use computer simulations that model the emissions, the physical-chemical processes and the transport. However before these models can be used, it must be evaluated against actual environmental data. Thus the final result, come from a combination of the model and observations. For ozone, Fiore et al (2002) estimate the ozone contribution from European and Asian emissions to surface air quality in the US using 1995 emissions, however there is good evidence that Chinese emissions have approximately doubled since then (Richter et al., 2005). Fiore et al., (2008) estimate the ozone impact from Asia using 2001 emissions. Zhang et al. (2008) show that the recent increase in Asian emissions (2000-2006) has significantly increased the impact on surface ozone in the US. They calculate that Asian emissions are responsible for an average of 7 ppbv of ozone at the surface in the western U.S. during spring. Weiss et al. (2006) shows that plumes of Asian pollution seen at the summit of Mt. Bachelor (2.7 km asl) can be enhanced by up to 28 ppbv for an 8-hour mean. However it is not clear how these plumes impact surface air quality in urban areas. While none of these analyses give exactly the information we seek, we can use these published studies as a basis to estimate the Asian impact on surface ozone in the US:

- Fiore, A.M., F.J. Dentener, O. Wild, C. Cuvelier, M.G. Schultz, P. Hess, C. Textor, M. Schulz, et al., Multi-model Estimates of Intercontinental Source-Receptor Relationships for Ozone Pollution, submitted to *J. Geophys. Res.*, July 21, 2008.
- Fiore A. M., D. J. Jacob, I. Bey, R. M. Yantosca, B. D. Field, A. C. Fusco, and J. G. Wilkinson (2002), Background ozone over the United States in summer: Origin, trend, and contribution to pollution episodes, *J. Geophys. Res.*, 107 (D15), 4275, doi:10.1029/2001JD000982.
- Richter, A., et al. (2005), Increase in tropospheric nitrogen dioxide over China observed from space, *Nature* 427, 129-132.
- Weiss-Penzias, P., Jaffe, D. A., McClintick, A., Jaeglé, L., & Liang, Q. (2004). Influence of long-range-transported pollution on the annual and diurnal cycles of carbon monoxide and ozone at Cheeka Peak Observatory. *J. Geophys. Res.*, 109, D23S14.

cardiovascular impacts, the Asian contribution is 2-5% of the annual standard, including dust and industrial pollution, but on a few days per year the impact can be quite large. In the most extreme case, which occurred in April 2001, Asian dust contributed approximately 50% of the particulate matter on a few days and resulted in concentrations that exceeded the daily PM_{2.5} primary standard at several cities in the western U.S.⁷ For mercury, a potent neurotoxin, the best way to understand the Asian contribution is to consider how much mercury deposition occurs, in both wet and dry forms. The Asian industrial contribution is approximately 10-30% of the total deposition across the US, with the highest contributions in Alaska and the western U.S.⁸ For all of these estimates, there are large uncertainties.

⁷ For particulate matter, the analysis of Chin et al (2007) show that dust is the most significant contribution to the fine particulate matter transported from Asia. This is also consistent with the analysis of Heald et al (2007). The modeling of Chin and the analysis of Fischer et al (2008) suggest that the Asian dust contribution in spring for the western US is ~1-3 ug/m³. Assuming this only occurs in spring, this is ~2-5% of the annual PM_{2.5} standard. The analysis of Husar et al., (2001) first documented large episodic transport of Asian dust to the US which occurred in 1998. Jaffe et al. (2003) show that in the most extreme case, which occurred in April 2001, the contribution from Asian dust to the fine particulate mass was up to 50% at several cities in the western US and resulted in concentrations that were greater than the daily PM_{2.5} primary standard (35 ug/m³).

Husar, R. B., Tratt, D. M., Schichtel, B. A., Falke, S. R., Li, F., Jaffe, D. A., et al. (2001). The Asian Dust Events of April 1998. *JGR-ATM*, 106(D16), 18317-18330.

VanCuren, R., & Cahill, T. (2002). Asian aerosols in North America: Frequency and concentration of fine dust. *J. Geophys. Res.*, 107(D24), 4804.

Jaffe, D. A., Snow, J. A., & Cooper, O. (2003c). The April 2001 Asian dust events: Transport and substantial impact on surface particulate matter concentrations across the United States. *EOS transactions*.

Heald, C. L., Jacob, D. J., Park, R. J., Alexander, B., Fairlie, T. D., Yantosca, R. M., et al. (2006). Transpacific transport of Asian anthropogenic aerosols and its impact on surface air quality in the United States. *J. Geophys. Res.*, 111, D14310.

Mian C., Diehl, T., Ginoux, P., & W., M. (2007). Intercontinental transport of pollution and dust aerosols: implications for regional air quality. *Atmos. Chem. Phys.*, 7, 5501-5517.

Fischer, E.V., Hsu, N.C., Jaffe, D.A., Jeong, M.-J, and Gong, S.L. A Decade of Dust: Asian Dust and Spring Air Quality in the Western U.S. Submitted to *Nature Geosci.*, June 2008.

Zhao, T. L., Gong, S. L., Zhang, X. Y., & Jaffe, D. A. (2008). Asian dust storm influence on North American ambient PM levels: observational evidence and controlling factors. *Atmos Chem Phys*, 8, 2717-2728.

⁸ See:

Jaffe, D. A., & Strode, S. (2008). Fate and Transport of Atmospheric Mercury from Asia. *Journal of Environmental Chemistry Environ. Chem*, 5(121).

Strode, S., Jaeglé, L., Jaffe, D. A., Swartzendruber, P., Selin, N., Holmes, C., et al. (2008). Trans-Pacific Transport of Mercury. *J. Geophys. Res.*

Travnikov, O. (2005). Contribution of the intercontinental atmospheric transport of mercury pollution in the Northern Hemisphere. *Atmos. Environ*, 39(39), 7541-7548.

Seigneur C., K. Vijayaraghavan, K. Lohman, P. Karamchandani, and C. Scott, (2004), Global Source Attribution for Mercury Deposition in the United States, *Environ. Sci. Technol.* 38, 555-569.

Finally, we turn to the question of what can the United States do to assist China in its quest to develop more sustainably. For this question there are two parts to my response, one focused on the traditional air pollutants, such as particulate matter, ozone, sulfur dioxide and nitrogen oxides and the second on the greenhouse gases. For the traditional air pollutants, high efficiency control technologies are available. The US can encourage rapid implementation of these technologies by providing technical assistance. This could be a win-win scenario for US industries involved in control technologies. Another approach is to help Chinese policy makers understand the economic benefits of a clean environment. For example the US could support joint research or symposia with China to understand the significant economic and social benefits of clean air. I believe it is also essential that we continue to support US based research on this issue, both as a means to understand the air quality impacts within the US and also as a means of monitoring Chinese compliance with future negotiated agreements⁹.

On greenhouse gas emissions we have a very different set of issues. Here, current technologies are not adequate and global leadership on the issue is lacking. China's per capita emissions of carbon dioxide are approximately 1/5th of those in the US, therefore it is not reasonable, for both economic and equity reasons, to expect that China will control its greenhouse gas emissions unilaterally. Given that the US is the largest per capita emitter of greenhouse gasses and the largest global economy, it is paramount that we show leadership on this issue by:

- reducing our reliance on fossil fuels;
- developing alternative energy sources;
- making energy conservation a hallmark of our economy;
- developing carbon sequestration strategies;
- providing assistance to developing nations to implement these strategies; and,
- participating fully in international negotiations on greenhouse gas reductions.

I believe these strategies are not only essential for stabilizing our climate, but will also improve

⁹ See, for example Jaffe et al., 2005, which shows a method to quantify Asian mercury emissions based on measurements at Mt. Bachelor in central Oregon:

Jaffe D. A., E. Prestbo, P. Swartzendruber, P. Weiss-Penzias, S. Kato, A. Takami, S. Hatakeyama and Y. Kajii.(2005) Export of Atmospheric Mercury from Asia. *Atmos. Environ.* 39, 3029-3038.

our national economy in the long-run.

This concludes my testimony. Again, I want to thank the commission for allowing me to present my testimony today and I would be happy to answer any questions.

Panel IV: Discussion, Questions and Answers

HEARING COCHAIR SLANE: Thank you, Dr. Jaffe.

Our first question will be from Chairman Wortzel.

CHAIRMAN WORTZEL: Thank you. I appreciate it. I want to take a second to educate myself and demonstrate my own ignorance because as I was reading this, you have one discussion of mercury and then another one of greenhouse gases, and mercury is not a greenhouse gas?

DR. JAFFE: That's correct.

CHAIRMAN WORTZEL: Okay. It's a heavy metal. It kind of gets up in the atmosphere?

DR. JAFFE: The unifying theme is coal is a very strong link to both.

CHAIRMAN WORTZEL: But you also in that testimony talk a lot about Asian pollution. Are you able to actually identify whether it's coming out of Japan, South Korea or China?

DR. JAFFE: To a degree. When we're talking about transport of air pollutants over very long distances, things mix, and so when you have two, I mean there's a border between these two countries, and they may have factories that are ten kilometers apart, ten miles apart, whatever. At that point, the pollutants become mixed.

When we in the scientific community refer to these, we are mostly trying to understand the intercontinental effects. So we lump all of these emissions together. If we want to go back and try to identify how much is due to individual countries, really the best we can say, as good as anything we can say is that China is about 60 to 70 percent of those emissions coming from Asia.

So if you want to know specifically the Chinese effect of those intercontinental effect, you could multiply my numbers by 60 to 70 percent.

CHAIRMAN WORTZEL: The other question then is, are there any epidemiological studies to go along with some of this research that would demonstrate to the Chinese government the impact of these pollutants and what that would cost them? I guess they don't provide health care anymore anyway, but what that's costing them in terms of human capital?

DR. JAFFE: Yes, I referred to the World Bank study. There

have been several scientific papers. The health effects of air pollution isn't my area of expertise. But for this testimony, I'm obviously connected in with that community, and there are a number of studies in the scientific literature, but then there was a more complete study done by the World Bank with Ministry of Environmental Protection from China as well, and that's where that number of 700,000 premature deaths annually came from.

It was a bit controversial and then when we talk about the four percent of GDP, we get into the question of how much is a human life worth? And that's a very controversial question. But I think without a doubt, helping the Chinese government and not just government, NGOs and citizens, to understand the economic and social health. I put it in the positive light--benefits of clean air. You want to put it in the negative air, you could say the detriment of dirty air is a very fundamental task that the U.S. could help on that overall would help build capacity for making environmental change within China.

CHAIRMAN WORTZEL: Dr. Lewis.

DR. LEWIS: I'd just add briefly. There was a movement in China a couple years back to discuss this idea of green GDP and how could you actually calculate the environmental impact on economic growth, because as I mentioned economic growth really being the overarching, motivating concern obviously. And to the extent that you could really quantify that seriously and understand how much the environmental impacts are hurting the economy, this would be a very powerful political message.

My understanding is that the challenges there are related to some of the challenges I mentioned related to data reliability and data quality and measurement, and these are complicated metrics to develop and controversial is another word, you know.

I think that there is some recognition of that, and I would see that as an area where there is certainly a need for future work and analysis.

CHAIRMAN WORTZEL: Thank you very much.

HEARING COCHAIR SLANE: Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman. I want to thank both the witnesses for their very helpful testimony. I've read it and you've really put some effort into it and I appreciate it.

Help me understand these very complicated issues. Dr. Aldy, the Co-Director of the Harvard Project on International Climate, testified earlier, and he said that China no longer fits the Kyoto developing country category. Do you both agree with that?

Dr. Lewis?

DR. LEWIS: Yes.

COMMISSIONER MULLOY: Yes.

DR. LEWIS: But I think that it's sort of, it's not black and white. There potentially should be more than two categories.

COMMISSIONER MULLOY: Okay. And what about you, Dr. Jaffe?

DR. JAFFE: I would just comment that the scale of their economy obviously is very large. On the other side of that, the per capita energy consumption, greenhouse gas emissions, again about one-fifth of ours. And so I think coming back--I was trained as a Ph.D. chemist so I'm out on a limb here when I talk about moral issues, but we really have to give some weight to the argument that we're talking about a billion people who have on average one-fifth the energy consumptions, let's say one-fifth the standard of living of ours. So there is a moral dimension to this problem.

COMMISSIONER MULLOY: Good. I look on this from a U.S. point of view, and I see us losing industries. Our auto industry is in trouble. We've lost the steel. We've lost a lot of industries, and both parties I think are now talking about, well, our salvation, we're going to develop green technologies. That's kind of the new game.

And so I guess both parties are talking about maybe the government giving tax incentives for R&D and other things to develop that kind of technology. So I say, okay, that may be the salvation for the U.S. to preserve some good jobs for our own people.

Dr. Lewis, on page eight of your testimony, you talk about China has placed a heavy emphasis on technology transfer in international climate negotiations, proposing a technology development transfer board so that these technologies that we might develop can be transmitted to them through the buying out of intellectual property rights.

Okay. So it looks to me like they're already thinking about how they can end up making the goods which really add the wealth to the society even if the R&D to develop the technologies is done here.

Dr. Jaffe, on page two of your testimony, you talk about technology transfer as well. You say the U.S. can encourage rapid implementation of these by providing technical assistance.

What I'm trying to grasp is how, if we put in the money and we develop these technologies, how do we end up providing some good jobs for our own citizens and selling green technology products to China rather than giving them the technology so that they can make them, and they probably make them more efficiently or at least at a lower price and ship them back here?

That's a question I would like to get both of you to talk about.

DR. LEWIS: I'm happy to start. I've spent a lot of time looking at China's clean energy technology industries, and in particular their wind power and solar power industries to try to understand how they

acquired the technology and where they are in terms of developing it domestically.

China really is ahead of us in many ways in these industries and part of that is because they've been very committed to domestic policies to support renewable energy in a way that we have to some extent over the years, but it's been somewhat more sporadic.

China has a national level renewable energy law. It has very aggressive targets for wind, and these targets are predominantly and almost 100 percent being met by domestically manufactured wind turbines made by companies in China, also made by GE in China and foreign manufacturers.

But their goal obviously, just as it would be our goal, is to have Chinese companies building these clean technologies, and they've really gotten a leg up on us in many ways in this. They're the largest manufacturer--the last time I checked--of solar photovoltaic panels in the world as well, although most of these unfortunately aren't being used in China. They're being exported to countries like Germany and countries that are willing to subsidize and think they can afford them.

So, in terms of what the U.S. can do to regain some of these jobs and industries, I think it's sending the right policy signals so that these are--I mean it costs a lot less to for the most part China has some savings, but shipping a wind turbine across the ocean is not a cheap thing.

If we could be making them here, we would use them here. And so a lot of it is having the policies in place that will put these technologies up in this country.

COMMISSIONER MULLOY: May Dr. Jaffe offer his--

HEARING COCHAIR SLANE: Please, yes, go ahead.

COMMISSIONER MULLOY: Dr. Jaffe.

DR. JAFFE: Sure. I won't comment on the job aspect because it's just really not in my area of expertise, but from an environmental point of view, I think if we talk about environmental targets, whether we're referring to mercury pollution in our own country or carbon dioxide emissions, it's a global. These are both global issues, and actually even though mercury and carbon dioxide have very different properties, there are some big similarities in that both are coal related.

China is becoming one of the biggest emitters of both of these, and they're really global issues.

And in a way, the Clean Air Mercury Rules which were passed in the United States in 2006, now on hold, scheduled to cost our economy about a billion dollars a year. There are, in our own interests there are strategies that we should be thinking about to engage international partners, particularly China on these issues, and we may find that there's cost effective things that we can do that are in our own best

interest both from carbon dioxide and from the point of view of mercury.

Going back to the example of the carbon sequestration issue, I think these are technologies that have to be developed ultimately by the regulatory fiat. That is someone has got to say there is a cost of emitting carbon dioxide into the atmosphere. It's no longer a free good, and so there has to be a means to enforce the development or force the development of those technologies.

Once those technologies are developed in the richer economies of the world, then we need to figure out how we can help other countries deploy them because it's in all of our interests.

COMMISSIONER MULLOY: Thank you.

HEARING COCHAIR SLANE: Dr. Lewis, you testified that Chinese do need financial and technical assistance, and essentially that's what they told us in April when we were over there, and really what they want is gasification, and it's very expensive. It's about \$2 billion per plant.

This morning we had testimony that said that they do not need any financial assistance. Can you expound on that?

DR. LEWIS: Sure. I think that there's sort of a few reasons why I think it's important for the U.S. to put money on the table. I agree with almost all of what was said this morning about the fact that China doesn't really need money to do this; they have a lot of money. The question is can we provide money for these key training and capacity building elements that can help to leverage?

This is really, we're talking millions to leverage billions of dollars in clean energy investments. But the reason why I think it's important for the U.S. to put some money on the table is really to show our commitment to working with China on this, and there's really been a long history of bilateral cooperation with China.

You heard from DOE and EPA about some of this this morning. But many of these programs, you know, the government came forward, we proposed things, and then the funding was later retracted or didn't live up to levels that we had promised, and the Chinese government just from people I've talked to are somewhat suspicious and worried about sort of future cooperation, and I think if nothing else, it sort of lends an element of seriousness, and it shows that we're willing really to talk.

I think the flip side of this is that China is going to be, and certainly should, put money on the table as well, and there was some discussion earlier about the clean technology fund that was proposed. My understanding is that China had expressed some interest in actually contributing to this fund.

So we're not just talking about sort of a big fund that would be

used to help pay for things in China. I think China needs to be paying into this pot as well, and I think they would be willing to do so. I think more important is showing that we're serious, that we're willing to engage bilaterally, and then really capitalize on where we have some strengths in helping them, and I think in many ways we'll find that there is some things that we can learn from them as well.

HEARING COCHAIR SLANE: Thank you.

Commissioner Bartholomew.

VICE CHAIRMAN BARTHOLOMEW: Thank you very much and thank you to both of our witnesses. I suppose the advantage you have having heard the earlier panels is you had some sense of what may be coming your way, which is great.

Dr. Jaffe, I'm going to give you kudos for being one of the few people who come to Washington and declines to answer something because it's outside your area of expertise. It generally doesn't stop people from answering questions.

I want to get back to this issue of capacity and commitment really because that's a big piece of it. I have two different ways to take it. One is in terms of data quality. How much money would it cost to set up the kind of data monitoring, data collection equipment and programs that you're talking about?

That's the first set of questions. The second set of questions is in the history of sort of the environmental movement, are there examples of countries where the people haven't led the way for the clean up to happen? Because I find myself thinking is there an incentive for a government to honestly measure the pollutants that might be coming forth if they know that those pollutants have consequences? Dr. Jaffe gets right to the heart of that World Bank study and the health consequences. The Chinese government tried to censor or to squash that study because they didn't want the information coming out.

So how do we deal with both of those sets of issues? How do we make sure that there's sufficient resources that a government itself commits to data quality? How do we make sure and advance perhaps the movement within a citizenry especially in a country where people have very limited rights to express themselves when they disagree with their government?

Thanks.

DR. JAFFE: First of all, in my experience in working with Chinese environmental scientists, they know what they're doing. And the data that is being collected there I believe is first rate. I mean okay.

The question becomes can we get access to the data? And I note, for instance, that right now you can go on a Chinese Ministry of

Environmental Protection Web site and get air pollution index for 20 Chinese cities, updated, I don't know remember exactly 20, updated daily including Beijing.

The problem is that there's a couple different scales that we use. There's the technical scientific scale where we would report numbers in parts per billion or micrograms per cubic meter. Here in the United States, we have the U.S. EPA has come up with a system to develop AQI, air quality index, to convert that from a technical scientific scale to a grade like A, B, C, D, zero to 100, or anything below 100 is representing generally good quality air.

But without knowing the conversion scale from the technical scientific unit to whether you're grading it A, B, C, D, it's a little tricky to know what they're reporting.

Actually there is information on that conversion scale and the Chinese are using a very lenient scale to report their air quality data publicly right now in light of the Olympics. That is 100, which is generally below 100 would be considered good air quality is actually two times the WHO standard for particulate matter.

So it's sort of like your child comes home with a D on this exam, and the teacher writes "excellent work" on it. So the grade is still there, but the scale has been shifted a bit.

So I believe the issue, I'm sort of going round about to your question, what would it cost. I think the Chinese are probably on track for developing reasonable and realistic systems for monitoring their own air pollution/air quality.

I have collaborated a little bit with some Chinese scientists. One of my colleagues from Oregon State is actually in Beijing right now doing some air quality measurements. I think there are elements of cooperation with U.S. and European scientists around China. I would be very surprised if the Chinese would be very interested in us saying, hey, we'd like to come in and install 50 air pollution monitors.

That would be shocking if they would let us do that, I mean as we wouldn't probably either here as well.

So let me see--I got off my--

VICE CHAIRMAN BARTHOLOMEW: That's all right. Mr. Chairman--

DR. JAFFE: So your question about how much would it cost.

VICE CHAIRMAN BARTHOLOMEW: Can we bump the second piece of my question to a second round of questions?

HEARING COCHAIR SLANE: Sure.

VICE CHAIRMAN BARTHOLOMEW: And perhaps give Dr. Lewis a chance to answer the question just about data quality and cost of collection.

DR. LEWIS: Thank you. I guess the types of data quality needs

that I was talking about aren't necessarily an issue of money. This is more of an issue of lack of understanding about--and I'm talking--I should really distinguish--not necessarily criteria air pollutants where you can sort of put measurements on smokestacks or on, you know, a limited number of point sources and actually have a pretty good understanding about what's happening.

Greenhouse gas emissions are coming from myriad sources all over the country, many, and are much harder to quantify and to understand. Just to give you a sense of sort of the margins of errors that we're working with here, I mean the U.S. Department of Energy's Energy Information Administration was in 2004 projecting where China's greenhouse gas emissions would be in 2007.

If they had a very good understanding of sort of the data issues and drivers, they wouldn't have been off by an order of magnitude that was equivalent to the total emissions of Africa, the Middle East and South America put together. I mean we're talking billions of tons of CO₂.

So this is partly an issue of access to data in China, but I think it's really more of an issue of the lack of accurate inventories that exist in China, not just that they're not sharing them, and a lack of understanding about really some of the core drivers in the economy of emissions, which is leading to these really unpredictable swings in emissions trends.

VICE CHAIRMAN BARTHOLOMEW: Can I get one clarification?

HEARING COCHAIR SLANE: Sure.

VICE CHAIRMAN BARTHOLOMEW: A lack of understanding on the part of Western scientists or a lack of understanding on the part of--

DR. LEWIS: No, within China, a grasp on all of the sources and drivers of emissions, greenhouse gas emissions, such that it's very hard for them to project a couple years in advance where their emissions will be down the road.

VICE CHAIRMAN BARTHOLOMEW: I'll ask my other question in a second round.

HEARING COCHAIR SLANE: Commissioner Fiedler.

COMMISSIONER FIEDLER: A couple of questions. Do either of you know of any other country in the world when discussing environmental compliance invokes the term "stability" in the discussion?

DR. JAFFE: Former Soviet Union.

COMMISSIONER FIEDLER: Did historically. Look, there's always been a fight in the United States between jobs and environmental protection. I mean that was an historic fight. It

actually continues, but that's not stability. We're not worried about when people lose their jobs whether the country is going to explode--yet anyway.

So the question here is allowing, accepting that in the negotiating sense, is that a legitimate concern? In other words, should we embrace that concern and say, yes that's a justifiable excuse for something?

DR. LEWIS: Well, I can start. I think we may be talking about different types of stability. I mean there's--

COMMISSIONER FIEDLER: No, they're only talking about one kind.

DR. LEWIS: Well, there's economic stability, but then there's also political stability.

COMMISSIONER FIEDLER: They're always talking about political stability.

DR. LEWIS: They're tied. Right. When you're talking about job loss in this country, I would argue that's more about economic stability. Of course how well the economy is doing is tied to how well our politicians are liked. But I think that in China, the concern, and this can also be a positive thing. I think that, you know, the fact that the fear of protests over environmentally related issues is a serious threat, does cause the leadership to pay more attention to environmental issues.

COMMISSIONER FIEDLER: Yes, and I think that's obvious, but not necessarily sufficient attention has been devoted.

Do you want to add?

DR. JAFFE: I'd just say rational policy requires information on the table about environmental and economic impacts; right. So we can't, you know, if the "Minister of Jobs" is making decisions without the environmental impacts, they're not making rational policy, in my opinion.

So whether that's in public view or not, your question about stability, again, I don't think I can answer that one, but--

COMMISSIONER FIEDLER: All right. It is actually an interesting discussion, but I'll leave it.

Let me go back to the scientific. Last year when we had a hearing similar to this, and we asked a question about Asian pollutants or Chinese origin pollutants, we were told, and this is simplistic, that in part the reason that we can't measure, and this was a discussion about LA actually at the time, was because we haven't accessed to baseline data in China on particulate matter.

In other words--and you've alluded a little bit in discussion about their unwillingness to share specific information. So scientifically, you're sitting on top of a mountain, you're doing

satellite photographs, so I have to presume that you sort of know patterns. So that there are particular parts of the country that you might actually want to know what the particulate matter is in its origin form to be able to ascertain whether or not there's any impact in the United States.

DR. JAFFE: Well, if we can talk about Asia for a minute and not China, and we can hold China in the background for a minute.

COMMISSIONER FIEDLER: Yes, okay. All countries. I don't care.

DR. JAFFE: We have data on three dozen specific transport events, let's call them days, over the last seven years, where we can say this crop of pollutants, these 20 parts per billion of ozone, this 20 microgram per cubic meter of particular matter, came from Asia. We are not limited by the fact that we don't know what the initial concentrations were in Asia.

We can quite unambiguously say this crop of pollutants came from Asia. We can then use computer simulations, what I call chemical transport models, and then help parse out how much of that came from China, how much of that came from coal-burning factories, how much of that came from Taiwan or Korea, and depending on how well our computer simulations work for those particular cases, we can then do that parsing.

But I do not believe, at least in terms of understanding the air quality impacts on the United States, that we are limited by what we know coming about, specifically, the concentrations in China.

COMMISSIONER FIEDLER: So the lack of data from China doesn't inhibit your ability to analyze pollutants in the United States?

DR. JAFFE: You know I have to be careful how I say this. We would do a better job if we had complete information coming from China.

COMMISSIONER FIEDLER: Does the United States government ever ask for it?

DR. JAFFE: I don't know the answer to that one.

COMMISSIONER FIEDLER: Do you? Is that an important question whether the United States government has asked? I mean neither of you know so it doesn't seem--am I to read that as not important?

DR. JAFFE: Well, I think it comes back to one of the things I learned from sitting here this morning was how disconnected the Chinese environmental system is, and this relates back to a question asked a little bit ago about environmental systems and the greenhouse gases. We now have satellites that can detect certain pollutants, and we have our mountaintop site as well as some NOAA sites that are sea-level sites, and with the confluence of that information, we're actually

getting much better at quantifying how much pollution is coming out of Asia on any given occurrence.

Now, that's different from what Dr. Lewis mentioned in terms of projecting the future. I don't project the future. I can tell you what's happening today by looking at my data from my mountaintop side or our aircraft data.

So if the goal is to understand how we can do the best job for quantifying 2008 pollution emissions emanating from Asia, that is actually something that we could put resources into, and through a combination of aircraft, satellite stations, we could improve our estimates of all of those things including the greenhouse gases. Does that answer your question?

COMMISSIONER FIEDLER: In part.

DR. JAFFE: Okay.

COMMISSIONER FIEDLER: We've expired.

DR. JAFFE: Okay. Sorry.

HEARING COCHAIR SLANE: Commissioner Reinsch.

HEARING COCHAIR REINSCH: Well, I'm sorry to hear you've expired.

DR. JAFFE: We wore them out.

HEARING COCHAIR REINSCH: On some occasions, but not on this one. Dr. Lewis, you made a reference to cap and trade programs in your oral statement. I was looking through your written testimony, and I couldn't find it. Can you elaborate a little bit on the Chinese attitude toward cap and trade programs?

DR. LEWIS: Well, I think, when you talk about cap and trade programs, this gets to what I was talking about, the idea of--when you talk about a cap, this is inherently linked to the idea that your capping not just greenhouse gas emissions, but you're capping economic growth, you're capping development, and so there is this real concern, I think, in China and all developing countries about the equity associated with any sort of cap.

HEARING COCHAIR REINSCH: Yes, but I'm talking specifically about a cap and trade approach to international program as a means of--

DR. LEWIS: To an international program?

HEARING COCHAIR REINSCH: Yes.

DR. LEWIS: So, to have trading, you need a cap essentially, and so if you were talking about a global cap and trade program, you need a global cap, which then would need to be basically divided up amongst all the countries of the world.

I think that this is something that a lot of economists talk about. This is something that on paper sounds quite nice theoretically, but in practice, getting to a point where every country in the world had a

piece of that cap is very complicated thing politically to negotiate as well as technically to follow through on for many of the data issues that I've mentioned.

HEARING COCHAIR REINSCH: That's what you think. What do the Chinese think?

DR. LEWIS: Well, I can only--

HEARING COCHAIR REINSCH: Do they agree with you?

DR. LEWIS: --speak from what I've heard the Chinese say, and it is this position that publicly they share, which is that a cap would be considered as a limit on their economic growth, and because of historic responsibility, this is not something they're willing to consider.

I in terms of what China would be willing to consider, which is what I try to talk about with them because I think we need to actually need to be moving towards something, a way that they will reduce their greenhouse gas emissions, is types of approaches, and I think I should say I don't think it's that they will ever rule out a cap. I'm talking today or the negotiations in 2012.

There are many things that China is going to need to do before they are even close to being able to take on a cap, and this has to do with a much better understanding of the quantification of their emissions, where they are today, where they're going to be in the future, and so I think getting them on that road is crucial.

I think since it's going to be important for the U.S. to sign on to any treaty, for China to do something, I think it's going to be important to figure out what that something is, and what we can reasonably expect China to commit to internationally.

HEARING COCHAIR REINSCH: Dr. Jaffe, do you want to make a comment?

DR. JAFFE: You reminded me of when I got detrained there on the last thought, which is that issue of helping China develop its own capacity for understanding its emissions, and my point previously about the disconnect of the Chinese system was that it strikes me as the Western scientific world may have a better handle on what the emissions coming out of China are, rather than what China knows itself. That was the continuation of my thought there.

HEARING COCHAIR REINSCH: Do they have any interest in accepting our data and our measurements as opposed to their own?

DR. JAFFE: Again, I'm going to have to pass on that one.

DR. LEWIS: I think I related topic is, you know, we're talking about sort of two different things, and there's the top-down emissions measurements where you can have--and this is not an area I'm an expert in--where you can have actual satellite measurements of what emissions are on a large basis, on a cumulative basis, or you can have the bottom-up inventories where you have each source, and

understanding where the emissions are coming from.

And the only reason this is an important distinction is because when you come to policy implementation, even if you could measure what the satellite, how many emissions were coming from China and what the quantity is, this doesn't help them necessarily implement policies to reduce those emissions.

You can't just sort of put an umbrella on the country and cap all their emissions from the top down. You need to actually have facility level policies in place. You need each source having things that are going to be reducing emissions, energy efficiency actions taken across the country. So I think that's why this bottom up inventory is extremely important, and I see that really where there is a lack of capacity.

HEARING COCHAIR REINSCH: No, I understand that. I just hadn't thought to bring this up until Dr. Jaffe mentioned it, but you made an important observation. It seems to me it's hard to agree on what you want to do if you don't agree in the beginning on what your share of the problem is or how serious it is. You can say in a gross sense, it's serious, but we may all be acting on the assumption that we're using the same tools and coming to the same conclusions, and in fact, if they're using different tools or coming to different conclusions, it's no surprise that they might come then to different policy solutions.

But what you're implying really, Dr. Jaffe, is that our system, our measurement data is better than theirs. Is that a fair statement?

DR. JAFFE: First of all, I just want to connect back to what Dr. Lewis just said. I think what she just said is very important, the top-down and the bottom-up approach, and when we talk about using satellites or observations like ours in Oregon or Washington, we get a large-scale view of what the emissions are in a large-scale region.

It must connect to the individual factory level, partly because that's where the policy and the control technology is, and if there's a disconnect between those two, then you're missing something. You're either missing understanding or you're missing factories. In fact, in China, there's an awful lot of small-scale operations that would slide under the radar in a normal Western sense. A lot of coal burning is done in very small-scale operations.

So I think the answer is that we have, to go back to your question about who's data is better, I think the Chinese data that I've seen is perfectly reasonable data quality, but we have some larger scale systems in place--satellite observations and the kind of work that we've been doing and others have been doing along the West Coast that have helped me be able to be very specifically pinpoint source regions for pollutants, and in our work, we identify, we're able to quantify how much mercury was coming out of Asia.

As it turned out, it was much larger than were originally estimated based on the bottom-up approach. It really had to do with missing a lot of small sources, a lot of small sources. Because when you add them up, then it made a big source.

So it's that kind of systems in place that we've been doing environmental science work in this country for a long time that is really just now developing within China.

HEARING COCHAIR REINSCH: Thank you.

HEARING COCHAIR SLANE: Thank you.

Commissioner Videnieks.

COMMISSIONER VIDENIEKS: Good afternoon. A quick observation and then a question to both of you. The president of India, I believe, said that pollution is an equal opportunity right. And the time factor being the difference. I lived both in the Bronx in New York when coal was prevalent and also in Washington state in Tacoma next to the smelter. Is that still in operation or not?

DR. JAFFE: No.

COMMISSIONER VIDENIEKS: It's not. My question is this: to what extent is pollution like a time bomb, like PRC apparently has several time bombs that would affect the fiscal situation? Is it a cumulative thing? You noticed the difference between mercury accumulation and CO2. Is pollution to be considered as a time bomb and when would we come, both in China and also globally, to a point-of-no-return? How much time do we have to work with these time bombs, if they are time bombs? This is for both of you.

DR. LEWIS: I'll start and then let Dr. Jaffe elaborate. When you're talking about greenhouse gases, this is a very different thing than talking about local air pollution, and so in that local air pollution, it matters where it's emitted because the health effects and the local environmental effects will be there, depending on air currents.

A ton of CO2 emitted in Beijing is exactly the same as a ton of CO2 emitted in Washington, D.C., for the most part, because with greenhouse gases for the most part, we're talking about the global impact. We're not talking about the local environmental health impact stemming from them. There are some exceptions there.

But for the most part, it doesn't matter where the ton is being emitted, and so this is important because in terms of the impacts that we're talking about, it's a very different sort of thing, and the cumulative impacts for greenhouse gases will be different from the cumulative health impacts that Dr. Jaffe was mentioning.

With climate change, we're concerned about the sort of big tipping points that scientists refer to of icecaps melting and thermohaline circulations shutdown in the oceans. So those are the types of cumulative effects for those gases.

DR. JAFFE: I think I agree with a lot of what Dr. Lewis just mentioned for carbon dioxide or greenhouse effect. We're looking at a couple of decades at a business as usual scenario, all of us just continuing on with our current policies is going to have pretty dire consequences for the planet.

When we're talking about the local air pollution, really those 700,000 premature deaths per year that I mentioned in China, as China reduces its sulfur, its particulate, its ozone, its nitrogen oxide emissions, we would expect that number to come down. Health would improve. People would live longer.

You mentioned mercury, and mercury is a bio-cumulating impact. Mercury accumulates in predominantly, our exposure predominantly in this country is in fish. There is some very low, a lot of very low-tech operations using mercury in China, in the provinces, and I haven't seen any health studies specifically on those regions, but based on our understanding of mercury bio-cumulation and the neurotoxic effect, I would expect that there is some quite significant consequences for that mercury contamination, particularly in children, young children, where it's a neurological effect. It affects IQ.

The longer China continues using these, particularly these low-tech methodologies for smelting and metal recovery in the provinces, the longer are these neurotoxin effects going to be prevalent and the harder it will be to get rid of.

COMMISSIONER VIDENIEKS: But are there any estimates out there related to the questions that Commissioner Fiedler asked about stability, time bombs, a time link? You mentioned a kind of a general link to timing, maybe a couple of decades for one, and is there some point of no return like the, like Dr. Lewis, you mentioned the cutoff point, point of no return?

DR. JAFFE: With respect to mercury or other pollutants or are you referring to greenhouse effects?

COMMISSIONER VIDENIEKS: Well, just pollution in general. It's a global issue, and so what is the drop-dead point for us to do something about it?

DR. JAFFE: I think a couple of decades is the time line which IPCC has identified as really critical for changing the nature if we want to avoid dangerous interference in the climate system, and that's the terminology that IPCC uses.

COMMISSIONER VIDENIEKS: Thank you.

HEARING COCHAIR SLANE: Commissioner Wortzel.

CHAIRMAN WORTZEL: Thank you again for sharing your time with us.

I want to take of the statements by Su Wei, who is the Director General of China's Office of the National Leading Group on Climate

Change from the National Development Reform Commission. He made a statement in Bali in December 2007, and one of the things he said was to control greenhouse gas emissions, China is going to increase its forest coverage rate to 20 percent.

Earlier today, Commissioner Fiedler talked about our trip throughout Shanxi Province, you could see them planting all these little baby trees--no water to water them, but they're in. Even if you did that and increased it, what, does that have a really dramatic effect on reducing greenhouse gases or is this sort of aspirational science?

DR. JAFFE: The devil is in the numbers, of course, here. And if you gave me about an hour and a calculator and the number of trees, I could give you a quick answer.

But I will say that there's no way that's a bad policy because another very important issue, and if you read some of the details in some of the written testimony that I submitted, one of the important things is we see dust impacts coming from China. And those are real air pollution impacts for us, and as I mentioned, that April 2001, which actually violated the air quality standard in a handful of cities not only in the western United States, all the way as far back east as Atlanta, and so dust emissions coming from the desert is a very important aspect.

And that's partly natural and it's partly human caused as a result of urbanization, spread of bad agricultural practices. So there is no way that planting trees can be a bad thing. Now with the water and the sulfur dioxide issues are real issues, and again the devil is in the details.

DR. LEWIS: Just to add briefly, it's estimated that--we've been talking a lot today about energy-related greenhouse gas emissions, forestry emissions from deforestation could be 20 to 30 percent of global greenhouse gas emissions so it's not insignificant.

Whether the policy that Su Wei mentioned would have an impact on that, you know, would really depend.

CHAIRMAN WORTZEL: I still have some time. One of the things when I left the Embassy in Beijing after the Tiananmen Massacre, I went to the Department of the Army Headquarters; we concluded that if we're going to continue any way of having a bilateral relationship with the People's Liberation Army, it would concentrate on environmental mitigation.

The Army does that pretty well in some of its areas. They were interested. You know it's a politically neutral approach that allows you to continue. Are there viable and active pollution mitigation programs that we have or what you might recommend in those areas with China?

DR. LEWIS: I'm sorry?

CHAIRMAN WORTZEL: Cleaning up mercury, pollution mitigation, getting rid of it, cleaning it up, cleaning up sites. That's another, it's not stopping gases coming out, but it's another problem of the environment.

DR. JAFFE: I should have brought a picture in my mind of these hundreds of small-scale mercury operations in, well, in this case, it was Sichuan Province, but I think there has to be a simultaneous development of economic opportunities for people who are very low down on the economic status list, economic opportunities, education in terms of the health effects, people working with mercury and breathing this stuff at levels that would just shoot our OSHA standards through the roof.

And education on the health impacts of that and those environmental opportunities, those economic opportunities. So I don't see any silver bullet that the Army could come in and start shoveling the mercury away and burying it somewhere. It has to be really a cross-programmatic for economic, environmental and capacity building.

HEARING COCHAIR SLANE: Thank you.

Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman.

Dr. Lewis, I wanted to come back to something you said in reply to an earlier question. You pointed out that the Chinese are actually ahead in some of these green technologies, and that you even mentioned GE being involved.

Have the Chinese provided incentives for the development of these technologies, and what role does GE have in helping them? I'd be very interested in that.

DR. LEWIS: Sure. My understanding is that we talk about technology transfer in the sort of abstract way, but in fact, technology transfer is happening all the time to China, and for the most part if you look at U.S. companies like GE, they're often willing to transfer technology to China if there is some economic benefit in it for them, and to the most extent, GE will see that it's ahead.

It has a competitive edge still in many technologies such that they can sometimes transfer a technology that's maybe last year's model or just slightly outdated, but still is advanced in the Chinese context, and that this potentially could be beneficial to both.

Examples of commercially driven models of tech transfer that I've seen just briefly would be GE agreeing to do a joint venture to develop an advanced natural gas turbine with a Chinese company in which that technology will be licensed to that Chinese partner in return for China agreeing to purchase a certain number of turbines out of that plant so that this is a large purchase up front in return for

agreeing to transfer this technology.

Another model would be GE moving its wind turbine manufacturing facility to China, training Chinese workers to manufacture its wind turbines that have the GE logo on them, but are in many ways being made in China by the Chinese engineers.

COMMISSIONER MULLOY: So here's what I imagine in my head when I hear this. I imagine the Chinese government has a strategy, incentives, and one of the things they do is incentivizing our corporations to make more money by doing the tech transfer, and then making the goods there, maybe even shipping them back here. Where does that leave our people?

DR. LEWIS: I think that if you talk to American companies, you'll hear different stories. I've heard many say that they had extremely positive experiences with their factories in China, that although you hear about concerns of IPR theft and things like that, that in fact being able to tap into the Chinese engineering base has been beneficial to them. I think that the key is maintaining a competitive edge in many of these industries.

COMMISSIONER MULLOY: Here's what bothers me? You have the Chinese government with a strategy incentivizing this stuff. On our side, you have corporations who have an incentive to make shareholder profits. Oftentimes, the CEOs get bonuses for doing that, and so they have an inclination to go along with this.

So you have the Chinese government benefiting, you have the Chinese people benefiting, you have the shareholders of the corporation benefiting. I think what about the American entity? Who's looking out for our workers and our national interests in this kind of game? Do you see what I'm talking about?

DR. LEWIS: Of course. There is absolutely no reason why our policymakers couldn't be putting the same incentives in place for GE to be manufacturing its wind turbines here. You can see Canada actually has put some more incentives in place to move such factories there. Spain has done this as well.

So this isn't just China issue. A lot of countries, a lot of states in the U.S. are putting incentives in place to attract green industries and high-tech industries, and I think that's fair game, and I think it could be very positive.

COMMISSIONER MULLOY: Do you have anything you want to add, Dr. Jaffe?

DR. JAFFE: Well, just that in the universities, we think of education as being the key, and so all I can say is that we need to figure out how to be at the cusp of the development of these high-end technologies, and obviously--

COMMISSIONER MULLOY: My thought is that many of our

best universities have a lot of students from China getting the best education that we can provide them, and the Chinese government is incentivizing those students to come back to China. So I think anybody who is imagining that that's going to be a long-term strategy, I don't think they're looking at the full picture.

DR. JAFFE: Can I ask you a question?

COMMISSIONER MULLOY: Yes, you can.

DR. JAFFE: Do you know what it costs to send your child to one of these top United States universities?

COMMISSIONER MULLOY: I do. I sent two of them.

HEARING COCHAIR SLANE: Commissioner Bartholomew.

VICE CHAIRMAN BARTHOLOMEW: Thank you.

This is very interesting testimony, and we really appreciate your being willing to think on the fly here as we go, and it just seems like every comment has raised another question in my head. But I can't let go the opportunity that this is the first time that I believe I've heard the military being characterized as environmentally friendly, which is an interesting point.

Dr. Lewis, your comment about how the U.S. estimates of Chinese emissions was off by an order of magnitude. If there is one thing that we've heard over the course of this Commission, it has been just about every U.S. government estimate about just about everything to do with China has been off by an order of magnitude, which is I think actually to say that what is going on in China is just happening at a rate that's been unforeseen, and people can't say. It's trade, it's about their military build-up, all these things.

So in some ways there is a surprise, but we continue to be surprised by the fact that people continue to be surprised.

I think your comments, Dr. Lewis, on the distinction or the difference between the responsibility for global implications and what's going on with local air pollution are really important. That really helped to clarify things for me. So thank you for that.

And Dr. Jaffe, we held a hearing in New Orleans a couple of months ago to look at the issue of actually seafood safety, seafood issues, both the impact on the Gulf Coast fisheries and the economies and also health and safety issues. So those local air pollution, somebody raised it there--the water that the fish are being farmed in. The fish are then being sent over to the United States in very large quantities. What are the implications for U.S. consumers' health for these things that people don't even seem to be thinking about?

I just wanted to mention that. There will be more when our report comes out in November. How about that as a teaser?

But I want to get back to the heart of the question that I was asking the first time around, which is the role of citizen movements in

all of this. We are seeing how difficult it is in this country to get action on global warming issues, global climate change. We are seeing the role of citizen movements in cleaning up local pollution has been-- Rachel Carson's book "Silent Spring" was over 40 years ago now--how do you see that unfolding in China?

Yes, environmental NGOs have often had more space than other NGOs in China, but in your interactions with your colleagues in China, do you see room for the citizenry to be able to take on these issues or will they by nature have to become more political in order to do it and then be shut down? Out of the scientific expertise, but it's an important issue.

DR. LEWIS: Yes, it's certainly a fascinating question and certainly an important one. I think that all environmental organizations around the world have grappled with actually how to make citizens care about climate change because it's not necessarily an issue that has impacts in your own backyard or it's harder to grasp what those impacts will be.

I think that the types of global scale, things we're going to start to see that could change public opinion around the world in the U.S. and in China would be the melting of glaciers at rapid rates. If the Greenland ice sheet disappears, things like this could really have an effect comparable to when we first saw the photos of the ozone hole in terms of raising public opinion about stratospheric ozone depletion.

But in terms of China and the citizen movements there and how this could affect environmental awareness, I think that we can't expect that environmental awareness is going to come about in China the same way that it has in the U.S. and in Europe because of many of the political reasons that you've mentioned.

That said, I think as you see people get wealthier and particularly in urban areas, people start to care more about how dirty their air is and their water, and as someone who has lived in Beijing, this is something I was very sensitive to, and you know, I think that it's all relative. We talk about tipping points and how long can we keep polluting until we need to stop? Well, it depends how dirty, how clean you want your air, how clean you want your water. So I think it's hard to put a number on it.

But I think it will be interesting to see how that comes about in China. I would guess it would be quite different from the type of environmental movement we saw come up in the '70s in the United States because of the difference in the political system. But I would still be optimistic that you'll see some pretty drastic changes.

VICE CHAIRMAN BARTHOLOMEW: Dr. Jaffe.

DR. JAFFE: Well, I have, China has clearly become a global economic power. I have a hard time seeing them going much further.

Part of the reason they've been able to do that is because they've embraced some elements of capitalism. They've allowed people to say you can invest your own money and get rich.

I have a hard time seeing the economy moving forward and becoming an accepted player without increasing democratization. I think the issue of, I'll go back to those 700,000 premature deaths a year and what Dr. Lewis just mentioned. As people get richer, they're going to insist on a cleaner environment. It's just hard for me to see that in ten or 20 years, China won't be more democratic than it is now.

Will it be enough? I don't know.

But again coming back to how does China become a participant in global greenhouse gas negotiations, they're going to have to know what their factories emit. Right now I don't think they know what their factories emit.

To do that is going to require an environmental agency that has more authority, more clout, more people than it does today. And I think actually going back to the point Commissioner Mulloy made about Chinese graduates coming to the U.S., I don't see that as a bad thing. Now, I do see it as a problem that we don't educate our own citizens well enough, but I think capacity building at every possible level is only a good thing because as we help Chinese citizens, students, scientists, social scientists, artists, whatever, understand the connections between a clean environment and economic and social well-being, I think anything we can do to help them understand that connection is going to be good, not only for them, but good for us, too.

We all teach this stuff--and I'm often reminded that actually I think the element of involving cost/benefit analysis. I've used 700,000 premature deaths and the four percent GDP impact in China. The United States did make a major step forward under Ronald Reagan when we started to insist that cost/benefit be included in all environmental regulations, actually all regulations.

What that forced us to go was changing our mentality from, gee, I like having frogs in my steam to, gee, those frogs have an environmental service, they have an economic benefit, they have a role in the ecosystem. Oh, boy, now I have to put a dollar cost on it. That's hard, but if I don't put a benefit to what those frogs do, then by definition, they go to zero.

So forcing us to put on a cost to environmental benefits or negative cost to the detriment is a very important step forward to say, hey, you can't just develop your economy without consideration of the environment. There are economic costs, we would say quality, I would say quality of life issues, but let's turn them into an economic cost, and then as we help the Chinese understand those economic costs, they would say, gee, maybe we shouldn't build that power plant without the

scrubber because it's going to actually cost us more money if we build it without the scrubber.

So again, capacity building. Everything we can do in capacity building I think is a good thing.

HEARING COCHAIR SLANE: Thank you.

Commissioner Fiedler.

COMMISSIONER FIEDLER: Two things. I'd like to go back to the 700,000 deaths that the World Bank. Did they project out increases in the number of deaths if the situation continues unabated? Or was that a number that was tough enough to publish, much less the projection?

DR. JAFFE: I don't think they projected out.

COMMISSIONER FIEDLER: So one has to be able to assume that 700,000 is a minimal number over time?

DR. JAFFE: Well, all pollution is not created equally. There's a big difference between CO2 and mercury and SO2 and particulate matter. Within China, the largest health effect is from particulate matter. It's also the easiest to control.

And sulfur dioxide emissions have continued to go up, but they're approaching the cusp where they're starting to turn the corner. Chinese companies are installing FGD, flue gas desulfurization, and other things. So it may be that that number may come down in the future. It's probably the best case scenario, or at least the pollutant that is going to be most easily regulated and controlled.

COMMISSIONER FIEDLER: Let me just take issue with something perhaps. On global climate change, I can understand where it might require a higher degree of education in science to understand, and reading about the debate in the science to understand the impacts.

I fiercely disagree on localized environmental pollution. Ordinary people are quite commonsensical and know when they can't breathe. And if you take a Chinese example of the Henan AIDS blood transfusions that raced AIDS through the community, those people knew what was happening to them after it happened.

They couldn't get any assistance. There's lots of other problems.

So the recognition among the populace in China that environmental degradation is harming them--all you have to do is go to Taiyuan, like we did, where people are wearing a mask. They're wearing a mask because they can't, because they don't want to breathe this stuff that is in their air.

But they also have no expectation that that's going to change. Okay. No real expectation. And I come back to the political in the end. I mean this is a political decision on the part of the Chinese government. So it's not simply a scientific solution. The question becomes--we've been talking all morning and all day about knowledge

versus commitment, and the commitment side of this stuff is political, and so I'm wondering where the nexus between deaths in the population, economic growth and subjective concerns about stability merge? And that seems to me be the point at which commitment develops in this country.

DR. LEWIS: Well, as I started off my testimony saying, I think that we really need to be looking at this nexus of energy security, of local, environmental and health effects of global climate change and of benefit to the economy. And I think that there are many solutions within China that can really address all of these issues simultaneously.

There are many instances where we can look at things that the leadership is very concerned about, energy efficiency, energy intensity of their economy being one of them, and we can see some very serious policies that have been put in place, for example, to try to, we talked about this runaway growth that's been happening in China in the last few years.

Yes, the U.S. was surprised by this; the Chinese leadership was equally surprised by this, and not necessarily pleased by it because of the local environmental effects and all these other effects that come along with it, even if there may be some economic benefit.

So you've seen policies to actually try to de-incentivize, to reduce the incentive for the exports of energy-intensive goods from China to other countries. China doesn't necessarily want to be the factory for the world of these very dirty, these dirty products. So I think that this is something that they are seeing it's in their interest to do these things. This will have benefits for some of the local environmental and health effects we've talked about, benefits for climate change. Potentially benefits for their economy as they move away from the heavy industrial base and move towards a more service-oriented economy. So I think that we need to look for ways to really capitalize upon all of these things.

COMMISSIONER FIEDLER: Thank you very much.

DR. JAFFE: Let me make two observations relating to that.

COMMISSIONER FIEDLER: Yes.

DR. JAFFE: The first is if you read the first two pages of that World Bank report, it talks about the great social benefit of this rapid industrialization. That is it took a lot of people from great poverty to a level at which--I've forgotten the average per capita income, but it's in the few thousand dollars per year from a number that was in the hundreds of dollars per year.

So there is a recognition that this economic growth has come with a social benefit, okay. That said, to go back to the health impacts aspect--this is sort of a contrasting view, to go back to the health impacts, there's clearly a recognition that the air pollution hurts

people. They know that.

What they may not understand is that it kills people, and who it kills will be the elderly.

COMMISSIONER FIEDLER: Yes.

DR. JAFFE: So grandma is going to die five years earlier than she would have otherwise because she lives in one of the 17 most polluted cities in the world or within 50 kilometers of one of the 17 most polluted cities in the world.

And so I think this connection between what we call premature mortality, people do die, their lives are cut short by these air pollution impacts, may not be as obvious to the average citizen on the street.

COMMISSIONER FIEDLER: Thank you.

HEARING COCHAIR SLANE: Thank you very much for a very stimulating hour-and-a-half. We appreciate your time.

We'll take a few minutes break here before the next panel.

[Whereupon, a short break was taken.]

PANEL V: U.S.-CHINA ENERGY TECHNOLOGY COOPERATION: CIVIL NUCLEAR ENERGY

HEARING COCHAIR SLANE: Our fifth and final panel of the day will discuss energy technology cooperation between the United States and China. It will focus specifically on civil nuclear energy.

Our first panelist is Dr. Andrew C. Kadak, Professor of the Practice at Massachusetts Institute of Technology. His research interests include the development of advanced reactors, in particular the high temperature pebble-bed gas reactor, space nuclear power systems, improved technology, neutral licensing standards for advanced reactors, and operation and management issues of existing nuclear power plants.

Our second panelist, Dr. Stephen Mladineo, is a Senior Program Manager at Pacific Northwest Laboratories, who has provided support to the Department of Energy on nuclear nonproliferation issues for the past 15 years.

He was a former U.S. Navy submarine commanding officer and was a Professor of National Security Strategy at the U.S. National War College.

Our witnesses have been asked to discuss the current state of China's civil nuclear power industry and the impacts of U.S.-China nuclear energy cooperation.

Thank you for being here, and we'll begin with Dr. Kadak.

STATEMENT OF ANDREW C. KADAK, Ph.D.
PROFESSOR OF THE PRACTICE, NUCLEAR SCIENCE AND
ENGINEERING DEPARTMENT, MASSACHUSETTS INSTITUTE
OF TECHNOLOGY, CAMBRIDGE, MASSACHUSETTS

DR. KADAK: Thank you very much. Thank you for the invitation and I appreciate the opportunity to share my thoughts with you about U.S.-China nuclear cooperation.

I am, as was mentioned, a Professor of the Practice in the Nuclear Science and Engineering Department. I received my Ph.D. and master's degrees in nuclear engineering from MIT. But I spent most of my life in the commercial nuclear sector as President and CEO of Yankee Atomic Electric Company, which was a nuclear operating and engineering company in Massachusetts. We provided nuclear engineering services to all nuclear energy plants in New England.

My personal background with the Chinese nuclear program began in 1998 when I and a number of fellow faculty went to a MIT-Tsinghua University workshop on nuclear energy, and at that time, there wasn't a lot of activity in nuclear in 1998 in China.

Subsequently, I was retained as a consultant to serve on a Senior Nuclear Safety Review Board of the four, and soon to be six, Daya Bay nuclear power stations operated by China Guangdong Nuclear Power Company

This brings me to China about twice a year, a week each time. So I think I have a pretty decent appreciation of the Chinese nuclear industry.

With that as an introduction, I'd like to share with you some answers to questions that you had posed. In terms of the Chinese civilian nuclear industry and how it's organized, my observation is that the Chinese are not very comfortable with organization charts, and I will leave to my formal written testimony what that organization is because that will take me at least 20 minutes to explain.

But given that, I think that the clear message is that the Chinese nuclear industry is controlled by the central government from top down, and it is quite clear that nothing gets done in China without government approval and the most senior group is the State Council of Ministers.

What I'd like to now point out is that there are several key areas that might be of interest to this committee. The first is the nuclear regulatory part. The Chinese have a National Nuclear Safety Administration which is their regulatory branch. They oversee the construction and operation of existing nuclear plants.

They also have a State Environmental Protection Administration,

which is part of the Ministry of Environmental Protection that reports to the State Council of Ministers as well. And SEPA, which is what it's called, is responsible for radiological monitoring and radioactive waste management.

No utility that proposes to build a nuclear plant or company can do so without the approval of the regulator and the Environmental Protection Agency organization.

The China National Nuclear Corporation controls most of the nuclear sector business in terms of research development and engineering, uranium mining, fabrication and all fuel cycle services.

There are two major companies who essentially build and operate nuclear power plants. One is the China Power Investment Corporation and the other is the China Guangdong Nuclear Power Company. These are the two that are entitled to actually build and operate Chinese nuclear power plants.

The fastest growing company is the China Guangdong Nuclear Power Company, and they are going to be a major player in China's commercial nuclear energy sector I think they've got about ten to 12 existing, well, new nuclear plants being planned.

China is also a leader in the development of the high temperature gas reactor, which brings me to back to Tsinghua University. They have an operating small high temperature gas reactor pebble-bed reactor just outside of Beijing. They have plans to build a full-scale demonstration pebble-bed reactor in Northeast China. The company they've formed to design and build this plant is called Chinergy. This project is a collaboration with Tsinghua University, China National Nuclear Construction Company, and the Huaneng Group, which is the largest utility in China. They hope to get this reactor operating by 2014.

In terms of China's new nuclear energy policy and who implements it, it's really run by the China Atomic Energy Agency, with the approval of the Commission on Science Technology and Industry for National Defense. The plan is implemented by the National Development and Reform Commission. So they've got a very strong hierarchy of controlling the nuclear developing in the country.

Let me address quickly the goals for expanding the civil use of nuclear. I was interested and listening very carefully to the environmental woes that were just mentioned in the previous panel, and I think we have a solution to at least part of those woes.

By 2030, China plans to have 20 percent of its electricity generated by nuclear. They generate only two percent now. Right now, there are 11 operating nuclear power plants, and they have about 21 new plants either on order or approved to start construction.

If they build--

HEARING COCHAIR SLANE: Sorry, Doctor, you say there's 20 on order?

DR. KADAK: 21 either under construction or about to start construction. So it's a massive effort.

If they build these 160,000 megawatts electric of nuclear generation by 2030, they will displace 1.2 billion metric tons of CO2 per year. That's huge.

In terms of concerns regarding the expansion of nuclear power in China, I think the only one that I would like to raise to your attention is assuring the quality of construction and making sure that they have trained operators and staff to run these plants.

In the United States, we built 100 nuclear plants in 25 years. The Chinese rate of construction is somewhat less than that. We think they can do this within the time table that they have outlined.

The other thing they need to do to keep up with this rapid growth is to make sure that the regulatory agency is also expanded at a pace to keep track of what's going on in terms of construction and operational oversight. The regulatory agency must have suitable resources to be sure that they can monitor the construction and operation of these plants.

In terms of our existing U.S.-China nuclear energy cooperation, it is very, very limited. Even though China has just joined the Generation IV International Forum on the development of the next generation nuclear plants and is active in the International Atomic Energy Agency initiatives, we really have limited interactions. The reason for that, which I hope this Commission can address formally, is the problem of granting Chinese scientists and engineers visas to come to the United States.

The visa process is woefully inadequate, in my opinion, and it takes months of effort. It is a very embarrassing experience for the Chinese who want to come here. When the U.S. actually decides on the visa, it's usually the day before their plane leaves, making it impossible to rely on their visits to the U.S. Many times, it's simply denied for no good reason. This happens to people who have already previously been granted U.S. visas as well.

Because of this, most of our meetings with our Chinese colleagues have to be done abroad in other countries, particularly in Europe. In my opinion, based on my experience at Daya Bay, it would be very good to have Chinese engineers, operators, maintenance people come to the United States to see what we do in terms of operating our nuclear power plants to learn from us, and then be able to benchmark their performance against our best performance. This is very difficult to arrange but would be hugely helpful in the overall safety mission of operating nuclear plants worldwide.

In terms of the cooperation changing over the last five years, not much has changed, again largely because of this visa problem.

Relative to the Westinghouse agreement with China to build four AP-1000 reactors, I will leave that to Steve to address because I think his testimony more focuses on that. It is clear that there is a lot of technology transfer and in my view, had they not agreed to do this, they would have not bought U.S. reactor technology.

Is this a unique transfer of technology? My observation is it's not because when we were the dominant leader in nuclear power, we transferred our technology through licenses to Europe--France, Germany, and Korea. Thus, this is not an unusual development in terms of trying to get our technology sold around the world.

I do worry a bit about the loss of competitiveness, but if we continue to develop new and more advanced technologies, I think that won't be a major problem. Clearly Westinghouse, when they signed this transfer agreement looked at this competitive question and decided for themselves this is okay from a business perspective, but I can't speak to that.

In terms of what implications could these technology transfers have on our security, for me it's hard to judge. Clearly, as I said earlier, if the United States had not done this, other countries would have gotten the contracts, and particularly the French.

In my judgment, having a U.S. market presence in China in the nuclear field helps U.S. security. By selling U.S. reactors to China, it positions our technology in their market and establishes relationships with the Chinese nuclear industry. By having these relationships and closer communication and cooperation, this helps our security in my opinion.

At this point, the Chinese market is so huge that most of their effort will be focused on meeting their own needs rather than attempting to compete in the U.S. market with Chinese technology.

In my last two minutes, I would like to mention some opportunities that exist for the promotion of further U.S. cooperation?

In light of the past panel, I think there are some things that you might not be aware of, but at Tsinghua University, there is a Low Carbon Energy Laboratory that has been established to develop advanced nuclear technologies; clean coal; advanced power transmission and security; and new and renewable energy sources including hydrogen, biomass - the usual list.

Recently, we've had representatives of Tsinghua visit us at MIT to see how we can participate in this particular kind of collaboration. MIT is carefully considering this proposal.

But if such initiatives were to be encouraged, I think it would be a great help to actually doing something with the Chinese.

I think the next question you asked was what role can the United States play in joint R&D development and technology assistance efforts influencing energy policy in China? I think we can play a significant role by helping improve the organizational infrastructure in China to create a viable and safe nuclear industry.

At present, my assessment is the commercial nuclear industry is directed from the top and implemented by organizations that rely on institutes and universities to actually do some of the design work. There isn't an equivalent of Westinghouse or General Electric that is able to manage the integrated design and construction.

I remember once I was in China, they were asking me, well, how do you guys organize to build and operate nuclear plants? I think if we were able to help in terms of establishing an organizational structure, that would be a great value to the country and to us since it would improve the overall safety of the plants.

Even though the Chinese are buying Western technology, there are still large gaps in their technical capabilities in design in terms of computer codes and analysis. This obviously also affects the safety of the plants for the long-term.

The other reactor that they are developing, and, I might add, leading in, is high-temperature pebble-bed reactor. This reactor could be useful for electricity generation and hydrogen production. But both of these areas are opportunities for technology exchange. You may know that under the Energy Policy Act of 2005, Congress has mandated the construction and operation of the Next Generation Nuclear Plant for the production of electricity and hydrogen. One of the technologies being considered for this plant is a pebble bed reactor.

Let me just sum up a little bit because I think I am over time. I am told to be stopped. China is the largest economy. I thought that was reading down, but it's reading up--sorry, I apologize.

HEARING COCHAIR SLANE: That's okay.

DR. KADAK: China is going to be the largest world economy and we have to engage with them, not only as consumers of Chinese products but as collaborators, to address the global climate and energy issues.

So this is what hope the committee will address. The bottom line is the more we work with the Chinese, the stronger will be our relationship. The Chinese culture is built on relationships, which we should nurture. So that's sort of the end.

Thank you very much.

[The statement follows:]

Prepared Statement of Andrew C. Kadak, Ph.D.

**Professor of the Practice, Nuclear Science and Engineering
Department, Massachusetts Institute of Technology, Cambridge,
Massachusetts**

My name is Andrew C. Kadak. I am a Professor of the Practice in the Nuclear Science and Engineering Department at the Massachusetts Institute of Technology. I received my Ph.D. and Master's degrees from MIT in nuclear engineering. I have spent my entire career, until I joined MIT in 1997, in the commercial nuclear power industry. My last position was President and CEO of the Yankee Atomic Electric Company which operated the Yankee Atomic Nuclear Power Station in Rowe, Massachusetts until it was shutdown and subsequently decommissioned. Yankee also provided engineering, safety analysis, licensing and environmental laboratory support to most of nine then operating nuclear plants in New England. Yankee was also involved in the design and construction of many New England nuclear plants.

Personal Background with the Chinese Nuclear Energy Program:

My introduction with the Chinese nuclear energy program began in 1998 when several MIT professors were invited to Beijing to conduct a workshop on nuclear energy with a large group of Chinese representing universities, regulators, several state agencies and some involved in the design and construction of nuclear plants in China. It should be noted that at that time, China's nuclear energy program was not emphasized by the government as an important element in their energy strategy.

Subsequently, at MIT my research interests began to focus on the design of advanced high temperature gas reactors using pebble bed fuel. This was also an area of research and development by Tsinghua University's Institute of Nuclear Energy Technology (INET). As a result of this common interest and following a visit of the president of Tsinghua University and several of his top scientists and engineers to MIT who were working on the pebble bed reactor, the Nuclear Engineering Department at MIT and Tsinghua University signed a memorandum of understanding for cooperation and technical exchange on pebble bed reactor issues. This agreement was subsequently approved as a separate agreement by then Secretary of Energy Richardson and his Chinese counterparts in a formal Part 810 technology exchange program. To date, we have been able to continue to have mutually productive exchanges at various meetings of the industry and visits to the Chinese HTR-10 pebble bed research reactor. The HTR-10 is the test reactor for China's future commercial pebble bed reactors now being licensed and planned for construction in China.

During this time period, I was also retained as a consultant to be a member of the Senior Nuclear Safety Oversight Board of the China Guangdong Nuclear Power Company that operates four existing 900 Mwe commercial nuclear plants at the Daya Bay site near Hong Kong. I have been spending a week at these plants twice per year for the last 4 years. Thus, my understanding and appreciation of the Chinese nuclear power program is current and in some depth.

I would like to answer your questions as posed with additional thoughts that might be of interest to the committee.

1) How is China's civilian nuclear power industry organized?

Based on my experience, the Chinese are not comfortable with organization charts and I have yet to find one of the Chinese nuclear industry. In March of 2008, there was a significant reorganization of the various ministries that oversee nuclear energy. The key agency is State Council of Ministers. Under the State Council of Ministers is the Commission for Science Technology and Industry for National Defense. This Commission controls the China Atomic Energy Agency which is responsible for planning and

managing the peaceful use of nuclear energy and promoting international cooperation. The state-owned State Assets Supervision and Administration Commission (SASAC) is an investor of state-owned assets on behalf of the central government. SASAC has a major role in nuclear expansion based on its ability to finance new nuclear projects for the benefit of the national government. The National Development and Reform Commission (NDRC) is the agency responsible for assessment and approval of major projects and is responsible for deciding which nuclear projects to pursue.

Also in March of 2008, a new National Energy Commission was created to strengthen the role of government in terms of managing the energy sector. It reports to the NDRC and is charged with developing an integrated energy development strategy and monitoring its implementation. The National Energy Commission will have a state energy bureau to integrate NDRC's energy management functions and to promote various energy development projects and conservation.

There are several other state agencies such as the State Nuclear Power Technology Corporation that is charged with technology selection for new plants that are purchased overseas. The SNPTC reports to China's State Council of Ministers.

National Nuclear Safety Administration is the nuclear regulatory branch which reports directly to the State Council of Ministers. NNSA licenses and oversees the safety of nuclear plants. The State Environmental Protection Administration (SEPA) is now part of the Ministry of Environmental Protection which also reports to the State Council. SEPA is responsible for radiological monitoring and radioactive waste management. A utility that proposes to build a nuclear plant must have approval from both the NNSA and the State Environmental Protection Administration.

The China National Nuclear Corporation (CNNC) controls most of the nuclear sector business including research and development engineering design, uranium mining, fuel fabrication and all fuel cycle services. It is also a major investor in all nuclear plants in China. The China Power Investment Corporation (CPI) is a major power generator and is currently the largest state-owned nuclear power holding company. One of its competitors is the China Guangdong Nuclear Power Company which along with CPI and the China National Nuclear Corporation are the only entities that have been designated to build and operate China's nuclear plants.

China has also decided, at least for the present, to build only pressurized water reactors which are supplied either domestically or purchased from France, Russia, Canada and the United States. The long-term goal of China is to have the capability to take over all of these designs through technology transfer agreements so that they can become completely capable of indigenously designing, supplying all components, and fuel for their reactors.

China has several companies that design and construct nuclear plants. They include: the China National Nuclear Corporation; the China Nuclear Engineering and Construction Group; the China Nuclear Engineering Company; the Shanghai Nuclear Energy Research and Design Institute; the Beijing Institute of Nuclear Engineering; and the China Nuclear Power Engineering Corporation. In addition, as the industry evolves and develops, separate companies are established to own and operate the nuclear power plants. These new plants have multiple owners with shares sold very similar to that which is done in the United States to mitigate risk and provide financing.

The fastest growing nuclear operating company is the China Guangdong Nuclear Power Company who own and operate the two Daya Bay and two Ling Ao nuclear plants with two under construction (Ling Dong). Additionally, China has an advanced pebble bed reactor project underway through another joint venture under a company by the name of Chinergy. Chinergy is owned by Tsinghua University, China National Nuclear Construction Company and Huaneng Group which is the largest utility in China. The

high temperature pebble bed reactor – HTR-PM will be built in northeast China in Shangdong province by 2014.

Who determines nuclear energy policy, and who implements that?

Nuclear energy policy is determined by the China Atomic Energy Agency with the approval of the Commission for Science Technology and Industry for National Defense which reports to the State Council of Ministers. The policy is implemented by the National Development and Reform Commission and the state-owned Assets Supervision and Administration Commission which supervises the China National Nuclear Corporation and the China Guangdong Nuclear Power Corporation. The National Energy Commission and the State Energy Bureau will also be engaged in implementation of the government manager of the energy sector.

What role do state owned enterprises play?

State owned enterprises are the companies that design, build and operate nuclear power stations in China. The utilities, and the companies mentioned above are all either state owned or controlled. They implement national energy policy as set by the State Council of Ministers.

2) What are China's goals for expanding the use of civil nuclear energy, and what impacts will this development have on China's energy supply and emission of greenhouse gases?

China has set extremely aggressive goals for its nuclear expansion. It appears that every year more nuclear plants are planned to meet their energy needs. China plans to generate 20% of its electricity from nuclear plants by 2030. At present, up to 60,000 MW electric of new nuclear capacity is being planned by 2020. Currently there are 11 operating nuclear plants producing about 2.4% of the electricity demand in China. Approximately 21 new nuclear plants are either under construction or about to start construction that have been approved by the State Council. In total, China plans to build at least 160,000 Mwe of nuclear generation by 2030. Unfortunately, due to the huge energy demands of China and the relatively small nuclear contribution to its present electric energy needs, the targeted percentage of nuclear in the electricity mix by 2020 is expected to be only 5% up from 2.4 % today. From an environmental perspective, if they are able to meet the 2030 goals, they will displace **1.2 Billion** metric tons of carbon dioxide per year if the plants were coal plants. Not a small amount!

What concerns exist regarding the expansion of nuclear power in China?

The rapid expansion of any industry is a concern from the standpoint of assuring quality of construction and a trained plant staff and operators. In the United States, during our rapid expansion of the nuclear industry in the 1960's and 1970's when we built over 100 nuclear plants in 25 years, the challenges we faced are similar to those being felt by the Chinese. The Chinese need to train craft labor to build the plants to nuclear standards and educate engineers for nuclear plant design and train operators for the many plants they have planned. China also needs to staff its regulatory agencies with nuclear qualified engineers for oversight and review of new project proposals. Since China would like to transfer foreign nuclear technology to indigenous design and manufacturing, effort needs to be made to assure that Chinese manufacturing companies comply with the strict nuclear quality standards. This will require additional inspections and regulatory attention.

The existing plants such as those at Daya Bay are becoming training grounds for future engineers, operators, craftsmen and the other workmen needed in the design construction, operation and maintenance of nuclear power stations. The Chinese realize that one of their major challenges is developing the needed human resources to support their rapid nuclear expansion. To give you an example, for the China

Guangdong Nuclear Power Company alone, they will need to hire more than 13,500 engineers, technicians and operators for their existing and future nuclear plants. To construct the plants that they plan to build, they will need over 4,500 people. While these numbers may seem large and unattainable, China is a country of 1.3 billion people. To put China's expansion plans in perspective, their planned build of plants connected to the grid each year is about 1/2 the US build rate of the 1970's (4.63 US to 2.46 China to 2020). My conclusion is that they can do it.

In order to keep up with this rapid growth, the regulatory oversight of construction and operation must be expanded at a pace to assure that the same level of quality of the first plants is maintained for all future plants. The NNSA must continue to grow and improve its oversight role to be able to cover all the different types of reactors that are presently being built in China. These include plants from Russia, the United States, France, Canada, and their own indigenous designed plants. The Chinese have made a conscious decision to focus on pressurized water reactors which will be standardized around units of approximately 1,000 MW electric. This will be helpful in terms of supporting the plants and in regulatory oversight.

3) What is the status of existing US China nuclear energy cooperation?

US China nuclear energy cooperation is limited. China has recently joined the Generation IV International Forum which is focused on the development of the next generation of nuclear plants. Its entry into this international collaboration took many years to materialize. China has been an active participant with the International Atomic Energy Agencies initiatives aimed at nuclear cooperation. At present, there are international agreements with the Westinghouse Electric Co. for the purchase of the AP 1000 nuclear plants and with the MIT Nuclear Engineering Department on development of the pebble bed reactor.

One of the difficulties in establishing international collaborations with China, which I hope this Commission can address, is the problem of granting Chinese scientists and engineers visas to allow them to come to the United States to meet with researchers, utilities and companies in the nuclear area. The process of technology exchange with China requires months of effort to obtain visas with outcomes in terms of actual attendance at meetings in the United States not decided until the last minute and most of the times visas are rejected. What this means for the United States is that most international meetings with the Chinese must be held outside of the United States to our detriment. Based on my experience with the Daya Bay plants, it would be very helpful to have Chinese engineers, managers and operators visit US plants for benchmarking of good performers so that they can directly observe how we run our plants. Such visits are extremely difficult to arrange.

How has that cooperation changed over the past five years, and what prospects exist for continued cooperation?

The cooperation with the United States over the past five years has not changed due to the problems of granting visas for Chinese nuclear scientists and engineers. Visits are infrequent and can never be assured. As past president of the American Nuclear Society and current Chairman of the International Nuclear Societies Council, I can testify to the difficulty of obtaining visas for distinguished Chinese scholars to receive awards and present papers at our conferences. If this problem can be solved, it's expected that a great deal more cooperation and communication can be established for the mutual benefit of both countries. These benefits include the sale of US commercial technology, collaborative research and development, particularly in technologies which the United States is not a leader such as high temperature gas reactors.

4) Last year, China inked an agreement with Westinghouse to build four AP 1000 nuclear reactors in

China. How long will it take to implement an agreement of this type and to complete construction of the reactors?

China's agreement with Westinghouse was the result of a multi-year process which, for the first time, resulted in the sale of a US nuclear power plant to China. The contract includes the supply and engineering for four AP 1000 nuclear islands at the Sanmen and Haiyang sites, fuel supply and a technology transfer contract which became effective on September 24, 2007. At present, site excavation work is in progress at both sites. The preliminary safety analysis report for the Sanmen plant was submitted to the Chinese regulatory authority in early 2008 with the first concrete pour planned in 2009. The first plant is expected to become operational in late 2013 with the remaining three plants to come online in 2014 and 2015.

What technology transfers are expected to occur?

The technology transfer contract provides for the transfer of Westinghouse and Shaw Engineering Company technology in the design and analysis, engineering, licensing, procurement, manufacture, construction, startup operation, and maintenance of the AP 1000 nuclear island. The objective of this technology transfer contract is to provide the Chinese with the capability to lead the design and engineering of future nuclear plants in China based on AP 1000 technology and to localize the capabilities for manufacturing construction, operation and maintenance. The nuclear island contract involves the Shanghai Nuclear Engineering Research and Design Institute and for progressive localization of equipment supply and support of Chinese procurement.

It is expected that these technology transfers will occur as the plants are being built and started up. It is also expected that Westinghouse will continue to play a major role in support of the Chinese development efforts through the supply of parts and services as they continue to do with Korea as part of a contract of technology transfer with the former Combustion Engineering Company which Westinghouse subsequently acquired.

What concerns exist regarding the US export of nuclear energy plants and technology?

Given this rather dramatic transfer of US technology to the Chinese, one must naturally ask whether this is unique in the industry. When one reviews the history of nuclear plant development worldwide, when the United States was the dominant leader, one observes similar types of technology transfers in the form of license agreements which were provided to French, German and Korean companies as they sought to develop their nuclear technologies. Thus, the China contractual relationships are not that unique.

What might be of concern is the loss of competitiveness of the US industries but whether the US transferred the technology or not, others would have been willing to do so to gain a foothold in the China market. I am sure Westinghouse carefully reviewed this business decision in this regard.

In terms of non-proliferation policy, since China is already a nuclear weapons state that issue is not as pressing. In signing the agreement, it is my understanding that both Westinghouse and the Chinese government both had to sign a similar Part 810 petition that limits the technology to transfer to China and prohibits transferring it to another nation without both parties approval and an agreement not to use the technology to create nuclear weapons which commercial nuclear plants are not designed to do.

What implications could be these technology transfers have on US security, and what impacts will this agreement have on US energy security?

The implications of this technology transfer on US security are hard to judge. On the one hand, it is quite clear that if Westinghouse had not agreed to these technology transfer agreements, which were conditions

of the sale, other companies would have won the contract. AREVA, a French nuclear vendor, which had already sold six nuclear power reactors to China, would have undoubtedly gotten the Westinghouse contracts without technology transfer agreements. It is my judgment that having a US market presence in China in the nuclear field helps US security. By selling US reactors to China, it positions US technology in their market and establishes relationships with the Chinese nuclear industry. By having these relationships and consequently closer communication and cooperation helps US security. At this point, the Chinese energy market is so huge that most of their effort will be focused on meeting their own needs rather than attempting to compete in the US market with Chinese technology.

In terms of our energy security, the major impacts of China's rapid nuclear expansion will be on the demand for uranium, the needed steel, concrete and heavy forgings which are all part of the world wide market. It is expected that the price of uranium and these other commodities will increase as more nuclear plants are built worldwide including the United States.

Commercial nuclear plants are not themselves proliferation risks. For China, a country which already possesses nuclear weapons, that risk is reduced further. China is capable enriching of uranium and reprocessing its spent fuel and recycling uranium and plutonium into the reactors, if needed. They are also embarking on a breeder reactor program to extend their nuclear fuel supply. The policy of the country is to become as self sufficient on as much of their energy needs as possible.

What opportunities exist for the promotion of further US China cooperation to improve energy security through the diversification of energy supplies and development of clean energy alternatives?

At present, China has an initiative underway at the Tsinghua University Low Carbon Energy Laboratory whose mission it is to develop advanced nuclear technologies, clean coal technology, advanced power transmission and security control technologies and new energy and renewable energy alternatives including hydrogen, biomass, wind power and energy efficiency options. Carbon capture and sequestration are also among the focus areas for this new university collaboration. China has passed national energy legislation that encourages development of these new energy, environment and conservation alternatives. Recently representatives of Tsinghua University visited MIT to explore opportunities for MIT to participate in a collaboration with the Tsinghua Low Carbon Energy Laboratory for research and development.

While development of clean, renewable energy alternatives is now being pursued in China, the question of "scale" remains. The Chinese have determined that nuclear energy is the best large scale clean energy alternative able to meet its energy and environmental needs. Given that nuclear plants can produce over 1000 MWe at one plant, when compared to renewables, rated at several megawatts each, it will be a daunting challenge to expand renewable energy sources to meaningful levels in a short time.

What role can the United States play including joint research and development efforts and technological assistance in influencing the energy policy of the People's Republic of China?

The United States can play a significant role in assisting China both in research and development but also in improving its organizational infrastructure to create a viable and safe nuclear industry. At present, the commercial nuclear industry is directed from the top and implemented by organizations such as the generating companies that rely on institute's and universities that are loosely coupled. There are no equivalent companies such as Westinghouse or General Electric that act as nuclear steam suppliers around which a nuclear industry can be built. Assisting the Chinese in helping structure their new civilian nuclear power business would be an important contribution.

Even though the Chinese are buying western technology, there are still large gaps in their technical capabilities in design in terms of computer codes and analysis capabilities. It is not clear how much of this

technology will be transferred to the Chinese from either the Westinghouse or AREVA new plant contract agreements. The Chinese also have an operating pebble bed reactor which is a high temperature helium cooled gas reactor that could be useful for electricity generation and high temperature process heat applications such as the production of hydrogen. Both areas are opportunities for enhanced technology exchange and cooperation.

In the United States, we have a congressionally mandated nuclear plant called the Next Generation Nuclear Plant (NGNP) which is to be built at the Idaho National laboratory in accordance with the Energy Policy Act of 2005. The experience of the Chinese in their operation of their HTR-10 pebble bed research reactor would be of great value to the United States. MIT has a collaboration agreement with Tsinghua University and its Institute of Nuclear and New Engineering Technology for pebble bed technology development. We have had a very productive information exchange program for many years but it has been difficult to find meaningful projects due to the difficulties associated with the visa issue and funding.

In terms of energy policy and direction, I think the US has already set an example for what might be possible in terms of deploying nuclear and other energy alternatives. Our clean coal program, coal gasification development, and coal to liquids programs could be joint programs. Chinese scientists and engineers are smart, clever people that could be very helpful in developing and demonstrating these new technologies. I hope that there can be US funded programs for joint research and development to harness the brilliance of US and Chinese scientists and engineers working on challenging world energy problems.

As China will soon be the world's largest economy, we must begin to be actively engaged not only as consumers of Chinese products but collaborators to address global climate and energy problems. Programs such as the proposed China-MIT collaboration on clean energy should be supported by the government and more technical exchange meetings should be encouraged in the commercial nuclear power sector. It is my belief that our security and overall environment will be enhanced by closer cooperation. The more we work with the Chinese, the stronger will be our relationship. The Chinese culture is built on relationships which we should nurture. If we want to affect Chinese energy policy, it will be based on these relationships.

Conclusion:

In conclusion, US China cooperation on nuclear technology could be of benefit to both countries. It is vitally important to the US nuclear program that the Chinese plants are well designed and operated safely. The US should be working to improve regulatory relationships with the Chinese regulatory bodies and Chinese nuclear engineers, maintenance people and operators should be allowed to come to the US to observe operations, engineering and design functions to establish world wide standards for their operations and future designs. To enable this to occur, we need a visa policy that allows for exchange visits without making it a painful process for both sides. My experience at both the academic and commercial levels in China is that the people are bright, open to new ideas, and share experiences once a level of personal trust is established. In my opinion, the market of China is huge and one which the United States industries can become a major player if our policies encourage interaction and cooperation.

In my earlier paper published several years ago in the Brown Journal of World Affairs entitled "Nuclear Power – Made in China", I speculated that since the US industry was in the doldrums at the time, perhaps we would be buying, as we do just about everything else, nuclear power plants made in China. Today, as we are beginning a nuclear renaissance in the US, I see great opportunities to sell China some of the innovative technologies that we have developed such as the Westinghouse AP-1000 reactors. I hope we can find ways to make this process easier so that our American industries can benefit from improved nuclear cooperation with China.

Thank you for your attention.

HEARING COCHAIR SLANE: Thank you.
Dr. Mladineo.

**STATEMENT OF STEPHEN V. MLADINEO
SENIOR PROGRAM MANAGER, PACIFIC NORTHWEST
NATIONAL LABORATORY, FALLS CHURCH, VIRGINIA**

MR. MLADINEO: Thank you. I appreciate the opportunity to address the Commission. My statement addresses a very narrow question. That is, what are the U.S. national security implications of the sale of the Westinghouse AP-1000 reactor and its technology to China?

My statement is principally based on research I did for the Nonproliferation Education Policy Center. It was published as a part of a research memorandum in March of this year.

I am a Senior Program Manager at Pacific Northwest National Laboratory, one of five Department of Energy Office of Science Multi-Program Laboratories. PNNL, as it's known, has a substantial portfolio in national and homeland security programs.

My focus is mostly on nonproliferation areas. Opinions in this statement reflect my personal views.

The AP-1000 reactor is a Generation 3 Plus reactor. The design is a conventional two-loop pressurized water reactor, very similar to other operating reactor plants in China.

In exploring the national security implications of the AP-1000 sale, I found only a tenuous link between the technology being provided by Westinghouse and specifically the Chinese Naval Nuclear Propulsion Program.

There was some concern that China might be able to reverse engineer some of the components of the AP-1000 for use in naval reactors because of China's demonstrated capability for reverse engineering complex technology. For a number of reasons, I conclude that it is unlikely that reverse engineering will provide China with technology that will improve its nuclear submarine fleet.

The primary difference between the early generation Chinese reactors and the AP-1000 is the passive safety design attributes. The passive safety systems include passive safety injection, passive residual heat removal and passive containment cooling. The natural forces used include gravity, natural circulation and compressed gas.

There appears to be no application of these passive safety design technologies to submarine reactors. For large surface ship reactors,

the techniques might be used to simplify some of the design features of emergency core cooling fill systems, specifically for loss of reactor coolant accidents, but these passive safety systems would not confer any additional military advantage.

The most likely component that might be applicable to Chinese nuclear submarines would be the Westinghouse canned motor reactor coolant pumps. Previous reactor installations provided by Russia and France used shaft seal pumps. Although the AP-1000 reactor coolant pumps will be much larger than what would be suitable for a naval reactor, there is some possibility that China could, with significant engineering, downscale the design to improve the reactor coolant pumps for submarines.

The military implications of improved reactor coolant pumps would be that they could potentially diminish the noise signature of Chinese submarines, thereby making them less detectable.

The Westinghouse contracts with the pump manufacturer, Curtiss-Wright, include the supply of pump hardware and oversight of some localized manufacturing of reactor coolant pumps with China's State Nuclear Power Technology Corporation.

In my opinion, the national security implications of this technology transfer are mitigated by the fact that technologies applicable to sound quieting in submarines involve much more than simply the reactor coolant pumps. Consequently, the national security risk associated with the transfer of AP-1000 reactor coolant pump technology to China is likely to be small.

A second technology attribute that might provide advantage to China's naval reactor program could be the digital instrumentation and control, or I&C systems. The AP-1000 I&C system uses a microprocessor based, distributed digital system to perform plant protection functions and safety monitoring as well as plant control functions.

However, digital I&C systems are not new to China's nuclear power program. For example, the Russian supplied reactors have modern digital Siemens-Areva I&C systems installed.

Most of the other design elements of the AP-1000 reactor are extensions of previous designs and appear to be refinements rather than technological breakthroughs.

The AP-1000 and other modern commercial reactors are an order of magnitude larger than a typical naval reactor. Many of the design safety and control mechanisms of the AP-1000 are driven by the large size of the core and are not applicable to a smaller core such as for a naval reactor.

With respect to construction engineering, the design of the reactor is a conventional pressurized water reactor, so construction

techniques such as welding, pipe manufacture and so forth are little different from earlier nuclear power plant construction projects.

The subject of China's nuclear weapons program deserves a brief mention in the context of enrichment requirements. Because of the small size of China's nuclear weapons force, the amount of highly enriched uranium and HEU and weapons plutonium that China has already produced and which is presumably stockpiled is far greater than was needed for this small number of nuclear weapons.

The existing stocks of HEU and plutonium would therefore likely be sufficient to support a substantially greater number of nuclear weapons. Therefore, it's unlikely that the increase in enrichment capacity that will be required for the expanding commercial power reactor fleet will increase the risk of a sudden surge to parity with the U.S. or Russia in nuclear weapons production.

In conclusion, the U.S. national security implications of the Westinghouse AP-1000 sale to China appear to be minimal. China may derive some incremental technological advances as a result of the deal by reverse engineering some of the technologies provided, but the point that Andy made, is that alternative sources of technology that might be available from Westinghouse competitors would likely provide similar benefits.

There appears to be no smoking gun concerning the application of AP-1000 technology to the development of Chinese naval reactors or expansion of its nuclear weapons capability. So in my opinion, the economic benefits to the U.S. outweigh the minimal risk associated with this technology transfer.

Thanks for your attention.
[The statement follows:]

**Prepared Statement of Stephen V. Mladineo
Senior Program Manager, Pacific Northwest National Laboratory,
Falls Church, Virginia**

**Stephen V. Mladineo
Senior Program Manager, Pacific Northwest National Laboratory
Testimony before the U.S.-China Economic and Security Review Commission
August 13, 2008
U.S.-China Energy Technology Cooperation: Civil Nuclear Energy**

I appreciate the opportunity to address the U.S.-China Economic and Security Review Commission. My statement is principally based on research I did concerning the Possible Military Implications of the Westinghouse AP1000 sale to China, for the Nonproliferation Education Policy Center (NPEC), published as part of a Research

Memorandum in March 2008.¹ I am a Senior Program Manager at Pacific Northwest National Laboratory (PNNL). PNNL is one of five Department of Energy Office of Science multi-program laboratories with a substantial portfolio in national and homeland security programs. Opinions in this statement reflect my personal views alone.

Before addressing the national security implications of the agreement between China and Westinghouse to build four AP1000 nuclear reactors in China, I would like to provide some brief background on the Westinghouse AP1000 nuclear reactor and China's energy program.

Westinghouse AP1000

The AP-1000 reactor is a Generation 3+ reactor, the standard nomenclature for the new generation of reactor designs that follow the Generation III Advanced Light Water Reactors developed in the 1990s.² The reactor plant design is a conventional two loop pressurized water reactor. As such, it is very similar to other operating reactor plants in China. The first AP1000 to be constructed anywhere will be the first of two reactors to be constructed at Sanmen in Zhejiang province in China. Additionally, the AP1000 is likely to be the reactor plant of choice in U.S. over the next few years. Several plants have been ordered by U.S. utilities, of which the first is expected to come on line in 2014.

China's Nuclear Program

China has a fairly advanced civilian nuclear power program that has been aided by technology transfer from France and Russia. Technologies include reactor plant construction and operation, and uranium isotope separation technology, principally centrifuges used for uranium enrichment. These technologies can be assumed to have been assimilated by the Chinese nuclear power industry. China has demonstrated its ability to construct and operate nuclear power plants and uranium enrichment plants.

Currently China has about 8600 MWe of nuclear power, making up a little less than 2% of China's overall electrical generating capacity. About 80% of China's electricity is produced from coal fired plants, with the environmental consequences that that entails. The remaining electrical generation capacity is a combination of oil and gas fired plants, hydroelectric, and wind turbines. As the Chinese economy is rapidly developing, electricity demand is growing very fast. In conjunction with rapidly growing coal, gas, hydro, biomass, and wind power, and an emphasis on demand-side efficiency, China has recently decided to increase its nuclear capacity to about 5% of the total electrical generating capacity by 2020. This will require a very ambitious program including the construction of some 30 reactors over the next 12 years that would produce between 50

¹ <http://www.npec-web.org/>

² Westinghouse Electric Company:
http://www.ap1000.westinghouse_nuclear.com/A4.asp

and 60 gigawatts of power.

One result of China's ambitious nuclear power expansion program is likely to be the continued requirement for technology and infrastructure assistance from the U.S. and other nuclear industry leaders. Shortly after signing the AP1000 deal with Westinghouse in 2007 for four new reactors at Sanmen and Haiyang, China signed an agreement with Areva to build two new reactor plants in Guangdong province. Westinghouse, Areva, and Russia's Atomstroyeksport will compete for the construction of the additional new reactors that China plans to build.

China began site preparation for the first of the four new AP1000 reactors in February 2008.³ Ground breaking occurred in July 2008, and construction will begin in early 2009. This first AP1000 reactor is expected to be operating by 2013, with the other three coming on line in 2014 and 2015.

National Security Implications

In exploring the national security implications of the AP1000 sale, I found only a tenuous link between the technology being provided by Westinghouse, and the Chinese naval nuclear propulsion program. I had some concern that China might be able to reverse engineer some of the components of the AP1000 for use in naval reactors because of China's demonstrated capability for reverse engineering complex technology.⁴ Nevertheless, for a number of reasons, I conclude that the likelihood that reverse engineering will provide China with technology that will improve its nuclear submarine fleet is unlikely.

The primary difference between the early generation Chinese reactors and the AP1000 is the passive safety design attributes. Westinghouse describes these attributes as:

- “ •No reliance on AC power
- Automatic response to accident condition assures safety
- Long term plant safety assured without active components (natural forces only)
- Containment reliability greatly increased by passive cooling

³ http://news.xinhuanet.com/english/2008-02/26/content_7674512.htm

⁴ China's mastery of nuclear power plant simulators is one example of this capability. China had relied on other countries to provide these simulators. However, because of the re-rating of some reactors China needed to update the simulators. According to the deputy general manager of China National Nuclear Corporation (CNNC), China has mastered the technology, and has now developed indigenous reactor simulators. <http://china-nuclear-power.co.uk/chinanuclearpower.aspx>

- In severe accidents, reactor vessel cooling keeps core debris in vessel
- Large margin to safety limits
- Defense in depth-active non-safety systems provide additional first line of defense”⁵

The passive safety systems include passive safety injection, passive residual heat removal, and passive containment cooling. The natural forces referenced include gravity, natural circulation, and compressed gas.⁶ There appears to be no application of these passive safety design technologies to submarine reactors. For large surface ship reactors the techniques might be used to simplify some design features of emergency core cooling fill systems. In these cases, the technologies provided are conceptually very simple, and would replace systems that are only for emergency core cooling in case of an accident that caused a loss of reactor coolant. Thus, these passive safety systems would not confer any additional military advantage.

In reviewing the AP1000 design, I concluded that the most likely advanced component that might be applicable to China’s nuclear submarines would be the Westinghouse canned motor reactor coolant pumps. Previous reactor installations provided by Russia and France used shaft seal pumps. Although the AP1000 reactor coolant pumps will be much larger than what would be suitable for a naval reactor, there is some possibility that China could, with significant engineering, downscale the design to improve the reactor coolant pumps for submarines. The military significance of improved reactor coolant pumps would be that they could potentially diminish the noise signature of Chinese submarines, thereby making them less detectable. According to Westinghouse, canned motor reactor coolant pumps have been used in U.S. naval reactors for many years.⁷ The Westinghouse contracts with the pump manufacturer, Curtiss-Wright, include the supply of pump hardware and oversight of some localized manufacturing of the reactor coolant pumps with China’s State Nuclear Power Technology Corporation.⁸ The national security implications of this technology transfer are mitigated by the fact that technologies applicable to sound quieting in submarines involve much more than the reactor coolant pumps. Consequently, the national security risk associated with the transfer of AP1000 reactor coolant pump technology to China is likely to be small.

Another technology attribute that might provide advantages to China’s naval reactor program could be the digital instrumentation and control (I&C) system designed for the AP1000. The AP1000 I&C system uses a microprocessor-based, distributed digital

⁵ Matzie, Regis A., “The AP1000 Reactor Nuclear Renaissance Option,” Tulane Engineering Forum, September 26, 2003

⁶Westinghouse Electric Company:

<http://www.ap1000.westinghousenuclear.com/A2.asp>

⁷Westinghouse Electric Company:

<http://www.ap1000.westinghouse nuclear.com/A3.asp>

⁸

<http://files.shareholder.com/downloads/CW/369059092x0x137155/2e9d80d2-72fa-4c2a-be6a-b8cb6eed19bd/269140.pdf>

system to perform plant protection functions and safety monitoring, as well as plant control functions. This system is advertised to improve reliability of the control systems, while ensuring that the operator knows the status of the plant continuously.⁹ The improved reliability of the software, electronics, and sensors in these systems could potentially be reverse engineered for application to naval reactors to improve reactor reliability.

However, digital I&C systems are not new to China's nuclear power industry. For example, the Russian supplied VVER-91 (VVER-1000) reactors have modern digital Siemens-Areva I&C systems. Therefore, the new technology gained from the AP1000 I&C systems is likely to be marginal. Additionally, the reliability advantages of a digital I&C system are not completely clear-cut. The U.S. Nuclear Regulatory Commission (NRC) and other national regulatory authorities have been concerned about the potential that undetected software malfunctions in a digital I&C system could lead to safety or reliability problems.

Most of the design elements of the AP1000 reactor are extensions of previous designs, and appear to be either the same as previous designs, or refinements, rather than technological breakthroughs. For example, the fuel bundles are standard 17x17 matrices of fuel rods that have been used in a number of reactor designs in the U.S. and Europe. The fuel element manufacturing technology is conventional, and well known.

Large commercial reactors such as the AP1000, VVER1000, GE's Advance Boiling Water Reactor, and Areva's EPR are an order of magnitude larger than a typical naval reactor. Many of the design, safety, and control mechanisms of the AP1000 are driven by the large size of the core. For example, the complex control and safety shutdown mechanisms consisting of control rods, gray rods, and boron dissolved in the reactor coolant are necessary to ensure proper flux distribution, to manage axial fuel burnout, and to compensate for such phenomena as xenon stability issues. These issues are simpler to manage in a smaller core such as for a naval reactor.

With respect to construction engineering, the design of the AP1000 reactor is a conventional pressurized water reactor, so construction techniques such as welding, pipe manufacture, and pressure vessel manufacture are little different from earlier nuclear power plant construction projects. The AP1000 uses modular construction to permit parallel construction activities, which saves construction time. China already has the capability to perform modular construction, such as is used in modern shipbuilding. Therefore, there would likely be no additional construction related technology from the AP1000 construction project that would advance China's naval reactor program.

I also looked at whether the infrastructure that China would develop to support their

⁹Nuclear Regulatory Commission; www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1793/chapter7.pdf

commercial reactor program could lead to a situation in which China could rapidly and massively increase its nuclear weapons arsenal. China is likely to continue to expand its enrichment capacity to try to accommodate its growing requirements for LEU fuel for its expanded nuclear power plant building program. Needed enrichment capacity for its naval reactors program is small by comparison with its power reactor needs. Even if China decided to begin to produce HEU for a new naval reactor design, the enrichment capacity requirements would be small in comparison to the overall enrichment requirements for power reactors.

The subject of China's Nuclear Weapons program deserves brief mention in the context of enrichment requirements. The Chinese government announced in November 1989 that it was ceasing production of HEU for military uses and that it would use its enrichment facilities exclusively for civilian applications.¹⁰ Although never announced, it is likely that weapons grade plutonium production also ceased by 1991. Albright and Hinderstein have estimated that China has roughly 21 metric tons of HEU and about 2.8 metric tons of weapons plutonium.¹¹ Because of the small size of China's nuclear weapons force, estimated to be in the neighborhood of 200 to 400 weapons, the amount of HEU and weapons plutonium that China has produced, and which is presumably stockpiled, is far greater than was needed for this number of nuclear weapons. The existing stocks of HEU and plutonium would therefore likely be sufficient to support a substantially greater number of nuclear weapons. Therefore it is unlikely that the increase in enrichment capacity that will be required for the expanding commercial power reactor fleet will increase the risk of a sudden surge to parity with the U.S. or Russia in nuclear weapons production.

Conclusion

The U.S. national security implications of the Westinghouse AP1000 sale to China appear to be minimal. China may derive some incremental technological advances as a result of the deal by reverse engineering some of the technologies provided. But alternative sources of technology that may be available from Westinghouse competitors would likely provide similar benefits. There appears to be no smoking gun concerning

¹⁰ Nuclear Threat Initiative, China Profiles, <http://www.nti.org/db/china/uenrich.htm>

¹¹ Albright, David and Corey Hinderstein, "Chinese Military Plutonium and Highly Enriched Uranium Inventories," Institute for Science and International Security, June 30, 2005

the application of AP1000 technology to the development of Chinese naval reactors, or expansion of its nuclear weapons capacity.

Panel V: Discussion, Questions and Answers

HEARING COCHAIR SLANE: Thank you, Doctor.

Mr. Chairman.

CHAIRMAN WORTZEL: Gentlemen, thank you very much. Two clear sets of testimony that somebody who hasn't spent a lot of time around nuclear reactors can understand pretty easily.

Dr. Kadak, I take one main point from your testimony. It's probably not the point that you wanted people to take away, but when COSTIND, the Commission on Science Technology and Industry for National Defense, is in charge of any program in China, its principal purpose is to derive military application. That's what COSTIND does. That's who ran their space program. That's why they have ASAT weapons and intercontinental ballistic missiles.

But if there is a reticence on the part of elements of the U.S. government to have Chinese scientists over here that COSTIND can identify and manipulate, it's probably because the U.S. Attorney just finished six espionage prosecutions from China, and they're probably worried about deemed exports, you know, in other words, you might not get exactly what you want on quieting that pump by looking at this reactor, but if you get exposed to enough nuclear science and scientists in the U.S. and ask enough questions, you might get the right answer.

That's the way those people think on the U.S. government side, and that might explain the reluctance to grant a lot of visas.

From your testimony, Mr. Mladineo, I take it that your summary on page four is really good, and what it boils down is they already got plenty of highly enriched uranium and plutonium to make loads of nuclear weapons and a few more isn't going to make a bit of difference. There is not much of a threat or a problem.

MR. MLADINEO: Not in the nuclear weapons, not to their nuclear weapons program.

CHAIRMAN WORTZEL: Right. Not in the nuclear weapons department.

MR. MLADINEO: Right.

CHAIRMAN WORTZEL: And the technology issue I've talked about so at least for me I think it's been helpful testimony. It's been useful. That's what I take out of both things, and if I'm way off base, I

just turn the mic over to both of you to correct me.

DR. KADAK: Let me start. Okay. Again, my hope relative to the visa issue is for the commercial nuclear power sector. Having spent probably almost two months in China physically in the plants, climbing all over them, it's very clear that they could benefit from seeing how we do things.

We try to write things down in our reports. It's very hard for them to understand what it is we're saying. So the idea would be to send a reactor operator to observe a control room operations; to see the discipline that's required; to see how they do corrective maintenance; to see how they deal with general maintenance. I think that's a hugely valuable thing because from the perspective of the commercial nuclear industry in the United States, we don't want an accident in China.

We don't want an accident anywhere. So maybe they're spying with other technologies, but we're talking commercial nuclear. I can tell you, a nuclear operator is not going to have any state secrets that could possibly ever be used in the weapons program of Russia.

When I was the President of the American Nuclear Society, we were going to give an international award to an elderly Chinese scientist. We had top former State Department officials and big international U.S. companies trying to get this gentleman a visa so he can just receive the award and then go back to China. On the last day before his trip, as I recall, his visa got denied.

This should be an embarrassment to the United States and our relationship with China and likely other countries. I hope you can differentiate between this and criminal prosecution that you mentioned. What I'm really trying to say is that we need to change this policy if we are ever to hope for a meaningful exchange in areas where we all have common interests including some of the environmental things that I mentioned that the Tsinghua University was trying to promote.

MR. MLADINEO: On the technology side, and Andy mentioned the idea that the commercial decision made by Westinghouse that they were going to get something out of this deal, is I think certainly valid. The economic benefits to the U.S. are going to be significant.

The other point on technology, though, is that technology is not static. We are exporting technology all the time and yet we seem to keep coming up with new technology that we have available that seems to be better than others in the world. So it doesn't worry me too much that we are exporting technology that might be exploited, as long as it's not used for purposes against us.

DR. KADAK: Can I just add one comment about canned rotor pumps? Steve mentioned it. Just so you know, Yankee Rowe plant was built in 1954. We had--guess what--canned rotor pumps in our

main coolant system. So if they haven't understood that they're available by now, the Chinese probably are not paying attention.

HEARING COCHAIR SLANE: Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman.

I want to follow up a point made by Chairman Wortzel. In your testimony, Dr. Kadak, on page four or page six, you talk about the Westinghouse sale, and you say the technology transfer contract provides for the transfer of Westinghouse and Shaw Engineering technology in the design, analysis, engineering, licensing, procurement, manufacture, construction, start-up, and maintenance of all this stuff.

Now, the objective of this technology transfer is to provide the Chinese with the capability to lead the design and engineering of future nuclear plants in China based on this technology which we've now transferred.

Was the Westinghouse technology, was that technology developed with U.S. taxpayer funds?

DR. KADAK: That's a question--

COMMISSIONER MULLOY: Our whole nuclear industry?

DR. KADAK: Well, the nuclear industry was started, as you probably know, back from the Navy, and that's back in the '50s.

COMMISSIONER MULLOY: Yes.

DR. KADAK: And that's where we sort of got our canned rotor pumps.

COMMISSIONER MULLOY: Right.

DR. KADAK: We built the Yankee Rowe Plant. Westinghouse was the designer.

COMMISSIONER MULLOY: Right.

DR. KADAK: And Westinghouse decided to use canned rotor pumps. So I think the commercial industry has evolved on its own path. Okay.

How much government investment there was in the commercial industry, and some people call it subsidies, I really can't tell you, but clearly there was obviously some government involvement in the development.

For example, even in the so-called evolutionary designs that people are now looking to build, there's government support. You know, DOE has funded some of the development but the ideas come from the commercial industry -- namely companies such as Westinghouse and General Electric. COMMISSIONER MULLOY: Okay. So here's my point, and I look at this, so the Chinese are--is this the normal way that a nuclear plant is sold to a country. Do they all do this? The technology transfer part is of the agreement?

DR. KADAK: As I mentioned in my oral testimony, that when

we started to sell these reactors to Europe, France, Germany, we first sold reactors with license agreements with Westinghouse where they would have had access to this technology. This is how they started their nuclear industry. The Westinghouse deal with China--and I don't have the details of it--is perhaps a little more extensive and quicker in terms of technology transfer. As I envision the technology transfer process, it will evolve over time because of the partners and the timing of the need for technology transfer. For example, since Shaw is one of the partners, the timing of engineering and maintenance support is different. Thus, I think it's going to be evolved over time as the plants are built.

In summary, I don't think it's necessarily that unique, but it could be a little bit more rapid in this case of China.

COMMISSIONER MULLOY: Now you say in your testimony further, you're talking about concern over the loss of competitiveness of U.S. industries.

DR. KADAK: Yes, yes.

COMMISSIONER MULLOY: But you say I'm sure Westinghouse carefully reviewed this business decision in this regard.

DR. KADAK: Yes.

COMMISSIONER MULLOY: Here's what bothers me. You have the Chinese government on one side negotiating, and you have Westinghouse on the other side. You don't have the U.S. government on the other side; you have Westinghouse. So they may make a short-term this is good for their profits, good for their shareholders, good for their CEO's bonus. Is this good for the United States?

Where does that calculation come into this? This is an enormously important transfer. It's not the normal transfer sale of a nuclear plant, much faster. The Chinese have ambitions to be major manufacturers, I assume, of these plants in time.

DR. KADAK: Yes.

COMMISSIONER MULLOY: Where does the U.S. government have a role in making this judgment of whether this is good or not?

DR. KADAK: Right now they don't, as best I can understand. But again I want to make sure that you understand that this is not that unique. Combustion Engineering was the company that spent a lot of time selling Combustion Engineering System 80 reactors to Korea. Now, Korea essentially has its own design based on the Combustion Engineering technology.

And Westinghouse is still or now Westinghouse--

COMMISSIONER MULLOY: Owned by Toshiba; right.

DR. KADAK: --bought Combustion. Bought Combustion, now Toshiba. Right. But the bottom line is Westinghouse still has an active engagement in Korea in terms of the technology that the

Koreans are now developing. So far we haven't seen the Koreans try to export commercial nuclear technology outside of the country.

So I think whether you like the global economy or not, this is the way I think business is going to be done in the future. Now, how does the American taxpayer get protected? The hope is through the jobs that Westinghouse has created in the United States and hopefully will continue to create based on selling this technology or building these reactors.

The Chinese are still going to need Westinghouse technical support for many, many years. But eventually they want to do their own thing.

COMMISSIONER MULLOY: But who made the judgment, and I'll just--

DR. KADAK: Yes.

COMMISSIONER MULLOY: --somehow Westinghouse could have said, well, no, we're not going to transfer quite that much technology. We want to be able to provide that to you that we still have, but who makes that judgment on what is good for the United States in this whole deal?

DR. KADAK: Again, I was not part of that negotiation. I don't know what the State Department had. I know there are export controls on U.S. technology. I know when we signed the agreement with Tsinghua University on pebble-bed cooperation; I had to get a Part 810 approval, which meant that whatever we shared had to be disclosed to the government.

So I assume that in the Westinghouse deal, since it was such a large deal, that the federal government had some review rights about what is, in fact, under export controls and what is not. So that's my guess. I just don't know for a fact.

COMMISSIONER MULLOY: Thank you, Mr. Chairman.

HEARING COCHAIR SLANE: Mr. Videnieks.

COMMISSIONER VIDENIEKS: Good afternoon. You just mentioned the agreement between MIT and Tsinghua University on pebble-bed reactors.

DR. KADAK: Yes.

COMMISSIONER VIDENIEKS: It's my understanding that they're light, they're proliferation proof, they're quick to install, they're suitable for remote locations. Then I heard one of you gentlemen say that currently there is only one under construction in PRC.

In order for them to achieve this goal by 2020, the 20 percent goal, wouldn't it be in everybody's interest to--I don't know who owns the data rights on these things now--to install a lot more than just one? How long does it take to actually build these things?

DR. KADAK: Well, probably the first one is going to take about four years, four years roughly. I didn't have a chance to fully explain that project. Chinergy is the company that they created to do the engineering, design and oversee construction.

The plan is that the company that's going to own this plant is Huaneng, a utility company, one of the largest in China. If this demonstration plant is successful, and it's supposed to be operational by about 2014, they plan to build 19 such modules in Shandong Province.

COMMISSIONER VIDENIEKS: So these are distinct from the other 20 reactors that you mentioned?

DR. KADAK: Correct.

COMMISSIONER VIDENIEKS: All right.

DR. KADAK: Correct. See, I don't think China has included these reactors in their big massive build-out, but if the local utility says these work for me, they will build more and more of them.

COMMISSIONER VIDENIEKS: Now, and this first one is just a demonstration project?

DR. KADAK: Correct.

COMMISSIONER VIDENIEKS: First one in the world?

DR. KADAK: It will be the first modern one in the world. The first research pebble bed reactor operated in Germany for 22 years but was shut down in 1988.

COMMISSIONER VIDENIEKS: Okay. Sir, do you have any comments? Who owns the data rights? MIT, Tsinghua together?

DR. KADAK: No, no. Most of the technology was developed by the Chinese. In fact, they have an operating small pebble-bed reactor which I mentioned previously and in my written testimony is also an area I thought would be another great technology exchange program.

As you know, in the United States-- now this gets to your point, I think, Mr. Mulloy--that we are intending to build the next generation nuclear plant, NGNP, in Idaho, at the Idaho National Laboratory. It's high temperature gas reactor. It could be a pebble-bed reactor or it could be a prismatic General Atomics reactor.

We could gain a huge amount of information from the Chinese about how to run a pebble-bed high temperature gas reactor from them if we had more close ties.

COMMISSIONER VIDENIEKS: How do these pebble-bed reactors differ from the routine reactors that many universities have installed, small scale, fairly small scale?

DR. KADAK: Yes. Most university reactors are water cooled, typically in a pool of water called "swimming pool" pool reactors. In these types of reactors, fuel assemblies are placed in the bottom of the pool to allow for the nuclear reaction to occur. That's a typical

university research reactor. The pebble bed reactor is a high temperature helium-cooled reactor where you're actually physically pumping helium through the core, and--

COMMISSIONER VIDENIEKS: And hydrogen would be one of the products?

DR. KADAK: They will use the heat from the reactor to make hydrogen.

COMMISSIONER VIDENIEKS: Okay.

DR. KADAK: And that's what the NGNP is intended to demonstrate.

COMMISSIONER VIDENIEKS: Thank you.

HEARING COCHAIR SLANE: Commissioner Fiedler.

COMMISSIONER FIEDLER: Just a quick question following up on the visas. So if we won't allow them in, where do they go? Where are they going?

DR. KADAK: Where are they going? Typically to meetings, technical meetings. In my example, I would hope they would be going to nuclear power stations to observe operations and maintenance.

COMMISSIONER FIEDLER: No. Since we don't let them in, are they going to Europe, are they going to France?

DR. KADAK: Oh, I'm sorry. They're going to Europe and Asia.

COMMISSIONER FIEDLER: So the Europeans are letting them in.

DR. KADAK: Oh, yes.

COMMISSIONER FIEDLER: So we're the only ones who aren't?

DR. KADAK: We're the ones that are most difficult.

COMMISSIONER FIEDLER: Others are difficult but we're the most or what?

DR. KADAK: Well, I attended a meeting in London and my Chinese colleague from Tsinghua was there, and he no problem getting into London.

COMMISSIONER FIEDLER: And so what does the U.S. government say to you when you--

DR. KADAK: No comment. I mean they don't give reasons for denial of visas.

COMMISSIONER FIEDLER: Okay. To the Chinese they don't give reasons, but to you do they give reasons?

DR. KADAK: To me, yes. When I go to China, absolutely.

COMMISSIONER FIEDLER: No. Does the U.S. government give you reasons why they're denying the Chinese?

DR. KADAK: No.

COMMISSIONER FIEDLER: Thank you.

HEARING COCHAIR SLANE: Commissioner Bartholomew.

VICE CHAIRMAN BARTHOLOMEW: Thank you very much,

gentlemen.

Mr. Mladineo, I'd also like to thank you for your service to our country. I can't imagine what it's actually like serving on a submarine, but I'm glad--

MR. MLADINEO: Thank you. It's actually a lot of fun.

VICE CHAIRMAN BARTHOLOMEW: Is it?

HEARING COCHAIR SLANE: Being as tall as he is.

VICE CHAIRMAN BARTHOLOMEW: I know being as tall as he is, it must really be something.

VICE CHAIRMAN BARTHOLOMEW: I once had breakfast on the Pompanito, which is a World War II submarine that's moored in San Francisco, and it was enough.

I want to get back to this issue, some of what Commissioner Mulloy was asking, but this issue of economic benefit and also I'd like to talk about technical benefit because a couple of years ago on a trip to Asia, I actually happened randomly to be seated next to somebody who was doing some of the negotiations for Westinghouse, and he had two very different kinds of things that he said.

One was with his company hat on, and the other was his, we started talking about tech transfer, and protection of intellectual property, all of those sorts of things. And he did admit to there being some concerns in his mind as an American and the future for his children, what would be happening as technology was being transferred and what was our ability going to be able to maintain a technological edge.

As we are undergoing a debate in this country now about the possibility of reviving a nuclear energy sector, do we stand to benefit at all from what we might be learning from our participation like Westinghouse participation in Chinese civilian nuclear plants?

If you talk about technology transfer, could it go from here, as Commissioner Mulloy said, invested in originally by the U.S. government somewhere along the way, to China, and then coming back? Do we have the capability here if we move into developing civilian nuclear plants to do those kinds of plants here? Are we going to end up having to import Chinese technology and Chinese products?

DR. KADAK: If you read my concluding sentence in my written testimony, the reason I think I was invited to this hearing was because I wrote a paper in the Brown World Affairs Journal about nuclear power made in China.

This was written several years ago when the United States nuclear industry was completely in the doldrums. Nobody was talking about building nuclear plants. So I sort of speculated that since we buy everything else in the United States made in China, why can't we buy nuclear plants made in China?

I think that was a stretch, but I made it to have some dramatic impact. But I'm going to look at the Korean example. Korea took the Combustion Engineering design and improved it. Okay. As far as I know, there's no reason why Westinghouse that bought Combustion Engineering could not employ those improvements in the U.S. version of that particular design, assuming somebody buys it.

The status of the U.S. nuclear, quote-unquote, "Renaissance" is real. Right now there have been, I believe, about eight to ten license applications filed with the Nuclear Regulatory Commission.

30 new reactors have been at least advertised as being on the list of plants that utilities want to build. If the process in the United States is successful, and the process I'm talking about is a licensing process, namely, you can get through it in a reasonable period of time, with some certainty that you will get a license at the end of that, there will be more applications.

The renaissance in the U.S. is as real as it has ever been. So I think we'll see new nuclear plants coming online in the United States in the 2015 to 2020 time frame. I think we're moving ahead, and what we learn, what we might learn from the Chinese or the Koreans or the French who have taken the Westinghouse design and also modified it could be very helpful to us.

MR. MLADINEO: There's another more immediate answer to your question, and that has to do with the fact that the first AP-1000 being constructed at Sanmen is actually the first AP-1000 to be constructed anywhere.

And Westinghouse will benefit from having the first-of-the-kind problems that occur with any kind of construction project take place and have the Chinese paying for it because then shortly thereafter they're going to be building AP-1000 reactors in the United States. There are already some under order. So there is some benefit to Westinghouse and to the U.S. from this experience.

Secretary Bodman when he made this announcement about the sale advertised that Westinghouse stated that the deal would create 5,000 jobs in the United States right off.

VICE CHAIRMAN BARTHOLOMEW: One more question quickly. Do we have the capacity in this country any more to manufacture the components that would be necessary in nuclear power plants here?

DR. KADAK: No. The reactor vessels for pretty much all of the plants worldwide are, I think, made in two places: one is Japan and one is Korea, I believe. So we're already out of the loop.

If all these reactors that people have announced are going to be built, and if we can build the reactor vessels or other components cheaper than in China or elsewhere, we'll see the rebuilding of that

infrastructure in the United States to support the U.S. industry.

VICE CHAIRMAN BARTHOLOMEW: And is there any evidence that the Chinese might be trying to learn how to manufacture those vessels?

DR. KADAK: They are, in fact, they're building them, but not to that size. So my sense is they will be making big vessels too because they'll need to make them for their reactors.

VICE CHAIRMAN BARTHOLOMEW: Interesting. Okay. Thank you.

HEARING COCHAIR REINSCH: If I can just interject something for a second, I've been working on this issue in another context, and my understanding is that the only company in the United States that makes large pressure reactor vessels is Babcock and Wilcox.

DR. KADAK: Yes.

HEARING COCHAIR REINSCH: But they tell me that they have the capacity to make, meet demand for one or two plants a year domestically.

DR. KADAK: I think they'll have to expand their plants. I mean the reactor vessel forgings are the key. They're not right now capable of making the big forgings. But I read that they were going to make an investment to do so.

HEARING COCHAIR REINSCH: Right. So one of the challenges that the United States faces if we're going to have the number of licensed plants constructed that you suggest is the need to undertake a significant expansion here, or we're going to essentially exchange one form of energy dependence for another because we're going to be relying on components from elsewhere.

My other understanding right now is that of the 39 power plants currently under construction worldwide, 30 of them are being built by the Russians. Is that correct?

DR. KADAK: I don't think it's that many by the Russians. I have not checked, but that sounds like a really high number.

HEARING COCHAIR REINSCH: Well, it does, and it's an interesting number.

DR. KADAK: Yes.

HEARING COCHAIR REINSCH: It also suggests, at least to me, that the United States has a lot to gain from building more of these things both for the reasons that Mr. Mladineo said and other experiential issues as well as the capacity to build up production capability, which I think is I think best undertaken by just building these things. But it's going to be awhile before we start building a lot of them here because of the permitting process.

DR. KADAK: Yes.

HEARING COCHAIR REINSCH: If we can get our hands on some of the others, I think it's going to be to our advantage down the road.

Thank you, Mr. Chairman.

HEARING COCHAIR SLANE: Commissioner Shea.

COMMISSIONER SHEA: Yes. Thank you both for being here. I'm sorry I didn't hear your oral testimony, but I did read your written testimony this weekend and thank you for the care you took in writing it.

I must admit I had sort of a head-shaking moment, Dr. Kadak, when in your testimony under the heading "Who determines nuclear energy policy and who implements that?," in the span of two sentences you listed nine separate agencies, and I won't read--I was just wondering if you could just in plain English tell me--and I'm not saying you didn't write in plain English--but just nine agencies in two sentences, and I just had to shake my head.

But could you answer that question?

DR. KADAK: Let me refer myself to the page--

COMMISSIONER SHEA: It's page three at the bottom.

DR. KADAK: It is logical. Okay.

COMMISSIONER SHEA: Okay.

DR. KADAK: And China Atomic Energy Agency is the overall policy setting agency, but before you go anywhere this Committee for Science Technology and Industry must approve it; right.

COMMISSIONER SHEA: Uh-huh.

DR. KADAK: And then the State Council of Ministers, which is the supernova of the bureaucracies, must also approve it. So under the direction of the State Council, things get done.

In terms of implementation of the policy itself, and that's the National Development and Reform Commission, now they implement the policy. This State-Owned Assets and--

COMMISSIONER SHEA: SASAC.

DR. KADAK: --Supervision Administration gives them the money. They make the investments to do this. And then the China National Nuclear Corporation are the builders, as are the China Guangdong Nuclear Power Corporation, which is say the operator.

So I was actually going to do this. I was going to try to do an organization chart, but that would be offensive maybe if I get it wrong, and if I get it right, it wouldn't be believed.

COMMISSIONER SHEA: Where does the National Energy Commission and the State Energy Bureau come in?

DR. KADAK: This is kind of new, and they, the National Energy Commission is supposed to sort of oversee the overall energy structure of China, and the State Energy Bureau is supposed to make sure that

that, on a local level, it's being implemented in accordance with the big grand plan.

And actually when I wrote this, I said, wow, that makes sense to me--a little.

COMMISSIONER SHEA: All right. Well, you made it make more sense to me. Does it work well? I mean is this smooth--

DR. KADAK: I have no idea.

COMMISSIONER SHEA: --functioning? This is how it's supposed to work in theory?

DR. KADAK: That's how it's supposed to work. When I go to China, I always try to visit with a gentleman from China Power and Light, who can help me interpret some of this stuff, and I sent this testimony to him.

I asked him if I've made any major mistakes. So far I have not heard back. If I do make a major mistake, I'll correct the record; okay?

A Chinese nuclear company must get approval for every plant that is built in China. The process is if this company, Guangdong, wants to build a nuclear plant, it's got to go through these loops to get approved, up to the State Council of Minister.

So it's not like in the United States. If I am a local utility, I can just build one with the proper regulatory approvals. In China, you can't do it that way. You'd have to apply for permission to build the plant through all these agencies, and then when you get it, you're good to go. Right now in China, they do all kinds of siting studies. For this next wave of new plants, they pretty much know where they're going to be because they've already done the site environmental surveys. They've done the seismology and geological studies. So they've got the sites pre-selected.

The major question nuclear generators in China have is whether they can get approval from the state to build these plants? This is the process. One wonders if it is better than our process, in terms of difficulty or getting it through. Probably, not. But once they approve, you're good to go, and that's the big difference.

COMMISSIONER SHEA: Okay. Thank you.

HEARING COCHAIR SLANE: Commissioner Mulloy.

COMMISSIONER MULLOY: Thank you, Mr. Chairman.

I want to come back, just probe this a little bit more. You made a comment about maybe this part of globalization. The way globalization has been sold to the American people is that we may lose the textile industry, we may lose the automobile industry, we may lose the electronic industry, but we're going to be doing the higher value added stuff, so we're going to do all right.

We're going to do the aerospace and we're going to do nuclear,

and then I look, and I see when Boeing wants to make a plane sale to China, there's a lot of tech transfers part of the sales agreement. It's not like they sell the airplane made here by Americans. They're transferring technology. So China is fast at work building its own aviation industry.

And then you come in and you talk about nuclear. That's another one that you think, well, higher value-added, we could do that. We're transferring that as well. As part of the price of making a sale, we transfer the technology.

Mr. Mladineo, you and Mr. Ferguson, who is another nuclear submarine officer wrote an article on the Westinghouse deal. You quote Steve Tritch, who is the head of Westinghouse, and Tritch, you say in that article acknowledged that the deal would make it possible for China to build future nuclear reactors with less help from foreign partners.

In other words, you see what I'm thinking? We're helping them develop their industry, but what are we going to be doing? What are our people going to be doing? What do we as a nation? We got 600, \$700 billion current account deficit. We ought to be thinking about that.

And then Bodman, Secretary Bodman in commenting on the sale said, quote, "The Chinese were very demanding in their negotiations."

Okay. Well, he wasn't involved in the negotiations, by the way. It was Westinghouse.

Then I come to this article by CRS that's in our briefing book--you haven't read it, but I've read it--and it talks about on the Chinese side, the PRC State Council, which is the highest governmental body, and four major state-owned enterprises including the State Nuclear Power Technology Corporation, which Chairman Wortzel says is pretty involved in military, were signing the contracts on behalf of the Chinese.

I'm just trying to understand, what do you think we're going to be doing as we transfer all of these high-value-added technologies to them and they don't, at some point they won't need us anymore? Do you both have a comment on it? Because I think, Mr. Mladineo, when you talk about national security, I think you focus very narrowly on national security is, without looking at the national economic security.

This Commission is charged to look at the economics as part of the larger national security understanding for our nation. So I'd like you both just to comment on that.

MR. MLADINEO: I understand the question, and I'm maybe overly sanguine about our ability to grow our technology and grow our abilities over time, but I don't think so. I think we've demonstrated our capacity to grow our technology and our leadership in a variety of

areas over the years.

I think there is always going to be a need for consultation on our part, and for leadership and assistance in helping to manage and improve the technology that we transfer overseas, and I'm just optimistic that it's going to continue.

DR. KADAK: I think what your bottom line is these transfers cost U.S. jobs. Okay.

COMMISSIONER MULLOY: Not just jobs. Economic wealth.

DR. KADAK: Okay. I'll even put economic wealth in there, but I must say that Westinghouse is getting some money for these reactors. Okay. And as Steve mentioned, they are estimating 5,000 U.S. jobs that would not have been there had Westinghouse not made the deal.

I knew Areva is hugely aggressively in China selling reactors. The four and now six reactors are French reactors, and they've gone down the same path in terms of--

COMMISSIONER MULLOY: Stop there. If I could just-- wouldn't it make more sense for us to get together with the others and say--

DR. KADAK: We're not going to do this.

COMMISSIONER MULLOY: --we don't transfer?

DR. KADAK: Yes.

COMMISSIONER MULLOY: That's not traditional trade. That's something else going on here. No, we're not going to do that.

DR. KADAK: I don't know if they've--I'm quite sure they haven't done that yet, but I'm not sure that's a good thing either necessarily. But the bottom line is, yes, had they not done all these transfers, clearly, and continued to buy U.S. reactors, that would have been better for the United States, no question.

COMMISSIONER MULLOY: It would have been better.

DR. KADAK: No question. But that's not the world in which these sales are being made.

COMMISSIONER MULLOY: Right.

DR. KADAK: Nor has it been the way sales in the past have been made to nations who want to develop their nuclear capabilities, their nuclear, commercial nuclear power capabilities.

So I wish we could reverse the clock, but it's not necessarily at this point reversible. And what Steve had suggested was that we've got to continue to innovate, continue to develop new technologies that these people will want to buy. That all people want to buy, including the Europeans.

One of the markets that we have yet to penetrate since the 1970s is Europe with our reactor technology. While we have sold reactors when Europe did have a nuclear industry, there is no new U.S. plant sold in Europe. So, yes, China is a big growing economy, but as I

mentioned in the testimony, I think it's better to play with them, and participate in their development than say, no, we're not going to play at all because then we just lose on both ends. And that's the challenge.

COMMISSIONER MULLOY: Thank you both very much.

DR. KADAK: Thank you.

HEARING COCHAIR SLANE: Commissioner Wortzel.

CHAIRMAN WORTZEL: I wonder if either of you could address any engineering similarities between the Westinghouse transfer to China and what might go into the technology transfer components of any deal that's being thought through with India? And second, if you're aware of contacts, cooperation between these Chinese State Council controlled organizations and the Iranian nuclear program?

DR. KADAK: I don't have any information on either of those two. I'm sorry.

MR. MLADINEO: Neither do I. I'm sorry.

HEARING COCHAIR SLANE: Commissioner Bartholomew.

VICE CHAIRMAN BARTHOLOMEW: Thank you.

Mr. Mladineo, I think I want to apologize on behalf of all of us. I think your name has probably been mispronounced about as many times as it's possible. So forgive us.

MR. MLADINEO: It's a frequent occurrence. Thank you.

VICE CHAIRMAN BARTHOLOMEW: Well, I have a multi-syllabic last name and it's amazing how many times people stumble over it.

And Commissioner Mulloy, while I would agree with you that it would really be just terrific if countries could work together, I think we have to acknowledge the reality that some of our allies in other countries will sell just about anything to anybody, and that certainly is one of the realities that we're up against. Commissioner Reinsch, you should be pleased with the fact I've acknowledged that.

But I'd like to go to one of the most compelling arguments that you've made about why the Westinghouse deal made sense, and that's about ability to help promote safety, both in construction and in operation. And in that line, I actually have a simple question for you both, which is would you be willing to live in a neighborhood in China where there's a nuclear power reactor?

DR. KADAK: Let me answer that first because I, like I said, for the last four years, I've observed how the Daya Bay plants are operated. We've had complete access to anything in the plant. Any time we request a visit down even to the sub-basements of these facilities, we have been shown what we wanted to see. The Chinese have been open and are always willing to learn from us.

I would be very comfortable living right next to the Daya Bay plants without any hesitation. You know, one of the things that people

try to judge about whether a nuclear plant is safe is not necessarily the technology, but the safety culture. You can build the same two plants right next to each other. One plant has a good safety culture; the other one doesn't. You can guess which one is going to have the accident, despite having the same technology and same design.

One of the things that I've observed in China is they're very strong on creating a safety culture there. That is the key ingredient in whether the plant is safe to live next to. My conclusion, based on the Daya Bay plants, is I would have no hesitation living next to them.

MR. MLADINEO: Based on the safety culture, I have the same response.

VICE CHAIRMAN BARTHOLOMEW: Then it raises an interesting question given some of the things that we've heard earlier in the day and at other hearings, which is about compliance. How is it that the Chinese government is being successful or has the will to create a safety culture there when we know with things like the coal-fired power plants, they're turning off scrubbers and things like that?

What is different? I understand what's different in terms of the technology. But what is it and how do we encourage replication of that in things that are not having to do with nuclear power?

DR. KADAK: Again, this may be due to the power of the state authorities. The last thing they want to see is any kind of an accident. The people who are running these plants know that if there is any event that affects the public, they will no longer have jobs, maybe not their lives. So I think that message is a very powerful one, especially in the nuclear arena where they know the potential consequences could be rather dramatic.

So from the management down, one of their prime concerns is making sure they don't have an incident that would cause any kind of a radiation release.

VICE CHAIRMAN BARTHOLOMEW: So there really is a commitment to preventing problems, not necessarily a structure to cover up problems if they happen?

DR. KADAK: The regulator is on site. They have an office on the property. The regulator is actively involved in the day-to-day operations of the plant. They go do tours, not as extensive as we do with the Nuclear Regulatory Commission, but they are there, and they approve every design change that's made to that plant.

As I said, I wouldn't mind living next to the Daya Bay plants. The difference in culture between a coal plant and nuclear plants is because I think there's an obvious recognition that there are big differences in consequences of accidents.

VICE CHAIRMAN BARTHOLOMEW: Anything more to add? No. Wonderful. Thank you.

HEARING COCHAIR SLANE: Thank you, gentlemen, very much. It was extremely helpful. We appreciate your time, and we will now adjourn.

[Whereupon, at 4:05 p.m., the hearing was adjourned.]

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

Additional information provided by Mark D. Levine to his testimony before the U.S.-China Economic and Security Review Commission hearing on August 13, 2008, on China's Energy Policies and their Environmental Impacts

August 29, 2008

On page 8 on my statement to the Commission I proposed a program funded at \$500M/yr (~\$200M of which would be devoted to China) to build capacity to reduce greenhouse gas emissions. In the course of my testimony, I was asked to provide additional information on the proposal. Below, I do so by means of questions and answers. The Qs and As relate specifically to China, although many of the answers apply to other countries as well.

What would be the purpose and activities of the Program that you propose?

Its purpose is to substantially enhance China's capacity for reducing energy-related CO₂ emissions primarily through enhanced energy efficiency. This would serve U.S. and global interests by materially reducing growth of greenhouse gas emissions. The program would build capacity in China through training, knowledge transfer, and general support for the development and implementation of policies to reduce greenhouse gas emissions in China.

China has the equivalent \$1.8 trillion in foreign reserves, of which more than \$1 trillion is in U.S. dollars. Why should the United States spend an additional \$200M/year on China? How can such an expenditure of taxpayer dollars be justified?

My statement to the Commission provides the overall rationale for the program: the important role of China in the global effort to reduce greenhouse gas emissions and the high potential return in CO₂ emissions cutbacks. **Each dollar devoted to this program would produce hundreds or thousands of dollars worth of emission reductions.** The

reason for this seemingly extraordinary ratio of costs to benefits of CO₂ emission reductions is that the funds are to help the Chinese government develop appropriate policies, not to implement them. The large expenditures for investments in equipment and infrastructure will be made by China -- and foreign investors if so desired -- as the result of these new policies.

Most of the \$200M/year of the program will be spent on U.S. experts who provide the knowledge transfer. A portion of the funds will be spent in China to supplement support by the Chinese government and private sector in training and developing programs and policies to reduce greenhouse gas emissions.

Overall, the program will in time result in a significant net reduction in U.S. funds going to China for greenhouse gas mitigation than would occur under the present international approach to such mitigation. At the present, a very large portion of the funds from outside China to reduce greenhouse gas emissions in China flow through the Clean Development Mechanism (CDM) of the Kyoto Protocol. CDM provides for certified emissions reduction carbon credits to be earned through investment in projects in China (and other developing countries) that reduce GHGs. CDM pays for the capital expenditures that lead to certified emissions reductions and does not pay for policy development. The total magnitude of CDM projects in China is in the billions of dollars worth of carbon credits. The credits are purchased by industrialized countries, resulting in a transfer of money to China. If the United States joins the new post-Kyoto climate treaty now being negotiated under U.S. auspices, it will likely send billions of dollars to China through the CDM mechanism

As I have indicated, CDM is a very expensive way to reduce greenhouse gas emissions. It is so expensive that, despite the large investments, it will have only a small impact on reducing overall Chinese greenhouse gas emissions. In contrast, the proposed program would spend a much smaller amount of money to transfer knowledge and build capabilities and to support policy reform can have a much larger impact on CO₂ emissions. The proposed program is a complement to CDM and would, hopefully, permit CDM to be phased down over time. As such, the proposed program is likely to reduce the flow of dollars to China, and assure that the investments in Chinese projects be made based on market considerations.

Can you give examples of activities that the program would enable?

In my statement to the Commission, I provide the example of our work with China on transfer of technical skills needed to develop and enact appliance standards. Another example is the support that was provided by a team of international experts on the development of fuel economy standards for vehicles. The Chinese were made aware of the approaches that other countries used to establish the standards, the levels of the standards selected, their feasibility, the costs, the ways of implementation, the approach

to developing test procedures for vehicles, the applicability of the standards to different types of vehicles, and a very wide array of other information. The Chinese experts and authorities gained this information in a variety of ways: formal training; study tours in different countries with standards; collaboration on research and analysis projects between Chinese and international experts; conferences; informal discussions and workshops among these individuals; creation of a network among the key experts and other interested parties so that information was readily available in China as the policy was being developed.

It is worth noting that both of these initiatives, and many others like it, have been made possible through the China Sustainable Energy Program of the US-based Energy Foundation. I consider this program, headquartered in San Francisco but with sizeable Beijing office, to be one successful model JEEPP. I'm sure there are other successful models in other fields.

How will JEEPP be administered?

For a variety of reasons, this is not the kind of program that governments are well-suited to carry out directly. Because JEEPP is intended to serve broad international environmental goals, the achievement of which needs to supersede short-term political considerations, it should be isolated from political fluctuations to the extent possible. Finally, the bureaucratic requirements of governments often render international programs such as this much less effective than they need to be.

It might appear that an international organization such as the United Nations would be appropriate for this endeavor. However, I do not favor this approach either. Based on years of participating in and observing multilateral, bilateral, and non-profit programs intended to work jointly with developing countries to achieve mutually agreed-upon energy and environmental objectives, I am convinced that non-profit foundations and organizations are much better able to achieve such objectives than governmental bodies. Of course, this requires the choice of a non-profit or foundation that is skillful in designing and carrying out programs in to support desired policy change in developing countries.

Because JEEPP involves substantial expenditures of government money, it is essential that there be government oversight. I recommend that a committee be formed to provide this oversight. Such a committee might consist of one or two members of the House and the Senate, representatives of the executive branch of government, and representatives of the public interest community, the private sector, etc. The committee would have a small staff and budget. The job of the staff would be to provide an annual evaluation of the performance of JEEPP, available to Congress, the executive branch of government, and the public.

There are many details to be worked out. The non-profit might be constituted as a public corporation. It should be able to accept foundation and private dollars in addition to

those contributed by the government. The criteria for its annual and five-yearly evaluation need to be established. (At five-year intervals, it is possible and necessary to assess impact of JEEPP.) Procurement procedures need to be simple as befits a non-profit or foundation (e.g., not subject to the Federal Acquisition Regulations), giving the organization wide discretion on how it will spend its funds. But safeguards against inappropriate use of the money need to be established. The system must be set up to avoid the development of a bureaucratic structure as such structures have hobbled government and international programs of this nature. Creativity will be needed to create an effective mechanism that is agile and not burdened by unnecessary bureaucracy.

If I want together more information about the ideas you are describing, how can I learn more?

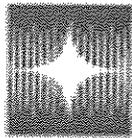
I have produced a draft paper that describes these ideas in much more detail than I can do here. I will share this paper in its present draft form to anyone interested in reviewing it and giving me suggestions for improving it. I can be reached at MDLevine@lbl.gov.

China's Energy Policies and Their Environmental Impacts, American Iron and Steel Institute, Steel Manufacturers Association, August 13, 2008.

BEFORE THE U.S.-CHINA ECONOMIC AND SECURITY
REVIEW COMMISSION

CHINA'S ENERGY POLICIES AND THEIR
ENVIRONMENTAL IMPACTS

AMERICAN IRON AND STEEL INSTITUTE
STEEL MANUFACTURERS ASSOCIATION



American
Iron and Steel
Institute



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These comments are submitted on behalf of the American Iron and Steel Institute (“AISI”) and the Steel Manufacturers Association (“SMA”). The members of AISI and SMA account for the vast majority of steel production in the United States. They are also among the largest recyclers in the world, collectively recycling over 70 million tons of steel annually.

Introduction

The Chinese government actively subsidizes energy supplies to the steel industry through a number of measures, including price caps on key energy inputs such as coal and electricity and export quotas on coke. The result is to encourage Chinese steel production and to give Chinese steel an artificial advantage in international competition. This advantage is reflected in the skyrocketing exports of steel from China in recent years.

The environmental consequences of these policies are dire. Although it has environmental laws on the books, China has consistently failed to enforce them. Chinese steel producers are in general much less energy efficient than their counterparts in many other countries, including the United States. Chinese energy subsidies to the steel industry result directly in higher greenhouse gas (“GHG”) emissions than would otherwise occur, to the detriment of the world’s climate.

Chinese Energy Subsidies to the Steel Industry

AISI and SMA addressed Chinese energy policy in some detail in a study they co-sponsored, *Money For Metal*, which was released in July 2007.¹ The report explained,

¹ See *Money for Metal: A Detailed Examination of Chinese Government Subsidies to its Steel Industry* (July 2007) (“Money for Metal”), available http://www.steel.org/AM/Template.cfm?Section=Home§ion=China_Focus&template=/CM/ContentDisplay.cfm&ContentFileID=10242 (last accessed Aug. 13, 2008).

among other things, that the Chinese government subsidizes the Chinese steel industry through restrictions on the export of metallurgical coke. Most steel in China is made in integrated mills from iron ore and coke (as opposed to the electric arc furnace or “EAF” method, which relies primarily on steel scrap). Metallurgical coke is a key raw material in steelmaking. An explicit aim of the export restrictions was “to preserve coke for its booming domestic steel industry.”²

When the European Union and other countries challenged these export restrictions as WTO-illegal, China agreed to end the quota system on coke exports in 2006 – but the quotas in fact remain in place. It then supplemented the quotas with a system of export taxes that further discouraged the exportation of coke. The effect was to make coke in China up to 15 percent cheaper than in other world markets.³ The report also found strong evidence that Chinese steel producers received discounted rates for electricity from the state-owned power companies, but noted that the lack of publicly available information made it difficult to quantify this subsidy.⁴

A recent study by the Alliance for American Manufacturing (“AAM”), *Shedding Light on Energy Subsidies in China: An Analysis of China’s Steel Industry from 2000 – 2007*,⁵ confirms and expands on these conclusions. AAM found that, between 2000 and 2007, the Chinese government bestowed approximately \$25.1 billion in subsidies on the

² *Money For Metal* at 71.

³ *Id.* at 72.

⁴ *Id.* at 75-76.

⁵ See *Shedding Light on Energy Subsidies in China: An Analysis of China’s Steel Industry from 2000 – 2007* (Jan. 8, 2008) (“Shedding Light on Energy Subsidies in China”). This study is available on AAM’s website at <http://www.americanmanufacturing.org/wordpress/wp-content/uploads/2008/01/energy-subsidies-in-china-jan-8-08.pdf> (last accessed Aug. 13, 2008).

Chinese steel industry.⁶ Significantly, although the level of subsidization fell in 2002 and 2003, after China joined the World Trade Organization, energy subsidies to the steel industry rose in 2004, and have continued to increase.⁷

Coal and Coke Subsidies

Until 2007, the Chinese government maintained a two-tiered pricing system for coal, with some prices set directly by the government and others determined by what passes for “the market” in this non-market economy. In addition, provincial authorities in particular provided subsidies directly to coal producers to encourage production and preserve employment.⁸ This combination resulted in subsidies to the coal industry, primarily for thermal coal (i.e., coal burned for heating and electric power generation) of \$11.2 billion between 2000 and 2007.⁹

As noted above, China’s restrictions on coke exports have had the effect of lowering the cost of coke for Chinese steelmakers. Despite promising to lift export quotas on coke by 2006, China kept them in place. Indeed, China has imposed a lower global export quota on coke in 2008 than in 2007,¹⁰ forcing even more coke onto the Chinese domestic market. In addition, Chinese authorities have indicated that, if coke exports continue to expand, they are prepared to increase the export tax on coke an additional five percent.¹¹

⁶ *Id.* at 4.

⁷ *Id.*

⁸ *Id.* at 30.

⁹ *Id.* at 29.

¹⁰ *China’s coke export quota keeps stable*, available at www.chinamining.org (July 17, 2008).

¹¹ *Id.*

At the same time, provincial governments in China have continued to provide subsidies directly to coke producers. Subsidies on Chinese coke totaled an astounding \$15.3 billion between 2000 and 2007.¹² Iron and steelmaking are practically the only uses for coke, so these subsidies directly benefited Chinese steel production.

Electricity

Although China produces steel primarily through the integrated method, the Chinese steel industry still uses a huge amount of electricity. Indeed, the Chinese steel industry alone consumes around 10 percent of China's total electricity.¹³ Electricity generation in China is controlled by the government, usually at the provincial level. Provincial authorities have consistently discounted electricity prices to steel producers. Indeed, in April 2007, in an attempt to halt the frenetic expansion of the steel industry, the central government in Beijing ordered 14 provinces to halt this practice.¹⁴ The AAM study estimates that, between 2000 and 2007, discounts on electricity and other practices provided the Chinese steel industry with \$916.4 million in subsidies.¹⁵

Despite its avowed intention of ending electricity subsidies, the Chinese government continues to act to keep electricity prices down. The most recent such action is a cap on prices of coal used in power plants. The National Development and Reform Commission ("NDRC"), the central government's main body for directing the economy, has decreed that prices of imported coal cannot rise above their June 19, 2007 levels.

¹² *Shedding Light on Energy Subsidies in China* at 31.

¹³ *Id.*

¹⁴ *Id.* at 32.

¹⁵ *Id.* at 35.

The stated reason for the price cap is to help power producers cope with rising costs.¹⁶ By keeping electricity prices down, this action also provides an advantage to China's steel producers. In addition, it discourages more efficient electricity production. It is possible that the NDRC will expand these price controls in the near future to cover coking coal and coke as well.¹⁷

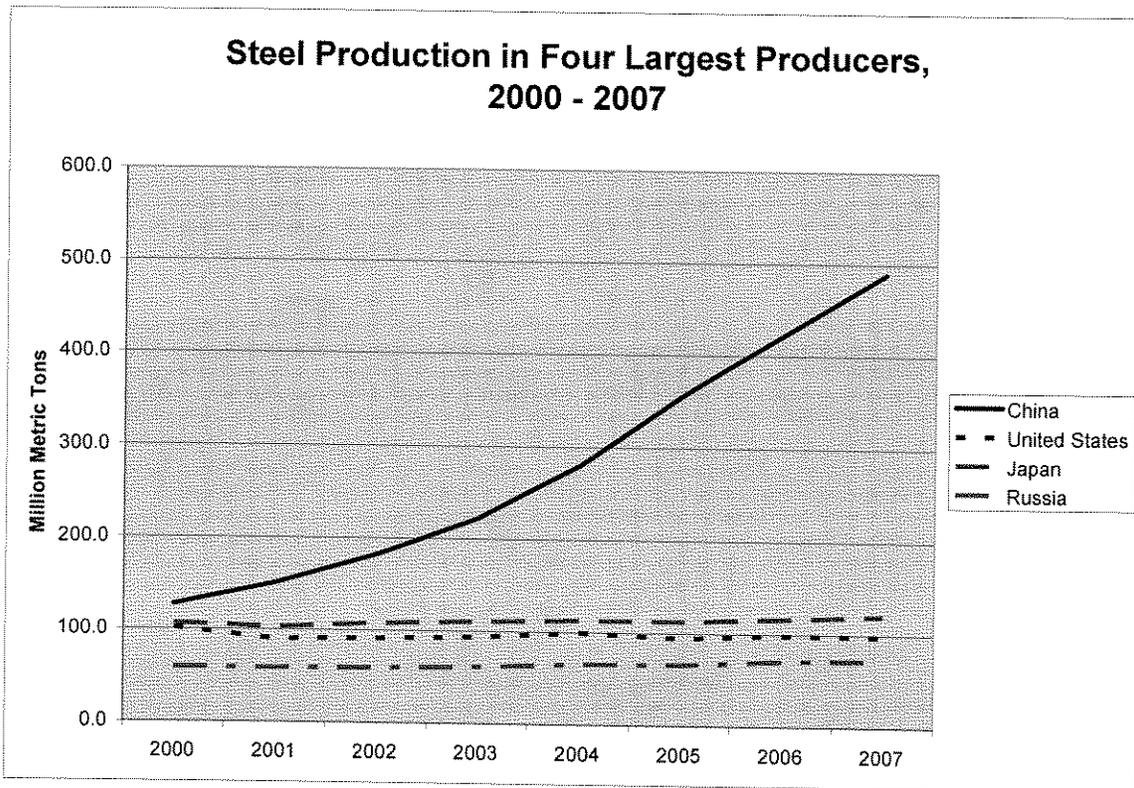
Effect of Subsidies on Production and Exports

China is by far the largest steel producer in the world, accounting for more than 36 percent of world steel production in 2007. China's dominance of world steel production is a very recent development. Between 2000 and 2007, Chinese steel production increased by 284.5 percent, from 127.2 million tons in 2000 to 489.2 million tons in 2007.¹⁸ In contrast, steel production in the United States remained remarkably steady over this period. The following chart shows the extent to which the expansion of steel production in China has grown at an exponentially more rapid rate than production in Japan, the United States, and Russia, the next three largest producers.

¹⁶ W. Ying, *China Orders Price Caps on Coal Used at Power Plants*, Bloomberg (July 24, 2008).

¹⁷ W. Ying and H. Yuan, *China Holds Meeting on Coking Coal, Steel Price Caps*, Bloomberg (July 25, 2008).

¹⁸ All steel production and export statistics are from the International Iron and Steel Institute's steel archive, available at http://www.worldsteel.org/?action=stats_search.



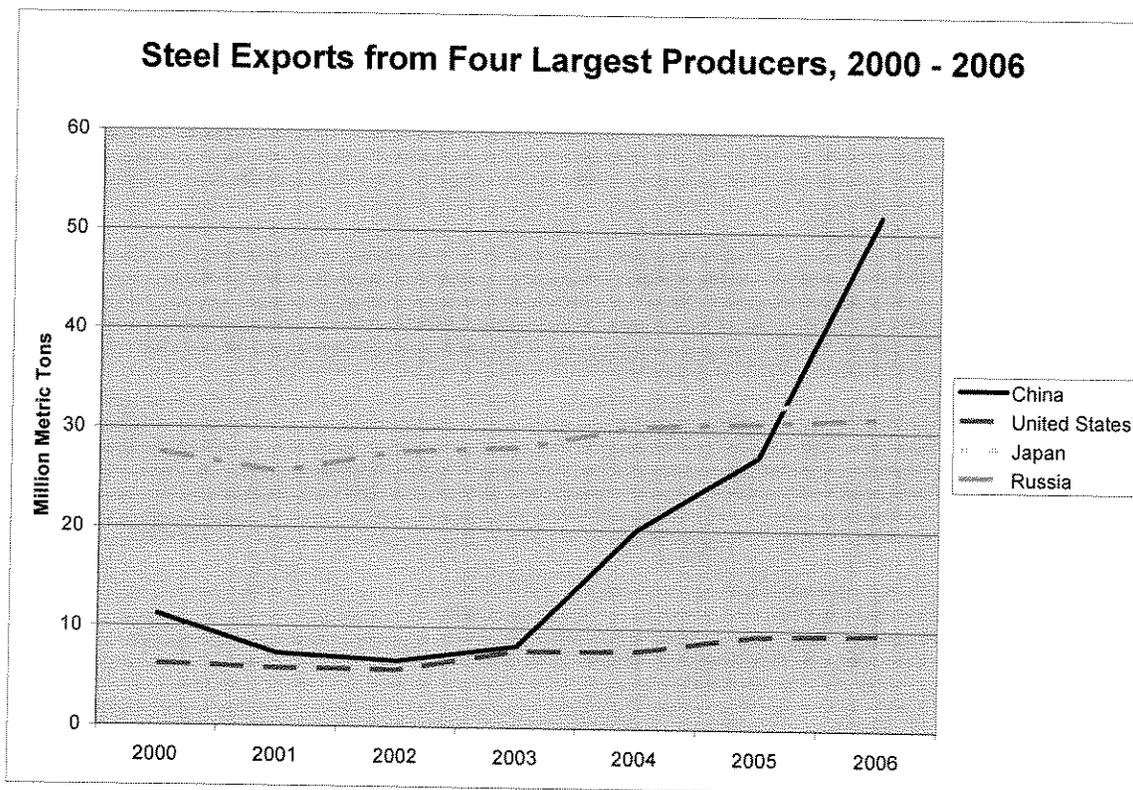
The growth in Chinese exports of steel has been even more dramatic. As recently as 2002, China exported only 6.6 million tons of steel, only 900,000 tons more than U.S. exports of steel in that year.¹⁹ In 2007, Chinese exports of finished steel reached 62.7 million tons, an increase of more than 450 percent from 2000.

Chinese steel exports for the first seven months of 2008 were 34.2 million tons, with July exports of 7.16 million tons representing an all-time monthly record.²⁰ The chart below compares this growth in Chinese steel exports to the export experience of the

¹⁹ See International Iron and Steel Institute, *Steel Statistical Yearbook 2007* 73-74 (2008).

²⁰ A. Cang, *China July Steel Product Exports Hit Record High*, Reuters (August 11, 2008).

next three largest producers -- Japan, the United States, and Russia -- for the period 2000 – 2006 (the last year for which complete data are available).²¹



While energy subsidies to the steel industry are not the sole cause of the explosive growth in Chinese steel production and exports, they clearly played a central role. Without such subsidies, there is simply no way the Chinese steel industry could have increased production and exports as it has. China's energy policy and its steel policy are inseparable.

Environmental Impact of China's Energy Subsidies

China's energy subsidies to the Chinese steel industry are having a profound effect on the world's environment. As *Money For Metal* noted, "the Chinese steel industry

²¹ *Steel Statistical Yearbook 2007* at 73-74.

has continued to pollute the environment with little concern for environmental regulations and with little enforcement from the government.”²² Steel production is such a major source of pollution in China that the Chinese government actually ordered steel producers near Beijing to shut down production during the Olympics in an attempt to ease Beijing’s air pollution.

The generally dismal environmental performance of the Chinese steel industry does not result from either a lack of access to technology or a lack of funds. Chinese steel producers enjoy the same access to the latest environmental technology that American and other steel producers have. With over \$2 trillion in foreign currency reserves, China certainly has the resources to purchase and operate the most modern technologies for reducing pollutants. Yet AISI and SMA representatives observed on various trips to China that some steel mills lacked even the most basic pollution control devices.²³ By encouraging excess production, China’s energy subsidies cause even more pollution from steel production.

The consequences of China’s energy policies are especially significant with respect to climate change. The Chinese steel industry is in general much less energy efficient than that in the United States. A recent study by the Peterson Institute for International Economics, based on International Iron and Steel Institute (IISI) data, estimates that Chinese emissions are approximately 1.5 metric tons per ton of steel greater than those for the United States.²⁴ Based on these estimates, China’s GHG emissions from

²² *Money For Metal* at 77.

²³ *Id.*

²⁴ T. Houser, R. Bradley, B. Childs, J. Werksman, and R. Heilmayr, *Leveling the Carbon Playing Field* 47 (2008).

steel production grew from 330.8 million metric tons in 2000 to 1.27 *billion* tons in 2007. In fact, this figure is almost certainly far too low for the earlier period, as it assumes that Chinese steel mills were as efficient in 2000 as they were in 2005, the year on which the Peterson study was based.

Implications for U.S. Environmental Policy

China's energy policies have profound implications for the United States. The United States is now actively considering how it can reduce greenhouse gas emissions. Practically every conceivable mode of regulation would result in increased energy costs, particularly for energy-intensive industries like steel. Adoption of a cap-and-trade system of emissions allowances such as that found in the European Union, for example, could result in increases in electricity costs of 50 percent or more. A combination of higher electricity and natural gas prices and the need to purchase emissions allowances could cost the U.S. steel industry up to \$5 billion per year.

America's steel industry is among the most energy-efficient in the world, but there is a very real concern that higher costs as a consequence of climate change legislation could render the U.S. steel industry less competitive internationally. Given the energy subsidies the Chinese steel industry receives, it would be especially difficult for our steel industry to compete with imports from China. This could well lead to "emissions migration," as production moves from the United States to countries like China. In such a situation, imports of steel from China could easily increase by 100 percent or more. In that case, global GHG emissions would actually increase, because steel production in China is generally more energy-intensive and less environmentally friendly than is steel production in the United States.

For every ton of steel that is produced in China instead of the United States, global greenhouse gas emissions rise by approximately 1.5 tons. If U.S. imports of Chinese steel doubled from their 2007 levels of 4.6 million tons, for example, the amount of greenhouse gases discharged into the atmosphere would increase by 6.9 million tons. In this way, China's energy policies not only harm the world's environment; they also limit the ability of other countries to take decisive action on climate change without risking the survival of their trade and energy-intensive industries.

Conclusions

China continues to provide massive energy subsidies to its steel industry, largely through price controls on key energy inputs, including coal and electricity, and through other means, including global export restrictions on coke. As a consequence, Chinese steel production and exports have grown enormously since 2000.

The Chinese steel companies have access to the same environmental technology that we do and the means to pay for it, but the Chinese steel industry has one of the highest rates of greenhouse gas emissions per ton of steel produced of any steel industry in the world. China's energy policies -- by enabling the Chinese steel industry to expand very rapidly, far in excess of domestic demand and in a way that is not based on market factors -- have caused the emission of at least three billion additional tons of greenhouse gases into the earth's atmosphere since 2000.

Due to their impacts outside of China on international trade, investment, and competitiveness, these Chinese government energy policies also limit the ability of the United States and other countries to take effective action to reduce their greenhouse gas emissions.