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How Developing Countries are Fighting Climate Change"
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Chairman Markey, Ranking Member Sensenbrenner, and distinguished Members of the Committee, it is my pleasure to be here with you today to discuss China's national greenhouse gas mitigation efforts and achievements. I applaud the committee for calling a hearing on the vitally important topic of how developing countries, including China, are already taking action to fight climate change.

Beginning with its Eleventh Five-Year Plan, which covers 2006 to 2010, China has recognized that it must reduce its rapid growth in energy demand and greenhouse gas emissions and accordingly has embarked on what President Obama in his speech to Congress last week called "the largest effort in history to make their economy energy efficient." It is important that the United States understand what measures China is taking to reduce its greenhouse gas emissions as well as how the United States can strengthen its engagement with China on climate change, because China and the United States together are the two countries that can have the greatest impact on mitigating climate change.[1] The Chinese viewed Secretary of State Clinton's recent visit to Beijing and her message of cooperation extremely favorably and are eager to find areas for mutual cooperation.

[1] For the Committee's benefit, I have attached to this written testimony a set of recommendations by the Natural Resources Defense Council on "Strengthening US-China Climate Change and Energy Engagement."

I am a Senior Attorney and Director of the China Program for the Natural Resources Defense Council (NRDC), and have worked on China energy and environmental issues for nearly twenty years. NRDC is a nonprofit environmental organization with a staff of nearly 400 lawyers, scientists and policy experts, including a staff of 25 working full time in Beijing on energy, climate, and environmental governance issues. Over the last twelve years, recognizing the importance of China to the global environment, we have been working with the Chinese government to help reduce China's CO_2 emissions by developing national energy codes and standards for buildings and equipment, promoting demand side management (DSM) energy efficiency programs and advanced energy technologies, and focusing on ways to improve environmental enforcement and governance. I am also the President of the China-U.S. Energy Efficiency Alliance, a non-profit organization that promotes technical exchanges between U.S. and Chinese government officials, utilities and energy experts to help China design and implement large-scale DSM energy efficiency programs targeted at China's industrial sector.

The Origins of China's Present Greenhouse Gas Mitigation Efforts

China is currently pursuing an aggressive and ambitious greenhouse gas mitigation program—a result of its recognition that its present development model is unsustainable and that climate change is likely to have serious impacts on its agricultural productivity and water resources (causing droughts in the north and flooding in the south and on its coasts), increase the incidence of extreme weather events, and lead to deterioration of its forests and other natural ecosystems. China is also keenly aware of the intimate connection between its enormous growth in energy demand and its energy security, and the serious public health and environmental damage caused by emissions of pollutants such as SO_2, NOx, particulate matter and mercury from its coal-dominated energy system.

China's greenhouse gas mitigation efforts are reflected in its National Assessment Report on Climate Change (December 2006), National Climate Change Action Plan (June 2007), and a Climate Change White Paper (October 2008), but have their roots in China's response to the tremendous and unexpected surge in energy growth that occurred beginning in 2002. From 1980 to 2000, China's GDP quadrupled, but energy demand

only doubled from 603 to 1,386 mtce ("million tons of coal equivalent") as a result of Chinese policymakers' emphasis on energy efficiency. In other words, energy grew at half the rate of GDP growth. Between 2000 and 2005, however, China's primary energy consumption skyrocketed from 1,386 to 2,225 mtce, an annual rate 1.5 times faster than the growth in GDP.[2] This sudden increase in energy demand and hence greenhouse gas emissions was not predicted by either international or domestic energy experts, and led China to rapidly increase its thermal power plant capacity to meet its energy needs. In 2006, for example, China added 90 GW ("gigawatt")[3] of coal-fired power capacity—this addition alone is enough to emit over 500 million tons of CO_2 per year for 40 years.[4] To put this in comparison, the entire European Union's Kyoto reduction commitment is 300 million tons of CO_2.[5] The rapid growth in energy demand occurred primarily because of an increasing dominance of heavy industry in China's economic structure—i.e., cement, iron and steel, and chemicals—which overshadowed improvements in energy efficiency.[6] It is this rapid growth in energy demand that resulted in China overtaking the United States as the largest greenhouse gas emitter some time in 2006 or 2007.[7]

Recognizing the need to rein in energy growth, China's leaders set out in the Eleventh Five Year Plan a goal of reducing energy intensity (energy consumption per unit of GDP) 20 percent from 2005 levels by 2010, *i.e.*, a 4 percent reduction per year. They also set a target of increasing the share of renewables in the energy mix to 10 percent by 2010 and 15 percent by 2020. If China succeeds in reducing its energy intensity by 20 percent by 2010, it will avoid emitting approximately 1.5 billion tons of CO_2,[8] constituting the largest single greenhouse gas mitigation program by any country. I will first address

[2] World Bank, *Sustainable Energy in China* (2006), pp. 11.
[3] One gigawatt is equivalent to 1 billion watts.
[4] Statement of Stephen Chu, Director, Lawrence Berkeley National Laboratory, before the U.S. Senate Committee on Finance, March 27, 2007.
[5] *Id*.
[6] Trevor Houser, Testimony before the U.S.-China Economic and Security Review Commission, June 14, 2007.
[7] Netherlands Environmental Assessment Agency, "China now no. 1 in CO2 emissions; USA in second position," June 19, 2007, available at www.pbl.nl.
[8] Jiang Lin, Nan Zhou, Mark Levine, and David Fridley, "Taking out 1 billion tons of CO2: The magic of China's 11th Five-Year Plan?", Energy Policy 36 (2008): 954-970.

China's efforts to reduce energy demand, then discuss their efforts to reduce the carbon intensity of their energy supply.

China's Efforts to Improve Energy Efficiency and Reduce Energy Demand

China appears to be making some progress in reaching its energy intensity goals. After reducing energy intensity by only 1.23 percent in 2006, it reduced energy intensity by 3.66 percent in 2007 and 4.59 percent in 2008. It accomplished this primarily through economic restructuring and a renewed emphasis on energy efficiency, although the global economic downturn also played a role starting in the last quarter of 2008. Major initiatives include:

- Replacing smaller, less efficient power plants and closing backwards production capacity,[9] slowing the expansion of high energy-consuming industries through the elimination or reduction of export tax rebates for energy intensive products, and using differential pricing of electricity and a "Green Credit" policy to encourage more efficient enterprises and limit or shut down less efficient enterprises.[10] China is also encouraging growth in the service and high-tech industries.
- A renewed emphasis on energy efficiency, particularly in the industrial sector, which accounted for 77 percent of delivered energy use in China in 2005.[11] One particular project of note is the "Top 1000" program, started in April 2006 to improve the energy efficiency of the top 1,000 energy consuming enterprises in nine sectors,[12] with a goal of saving 100 mtce by 2010. These 1,000 enterprises alone constituted 33 percent of national energy consumption and 47 percent of industrial energy consumption in 2004, and represented approximately 43 percent of China's CO_2 emissions in 2006.[13] Although data is limited, a preliminary

[9] In 2007, for example, China closed 14.38 GW of small thermal power plants, 46.59 million tons of iron smelting capacity, 37.47 million tons of steelmaking capacity and 52 million tons of cement production capacity.
[10] Lynn Price, Xuejun Wang and Jiang Yun, *China's Top-1000 Energy-Consuming Enterprises Program: Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China*, LBNL-519E, pp. 9.
[11] EIA, *International Energy Outlook 2008*, available at http://www.eia.doe.gov/oiaf/ieo/world.html.
[12] The nine sectors are iron and steel, non-ferrous metal, chemicals, petroleum/petrochemicals, construction material, textiles, paper, coal mining and power generation.
[13] L. Price et al., *China's Top-1000 Energy-Consuming Enterprises Program*, pp. 18.

assessment concluded that the Top 1000 program is on track to meet or surpass its target of saving 100 mtce per year, which would translate into a reduction in CO_2 emissions of 300 to 450 million tons, and could constitute 10 to 25 percent of the savings necessary to meet China's 20 percent energy intensity reduction target.[14]

- Funding energy efficiency at the national and provincial level. The central government allocated 23.5 billion RMB ($3.4 billion) in 2007 and 41.8 billion RMB ($6 billion) in 2008 to promote energy efficiency and reduce emissions.[15] A portion of this funding is used to reward enterprises that can demonstrate aggregate savings of 10,000 tons of coal equivalent per year from energy conservation projects by providing 200-250 RMB ($29-36) for every ton of coal saved.[16] Provincial-level energy efficiency funds also exist; for example, Shandong province has initiated a 2.13 billion RMB ($304 million) fund for local enterprises.[17]
- Beginning to implement provincial and municipal demand side management programs, based on experience in states such as California, in which utilities or another regulated party uses technical assistance, funding (such as a system benefits charge fund) and information programs to reduce peak load and overall energy demand through large-scale investments in energy efficiency. The NRDC and China-U.S. Energy Efficiency Alliance have established a pilot program that has avoided the need to build 300 MW of electric capacity in Jiangsu province, eliminating 1.84 $mtCO_2e$.[18] A World Bank study concluded that with the proper policies and incentives, DSM programs could reduce electricity needs by 220 terawatt hours[19] and avoid the need to build more than 100 GW of electric capacity by 2020.[20] Tapping even half of this potential would reduce coal

[14] *Id.,* pp. 27.
[15] *Id.*, pp. 8.
[16] *Id.*
[17] *Id*.
[18] Million tons of CO_2 equivalent.
[19] A terawatt is equivalent to 1 trillion watts.
[20] Zhaoguang Hu, David Moskowitz, and Jianping Zhao, *Demand Side Management in China's Restructured Power's Industry* (December 2005), World Bank Energy Sector Management Assistance Program.

consumption by about 37 mtce in 2020, avoiding 93 million tons of CO_2 emissions.

- Continuing to develop and implement building energy codes, appliance and equipment energy efficiency standards and labeling programs, and stricter vehicle fuel efficiency standards. China is building 2 billion square meters of floor space each year, half of the world's total. As more and more Chinese move into cities and begin to use modern conveniences and personal automobiles, maintaining efficiency standards will be crucial to slowing greenhouse gas emissions. Between 2000 and 2020, improved efficiency in electric appliances and gas water heaters is projected to reduce carbon emissions by more than 1.1 billion tons of CO_2.[21] However, monitoring and enforcement of these standards will be crucial to ensuring that the potential GHG reductions from these programs are indeed achieved.
- Launching a rebate program last April to subsidize the purchase of energy efficient light bulbs, offering a 30 percent subsidy on wholesale purchases and a 50 percent subsidy on retail sales. Some local governments offered additional subsidies of up to 40 percent. Lighting now accounts for about 12 percent of China's total electricity consumption, and using energy-saving bulbs could cut such power consumption by 60 to 80 percent. By the end of January 2009, 62 million energy-saving light bulbs had been sold under the subsidy program, which will help save 3.2 billion kWh of electricity annually and eliminate 3.2 million tons of CO_2 emissions. China announced last week that it will double the size of the program in 2009, subsidizing 100 million energy-efficient light bulbs this year. China is also beginning to work on a program to phase out the more than 1 billion ordinary bulbs that the country consumes every year.
- Raising fuel economy standards from 36 to 43 mpg this year and instituting graduated sales taxes favoring smaller cars, in order to slow growth in oil consumption fueled by the rapid expansion in personal vehicles.[22] China has also begun to bring its oil prices more in line with international markets, which would

[21] Mark D. Levine and Nathaniel T. Aden, *Global Carbon Emissions in the Coming Decades: The Case of China* (2008), Annual Review of Environment and Resources, pp. 32.
[22] 9.4 million cars were sold in China in 2008.

reduce demand over the long term. In early 2009, Beijing prohibited the driving of all heavily polluting yellow-label vehicles (which account for 10 percent of the total number of motor vehicles but 50 percent of emissions) within the city limits, and provided cash rebates to help ease the transition. The Chinese government also announced two weeks ago that it will offer cash rebates ranging from 50,000 RMB ($7,353) for small hybrid passenger cars to 600,000 RMB ($87,719) for large, fuel cell powered commercial buses in 13 major cities, including Beijing and Shanghai. China plans to put 60,000 new-energy vehicles for trial runs in 11 cities by 2012 for public transportation and public services. And the Ministry of Railways just signed a purchase agreement valued at 27 billion RMB ($3.95 billion) to purchase 500 clean and energy-efficient locomotives to replace diesel-powered engines on various lines. Replacing one diesel locomotive with an electric locomotive is equivalent to eliminating emissions from 4,000 vehicles.

- Finally, the government is raising public awareness of the need to "save energy and reduce emissions" (*jie neng jian pai)*, has amended the energy conservation law, and is using improvements in energy efficiency as one measure by which government officials' performance is evaluated. A recent nationwide public opinion survey found that three out of every four Chinese citizens, or 76 percent, believe that environmental problems in China are "very serious" or "relatively serious."

Although China has made significant progress in improving its energy efficiency, much more can be done. China's energy intensity is currently four times that of the US and nine times that of Japan. According to McKinsey Global Institute estimates, if China were to pursue all cost-effective energy efficiency options, it could reduce energy use by approximately 1,050 mtce in 2020.[23] By doing so, it could cut its projected energy demand by about 23 percent and its CO_2 emissions by at least 20 percent from a business as usual scenario.[24] Many of these investments in energy efficiency are cost-effective, and the International Energy Agency estimates that on average every additional $1 spent

[23] Based on estimates by the McKinsey Global Institute in *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity* (2007), pp. 34.
[24] McKinsey Global Institute, *Leapfrogging to Higher Energy Productivity in China* (2007).

on more efficient electrical equipment, appliances and buildings avoids more than $2 in investment in electricity supply.[25] It is estimated that China will require investments of 150-200 million RMB ($21-29 billion) per year to reduce the growth rate of energy demand to half the growth rate of the economy over the next 15-20 years.[26]

Further progress in reducing energy demand will depend on reforming incentives in the electric industry, so that grid companies and utilities are rewarded for improving energy efficiency (i.e., decoupling), and engaging with commercial banks and the small but growing Energy Service Company market to ensure that energy efficiency investments can be a sizable and sustainable market. There is also a need to increase technical capacity in energy auditing and energy efficiency retrofit design and implementation. Implementation of all of these efforts will require a sustained effort to monitor and enforce energy efficiency standards in industry, power plants, buildings, appliances, equipment and automobiles.

China's Efforts to Reduce the Carbon Intensity of its Energy Supply

China has also sought to reduce the carbon intensity of its energy supply by closing down smaller, inefficient thermal power plants and increasing the share of less carbon-intensive sources of energy, notably hydropower, wind and nuclear:

- At the end of 2008, China had a total installed electric power capacity of 792 GW, constituting 76 percent thermal power capacity, 22 percent hydropower, 1.6 percent wind, and 1.1 percent nuclear. In 2008, it expanded its total thermal power capacity by 66 GW, or about two new 600 MW power plants per week. This is consistent with the pace of expansion in recent years, which saw thermal power additions jump from an increase of 15 GW in 2004 to 86 GW in 2005, 93 GW in 2006 and 70 GW in 2007. China also expanded hydropower by 20 GW and windpower by 6.4 GW in 2008. In terms of actual electricity generated, China generated a total 3,443 TWh in 2008, comprised of 2,779 TWh of thermal

[25] International Energy Agency, *World Energy Outlook 2006*.
[26] L. Price et al., *China's Top-1000 Energy-Consuming Enterprises Program*, pp. 8.

(80.1%), 563 TWh of hydro (16.4%), 68.4 TWh of nuclear (2%) and 12.8 TWh of wind (0.4%).

- China's thermal power expansion, however, is occurring through replacement of smaller, less efficient power plants with larger, more efficient plants. China shut down 34 GW of small, inefficient plants from 2006-08, and plans to close another 31 GW of inefficient plants during the next three years. This has improved average efficiency from about 370 grams of coal per kWh in 2005 to 349 grams of coal per kWh in 2008. China is also pursuing cleaner thermal power generation technologies such as combined heat and power, integrated gasification combined cycle (IGCC) and carbon capture and storage (CCS). GreenGen, a joint venture established by Chinese utilities, is building China's first IGCC power plant in Tianjin, which is slated to come online with 250 MW capacity in 2010 and expand to 650 MW with CCS by 2020. The Chinese utility Huaneng Group started a pilot CCS project in Beijing last summer.
- China passed a Renewable Energy Law in 2005 and a Medium and Long-Term Development Plan for Renewable Energy in 2007 to encourage the growth of renewables. The renewable energy plan calls for the share of renewable energy in primary energy to reach 10 percent by 2010 and 15 percent by 2020. To help meet these targets, China has regulations that encourage the construction of renewable energy facilities and offer financial incentives and reduced taxes for renewable energy projects, including loan discounts and a feed-in program.
- Wind capacity doubled in 2008 from 5.9 GW to 12.3 GW, thus passing China's goal of 10 GW wind capacity by 2010. China plans to continue its rapid expansion of windpower and to improve the quality of its domestically manufactured wind turbines and connection with the grid. China's installed solar capacity is small but growing; it is planning to build a 10 MW solar PV power plant in Dunhuang, which would be the largest in the country. China is the world's largest manufacturer of solar PV panels, although almost all of this is exported. China also produces 80 percent of the world's solar water heaters, which make up 20 percent of its water heating units.

- China presently has 11 nuclear reactors with 9 GW of capacity, accounting for over 1 percent of its energy mix. It is likely to raise its target from 4 percent to 5 percent of energy production by 2020, or about 60 to 70 GW total capacity.

Finally, let me mention a few mitigation measures that do not fall neatly into the categories of energy efficiency or energy supply. China has afforestation efforts and forest management efforts aimed at raising forest coverage to 20 percent by 2010. It is exploring the idea of eco-cities and smart growth and increasing the use of mass transit. It has joined the Methane to Markets Partnership to better utilize coal bed methane. In addition, China's 4 trillion RMB ($585 billion) economic stimulus package includes 600 billion RMB ($88 billion) for building intercity rail lines, 476 billion ($70 billion) for new electricity grid infrastructure and 350 billion RMB ($50 billion) for energy efficiency and environmental protection projects.

In sum, China is working aggressively to improve its energy efficiency and to reduce the carbon intensity of its energy mix. The speed with which its economy is growing means that it faces a challenging task, but a sustained and sizeable effort to reduce its energy demand and the carbon intensity of its energy supply could result in a substantial reduction in the growth of its greenhouse gas emissions. According to a recently issued McKinsey study, if China pursued energy efficiency to the full extent possible and cut coal to 34 percent of its power supply, it could nearly cut in half its projected greenhouse gas emissions in 2030.[27]

China is taking enormous steps to reduce its impact on climate change and it is likely to continue and possibly intensify these efforts in the future. It has devoted significant economic and political resources to achieving the targets it has set for itself and demonstrated a willingness to pursue results. The United States can take China's mitigation actions to date as a strong signal that it intends to take concrete and meaningful steps to address climate change in the future.

[27] McKinsey & Company, *China's Green Revolution: Prioritizing Technologies to Achieve Energy and Environmental Sustainability* (2009).

I thank the committee for inviting me to participate in this hearing and look forward to answering any questions you may have.