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China Needs Help with Climate Change

KELLY SIMS GALLAGHER

This year, China will have become the largest aggregate emitter of greenhouse gases in the world, surpassing the United States for the first time since records have been kept. America will be the largest per-capita emitter and the second-largest aggregate emitter. These two countries have the unique ability to make or break the global climate change problem.

While it has long been recognized that China would be a pivotal nation in terms of dealing with climate change, the rate of growth of greenhouse gas emissions in China has been breathtaking, even to the Chinese themselves. At a minimum, it is now imperative to find incentives and mechanisms to induce China to reduce the growth of its emissions in the near term and, ultimately, to significantly reduce emissions below current levels.

It is also imperative to assist China in this endeavor. Indeed, increased cooperation between Washington and Beijing is probably necessary if the climate change threat is to be effectively addressed. This will require that the two countries stop using each other as an excuse for inaction and instead form a partnership to ameliorate global warming.

Based on China and America's shared challenges of reducing greenhouse gas emissions and their economies' reliance on coal, a climate partnership should include high-level policy coordination and the establishment of a fund to provide low-cost financing for low-carbon projects in both countries. It should include capacity-building measures to help enhance the effectiveness of China's institutions, policies, and enforcement measures to reduce emissions. And it should include a joint innovation initiative to promote pre-commercial research, development, and demonstration of low-carbon technologies, particularly focused on carbon capture and storage, renewable energy, and energy efficiency technologies.

A BIG-TIME EMITTER

China's contribution to the gases that are warming the world by trapping heat in the atmosphere is a direct result of the country's astonishingly rapid economic growth and rising demand for energy. Along with the United States, China is now one of the world's two largest energy producers and consumers. In terms of oil and electricity consumption, the People's Republic remains somewhat behind the United States. It consumes two-thirds as much commercial energy as America does, consumes one-third as much oil, imports one-third as much petroleum (although China's oil import growth rate has been much faster in recent years), and uses two-thirds as much electricity.

But when it comes to coal, the picture is different. China consumes twice as much coal as does the United States, though it has only 13 percent of the world's coal reserves, compared with 27 percent for the United States. Coal absolutely dominates the energy picture in China, accounting for 70 percent of its commercial energy supply. In 2006, China reportedly consumed 2.8 billion metric tons of coal, mostly for power plants and industry. By comparison, the United States consumed 1.3 billion metric tons, nearly all of which was used by power plants. In the United States, coal accounts for one-third of the total energy supply and half the country's electricity generation.

The growth in China's power sector has been almost unbelievably fast. Between 2005 and 2006, for example, electricity capacity increased by about 20 percent, from 517 gigawatts (GW) to 622 GW, nearly all of which was coal-fired. At this growth

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rate, China's total power sector capacity increased by double every three and a half years.

The transportation sector at this point is a relatively small consumer of energy in China, accounting for less than 10 percent of overall consumption. China has adopted new fuel-efficiency standards for passenger cars and tax policies for fuel consumption that should help to avoid a big increase in oil consumption. But the potential market for automobiles in China is huge. Fuel efficiency standards will need to be further strengthened and complementary measures introduced to reduce demand for cars if China is to avoid becoming the biggest oil-consuming country in the world.

As a result of all this industrial development, the growth in China's greenhouse emissions has been considerable. According to the latest official data from America's Oak Ridge National Laboratory, China in 2004 accounted for approximately 18 percent of the world's total carbon dioxide emissions from fossil fuel–burning and cement production, as compared with 22 percent for the United States. As of 2007, we now know that China has caught up to the United States. (China's per-capita emissions, on the other hand, are only one-fifth those of the United States.)

The rate of growth of greenhouse gas emissions in China has been breathtaking, even to the Chinese themselves.

Both countries have signed and ratified the United Nations Framework Convention on Climate Change. Both have also signed the Kyoto Protocol, but only China has ratified it. At the central government level, neither country has binding policies aimed specifically at reducing greenhouse gas emissions, although both have efficiency-oriented policies that have the benefit of reducing carbon emissions.

In June, the Chinese government for the first time issued a specific package of voluntary measures aimed at cutting greenhouse gas emissions; several sets of voluntary policies have been promoted as well by the past three presidential administrations in the United States. At the state and local levels, many US governmental entities have passed regulations to reduce carbon dioxide emissions. This is not true of China's provinces and localities, where many local governmental bodies ignore or flout even the most basic energy-efficiency policies.

ENERGY CHALLENGES

China's energy-related challenges are many. They include the country's need for energy to sustain economic growth, its increasing dependency on foreign oil and gas, its aspiration to provide modern forms of energy to the poor, its increasingly severe urban air pollution, and its already massive acid deposition (dispersed in rain or deposited on surfaces). This is not to dismiss growing domestic and international concerns about global climate change or the need for affordable, advanced energy technologies to address all of these challenges. However, as China begins to consider how to address global warming, it will be simultaneously weighing the competing energy-related challenges, all of which are seen as more pressing by the Chinese government today.

Economically, China's growing energy consumption presents both challenges and opportunities. One concern is that as China imports greater amounts of energy, prices of these commodities could rise until supply catches up, and price spikes will be especially likely during supply disruptions. At the same time, there is a pressing need simply to supply enough energy, especially in the form of electricity, to meet the very high demand created by Chinese industry. The power sector has been through several boom-and-bust cycles because, when electricity shortages emerge, the power industry responds by adding huge quantities of new capacity as fast as it can. This causes oversupply for a time until the economy catches up and a new shortage emerges. The shortages have been harmful to the Chinese economy intermittently, whenever electricity has been rationed and factories have been forced to shut down.

On the opportunity side, the Chinese energy sector is already large and is growing rapidly, so it represents a remarkable market opportunity for both Chinese and foreign energy services companies. In 2006 alone, China installed 101 GW of new power capacity, 90 GW of which was coal-fired. To put this astounding number in perspective, India's entire electricity system, as of 2004, was 131 GW.

Despite the perception that China has become an industrial powerhouse, 135 million Chinese still live in absolute poverty (on less than $1 a day) and millions more remain just above that arbitrary

poverty divide, so there is a tremendous imperative to foster economic development and high growth rates. In addition, the need to provide better energy services to the poor—to improve the quality of life for those still reliant on traditional forms of energy such as charcoal, crop wastes, and dung—remains very much a preoccupation of the Chinese government. Because of the country's gigantic population, China's total energy consumption and greenhouse gas emissions would still be large even if everyone consumed a very small amount of energy.

Since the beginning of the twenty-first century, China has emerged as a major consumer of oil, and there is strong potential for China to become a major natural gas consumer as well, especially when it gets serious about reducing its greenhouse gas emissions. China became a net importer of oil in the mid-1990s. It is now the world's second-largest consumer of oil, and the third-largest oil importer.

About half of China's oil imports come from the Middle East. However, Angola became its largest supplier in 2006, and China has invested heavily in energy resources in Africa. Although there have been several new oil discoveries in China recently, reserves there are on the decline. China has relatively few natural gas reserves, and therefore uses virtually no natural gas in its power sector. It is trying to increase production of coal-bed methane. If China decides to increase its use of natural gas, it will likely import it through liquid natural gas import terminals on the coast or by overland pipeline from Central Asia or Russia. In any event, China's long-term energy security depends not only on its having sufficient supplies of energy to sustain its rapid economic growth, but also on its ability to manage the growth in energy demand. Unmanaged demand, it is becoming clear, will cause intolerable environmental damage.

Coal is at the heart of many of China's environmental woes. Particulate matter from coal is a major air pollutant. Sulfur dioxide emissions from coal combustion, the source of most acid deposition, rose 27 percent between 2001 and 2005. Coal is also the most carbon-intensive of the fossil fuels, and it is China's main source of energy. It accounts for four-fifths of China's CO_2 emissions, most of which come from the industrial and electricity sectors. As of 2000, electricity accounted for 52 percent of China's CO_2 emissions (and 75 percent of China's electricity is consumed by industry), while cement production accounted for 28 percent, iron and steel production for 9 percent, and transportation for 8 percent. Already today, annual emissions from Chinese coal are three times as great as US emissions from transportation, although US transportation emissions are 17 times higher than Chinese transportation emissions.

The possible impact of climate change on China itself has not been studied as well as the possible impact on the United States, but it is clear that we could see very adverse effects on China's water supply, agriculture, and sea levels. Between 1956 and 2000, precipitation decreased 50–120 millimeters per year along the northern Yellow River, an already arid region. During the same period, precipitation increased 60–130 millimeters per year along the southern Yangtze River, an area that has long been plagued by heavy flooding. The mountain glaciers on the Tibetan plateau are receding rapidly, which carries major implications for fresh water supply in already water-stressed northern China. The glacier in the Tianshan Mountains that is the source of the Urumqi River, for example, shrank 11.3 percent between 1962 and 2001. Meanwhile, a sea level rise of 30 centimeters would cause massive coastal inundation. Chinese analysts have estimated this would cause the equivalent of $7.5 billion in economic losses to the Pearl River Delta area, $1.3 billion for the Yangtze Delta area, and $6.9 billion for the Yellow River Delta (including the Bohai Sea).

THE CHINESE APPROACH

China has already taken important steps toward moderating future growth in greenhouse gas emissions, largely through energy efficiency and renewable energy measures. Energy intensity (the amount of energy used to generate economic activity, usually calculated as total energy consumption divided by GDP) dramatically declined in China from 1980 to 2004. This means that China's overall energy efficiency improved and that significant growth in greenhouse gas emissions was avoided. Despite this improvement, however, China's overall energy efficiency remains considerably lower than most industrialized countries' and, unfortunately, it appears to have worsened in the past two years.

The central government has set forth some aggressive policies and targets for energy efficiency for the coming years. Because so much of China's energy is derived from coal, efficiency measures that reduce coal combustion will greatly help to reduce greenhouse gas emissions. China's 11th Five-Year Plan (2006–2010) called for a 20 percent reduction in energy intensity by 2010. This goal

is already proving hard to achieve—last year's efficiency improvements fell short of the plan's objective, and in 2005 China's energy intensity actually *increased* slightly. Even so, the energy intensity target was at the heart of the climate change plan that the Chinese government announced in June 2007 in advance of the Group of Eight summit. By improving thermal efficiency, Beijing estimated that it could reduce China's carbon dioxide emissions by a total of 110 million tons by 2010.

The Chinese government issued its first fuel efficiency standards for passenger cars in 2005, and they will be strengthened in 2008. China also has implemented vehicle excise taxes so that the purchase of a car or sport utility vehicle with a big engine requires a much higher tax payment than does the purchase of a car with a small, energy-efficient engine. In the case of both fuel efficiency standards and excise taxes, China's policies are more stringent than comparable ones in the United States. And Beijing has adopted strong efficiency standards for appliances as well. The China Energy Group at Lawrence Berkeley National Laboratory estimates that, by 2010, those standards will have reduced carbon dioxide emissions in China by 40 million tons. By comparison, the US appliance standards will have saved 50 million tons of CO_2 by 2010.

Many local governmental bodies ignore or flout even the most basic energy-efficiency policies.

The Chinese government has also aggressively promoted low-carbon energy supply options, especially renewable energy, hydropower, and nuclear energy. If you exclude large hydropower but include small hydropower, China has twice as much installed renewable power capacity as the United States. In fact, as of 2005, China led the world in total installed renewable energy capacity at 42 GW, compared to 23 GW in the United States. China accounts for 63 percent of the solar hot water capacity in the world, and as of 2005 it had installed 1.3 GW of wind capacity.

China in 2005 enacted a Renewable Energy Law that requires grid operators to purchase electricity from renewable generators. It sets a target of 10 percent of electric power generation capacity coming from renewable energy sources by 2010 (not including large hydro). By expanding bioenergy, solar, wind, geothermal, and tidal energy sources, the government estimates it can reduce CO_2 emissions another 90 million tons by 2010. The government has exploited its large hydropower resources at some social and ecological cost, such as forced relocations of communities, loss of ecosystems, and decreased river flow, but it believes it has substantial scope for increasing hydropower further still. In fact, it estimated this year that it could achieve a reduction of 500 million tons of carbon dioxide by 2010 with increased hydropower.

Compared with coal and hydro, China has scarcely begun its expansion of nuclear power. By 2020, the government plans to have built 40 GW of new nuclear power plants. But even if Beijing meets that goal, the 40 GW would only account for about 4 percent of the total electric capacity anticipated to exist by then.

The Chinese government is also devoting a substantial portion of its R&D dollars to the research, development, and demonstration of advanced energy technologies. During the period covered by the 11th Five-Year Plan, the Ministry of Science and Technology's budget for energy research, development, and demonstration is about 3.5 billion yuan (about $466 million). The budget for advanced coal technology is about 700 million yuan (about $93 million). Five coal co-production and gasification demonstration projects are planned for the next five years, in collaboration with Chinese industry. If all are actually built, there will be more coal gasification and co-production plants in China than in the United States.

POWERED BY COAL

Despite all of the Chinese government's laudable efforts to improve energy efficiency and expand the use of low-carbon energy sources such as renewable energy, nuclear power, and hydroelectric power, China's carbon dioxide emissions grew at the worrying rate of 9 percent per year from 1999 to 2004. At this rate, the Chinese will double emissions by 2009. The main drivers of this growth are heavy reliance on coal using conventional technologies, the still relatively poor efficiency of most power-plant technologies, and the weakness of government institutions when it comes to implementing and enforcing policies.

China's heavy reliance on the most greenhouse gas–intensive fuel of all—namely, coal—com-

pounds the challenge of addressing global warming. Even with all of the measures taken so far to diversify energy supply, coal still accounts for 80 percent of China's greenhouse gas emissions. Even if a large increase in consumption of natural gas were achieved, it would not make much of an impact on emissions because it currently represents such a small portion of China's energy supply (less than 5 percent).

The other way to reduce emissions of heat-trapping gases, other than switching to cleaner fuels, is to improve the energy efficiency of China's power plants, as the government has recognized. More than half of China's power plants are smaller than 300 megawatts (MW)—in fact, more than 5,000 plants are smaller than 100 MW. This results in very poor energy efficiency. There are a handful of supercritical (high-efficiency) plants, and the first ultra-supercritical pulverized coal plant (the Huaneng Group's Yu-Huan plant) came on line in November 2006. Thirty-four additional ultra-supercritical plants are under construction. Yet, as impressive as this seems, China built three times that number of traditional coal plants last year alone. A more comprehensive policy is needed, one that will result in all new plants being high-efficiency or capable of capturing carbon.

Each new coal-fired power plant represents a 50- to 75-year commitment (and source of emissions) because these plants are unlikely to be prematurely retired. The International Energy Agency estimates that 55 percent of the new coal-fired power plants that will be constructed in the world between now and 2030 will be built in China. By using the cheapest technologies currently available for its power plants and industrial facilities (which is perfectly rational in strict economic terms), China is effectively locking itself and the world into high greenhouse gas emissions in the coming decades. This is so because technologies to economically capture carbon from conventional power plants do not currently exist. (In fact, this reflects an urgent need for additional R&D.)

Therefore, since the rapid growth in power plants and related infrastructure in China is expected to continue, "leapfrogging" to lower-carbon technologies in the near term is critical. Will all of the new plants that China is building use conventional high-carbon technologies or best-available low-carbon technologies? Much depends on the answer. Within five to ten years, if it maintains its recent rate of growth, China's energy sector will have installed the same amount of electricity capacity as the United States currently has (992 GW), virtually all of it in conventional coal-fired power.

We have learned that technological leapfrogging is not an automatic process. Developing countries either lack technical capabilities or cannot afford the costs of more advanced technologies. To achieve leapfrogging in coal-fired power plant technologies, the Chinese will need policies and incentives that mandate or promote the use of lower-carbon technologies.

WHAT NOW?

China may be more likely to develop these policies and incentives, however, if they are part of an international initiative that features a new climate partnership between the United States and China. Given the stakes in global warming, there is little time to lose in starting to build such a partnership. First, as soon as the United States has established a domestic mandatory program to reduce greenhouse gases, Washington should ask Beijing to adopt one as well, unique to its own circumstances.

In addition, the United States should consider forming a bilateral or multilateral investment fund to accelerate the deployment of low-carbon technologies in China. This fund could provide low- or no-interest loans or direct grants for major new industrial facilities or power plants that use low-carbon technologies. Without policies in place that effectively require the use of low-carbon technologies (for example, carbon dioxide performance standards or carbon taxes), or incentive programs that make the use of low-carbon technologies financially attractive (for example, special loans for coal gasification with carbon capture), the private sector will have little or no incentive to develop, transfer, and deploy low-carbon energy technologies in China. The establishment of concrete greenhouse gas policies and financial incentive programs in both the United States and China is of the utmost urgency.

Meanwhile, there is considerable scope for enhanced energy-technology cooperation between the two countries. Joint research, development, and demonstration projects can be valuable for both China and the United States. They can also provide a mechanism for bringing the US private sector in contact with Chinese partners. While there has been ongoing technology cooperation between the US Department of Energy and the Chinese Ministry of Science and Technology through protocols on fos-

sil energy, energy efficiency, and renewable energy, this cooperation has been inadequate, underfunded, and a low priority for the US government. The areas that should be given high priority include research, development, and demonstration of carbon capture and storage, renewable energy, energy storage, and energy efficiency technologies.

Finally, the United States needs to significantly bolster its cooperative activities related to increasing China's capacity for energy and environmental data collection and reporting, policy making, institution building, and regulatory enforcement. As a developing country, China still lacks many of the institutions, policies, and enforcement mechanisms that are needed to foster technology transfer and environmental protection. This is particularly the case at the provincial and county levels, and it has become one of the biggest obstacles to the achievement of real gains in energy efficiency and reduced greenhouse gas emissions.

Moral and practical

Chinese leaders increasingly are expressing concern about the effects of global warming on China itself, while also worrying about the general deterioration of China's air and water quality. As international pressure builds because of China's new status as the largest overall emitter, and as scientific evidence accumulates regarding China's own vulnerability to climate change, the government in Beijing likely will be looking for help and ideas for how to reduce emissions. As a matter of morality, the United States would do well to acknowledge that it put the largest portion of greenhouse gases into the atmosphere during the twentieth century, just as China will be the dominant emitter during the twenty-first century, and so it has an obligation to help China, still very much a developing country, confront this challenge.

Similarly, the pragmatic response would be to acknowledge that, since the two countries are the world's biggest emitters, the United States might as well form a partnership with China to develop creative ideas, technologies, and policies for preventing dangerous climate change in ways that are designed to produce mutual benefits. Such a partnership could help produce innovative low-carbon technologies for public and private benefit, wider and more open markets for advanced energy technologies, investment opportunities for Wall Street, and a more effective governance system in China. Catastrophic climate change might still be avoided if, but only if, the United States and China both act in time to reduce their emissions. ■