SUSTAINABLE DEVELOPMENT

Climate Change—the Chinese Challenge

Controlling CO_2 emissions without hindering economic development is a major challenge for China and the world.

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In 2006, China's carbon dioxide emission rate reached 1.6 GtC (gigatons of carbon or 10^{15} g carbon) per year (see chart, below) (*1*–*3*). Economic growth is projected to continue at higher than 7% per year; at this rate, Gross Domestic Product (GDP) would quadruple in 20 years. The associated high CO_2 emission rate would substantially affect the goal of avoiding dangerous climate change as set by the United Nations Framework Convention on Climate Change (UNFCCC). The conflict between economic development and keeping atmospheric greenhouse gases at a manageable level poses one of the greatest challenges of this century.

The Impact of Climate Change on China

China will be one of the worst-impacted regions in the world if climate changes as predicted (*4*). Three main industrial centers of China are on lowland areas: the Gulf of Bohai region with the Beijing-Tianjin axis, the Yangtze River delta radiating inland from Shanghai, and the Pearl River delta encompassing Hong Kong and Guangzhou. A sea-level rise of a meter would inundate 92,000 km^2 of land in these three regions (*5*).

Mountain glaciers have melted by 21% over the past 50 years in northwestern China (*5*). Under the projected climate change scenarios, temperature in the Tibet region would rise 3° to 6°C by 2100 (*4*). The melting of the permafrost might threaten the newly completed Qinghai-Tibet Railway (*6*). Aside from the Yangtze and the Yellow rivers, several major Asian rivers, such as Ganges and Mekong, originate from the Tibetan plateau, and the changing water resources may lead to tension with the neighboring countries.

The geography and climatology of China already give rise to frequent extreme events. The summer storms moving eastward along the river systems, which are generally oriented west to east, dump large amounts of rainfall that cause severe flooding. Indeed, the Three Gorges Dam was motivated largely on the premise of flood control. In the summer of 2006, Chongqing and Sichuan in the upper Yangtze Basin experienced a once-every-100-years drought, followed by a similarly rare flood in 2007, a harbinger of the projected intensification of extreme events in southern and eastern China (*5*).

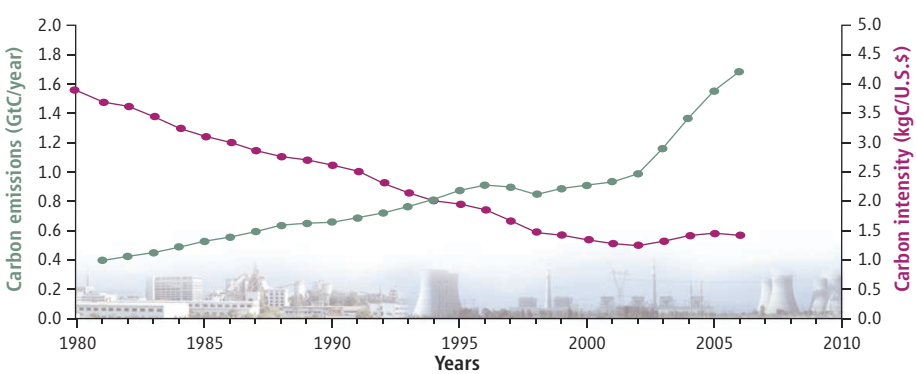
Half of the country's land area is arid or semiarid. Water shortage in northern China over the last three decades led to the ongoing construction of the South-North Water Diversion Project, a gigantic project that will divert water from three points of the Yangtze River basin to the north. Global warming is likely to enhance such drying. China's agricultural output could be reduced by 5 to 10% by 2030 (*5*), thus adding stress to a country that has 20% of the world's population and only 7% of the arable land. Similarly, major ecosystem impacts are expected with the loss of tundra and mountain forests and the intensification of fires (*5*).

Drivers of CO_2 Emissions and Coal Use

China's GDP has grown by 9.5% per year over the last 27 years, while its CO_2 emissions have increased by only 5.4% per year (*1*–*3*), corresponding to a large decrease in carbon intensity (carbon emission per unit of GDP) (see chart, below)—a remarkable achievement, as energy consumption generally grows faster than GDP during the early stages of industrialization. One important reason for this was the government's emphasis on energy efficiency. China's per capita emission is still low (one-fourth of U.S. CO_2 emissions), but the large population and high speed of economic development have led to a large increase in energy demand and have been primary drivers of the recent acceleration in global carbon emissions (*7*). The rebound in carbon intensity in the last few years (see chart, below) was caused mainly by accelerated urbanization and industrialization (see photo, page 731). For instance, stimulated by a construction boom, steel production has increased from 140 to 419 million tons from 2000 to 2006, now accounting for 34% of world total. In 2006, 7.2 million cars were sold, compared with 1.2 million in 1999. However, about 23% of the CO_2 emissions are a result of producing goods exported to other countries (*8*).

The large population dictates that China cannot duplicate the energy-intensive Western model because of resource limitations. In 2006, China imported 47% of its crude oil and is projected to import 60% by 2020. Given escalating oil prices and concerns about energy security, China has no alternative but to focus on domestic resources.

China has one of the largest coal reserves in the world, and coal accounts for 67% of its primary energy use, compared with 24% for the world average (*9*). China is currently bringing two additional coal-fired power plants to the electric power grid every week (*10*). Although the government had set the goal of 20% reduction in energy intensity (energy consumption per unit GDP) in the 11th Five-Year Plan period (2006–10) (*11*), the goal looks unlikely



CO_2 emissions and carbon intensity for China from 1980 to 2006 (*1*–*3*).

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to be met, as energy intensity has decreased by only 1.23% in 2006. In a hypothetical scenario in which carbon intensity keeps pace with a GDP growth rate of 7%, by 2030, China would be emitting as much as the world as a whole is today (8 GtC/year). If China could limit carbon intensity at half of the economic growth rate, as was done in the 1980s–90s (*1*–*3*), a quadrupling of GDP in 20 years would still lead to CO_2 emissions of 3 to 4 GtC/year.

Rapid development leads to high energy demand and CO_2 emissions.

PHOTO CREDIT: JAY GREGG

Opportunities

The most effective near-term strategy is energy conservation and efficiency. Because infrastructure has a long lifetime, it is much more cost-effective to design and build from the ground up rather than retrofit afterwards. Many energy-saving measures can be highly effective, and long-term energy savings can substantially outweigh the initial investment. However, such measures are often not implemented because of market and institutional barriers. For instance, when offered the choice of paying a few percent extra for energy-efficient construction, the owners of a new building often choose not to, because of the burden on their budget and uncertainty about future savings.

International investment of carbon funds should be aggressively directed to the infrastructure buildup in China to prevent a legacy effect of inefficient technologies. For instance, funds can be used to subsidize low-interest loans to energy-efficient buildings or to pay for technology transfer. Research and development in technology, such as renewable energy, energy efficiency, and carbon sequestration, in the developed countries could be conducted in collaboration with Chinese partners, so that these technologies could be implemented as early as possible.

Rural development must avoid the pollution-heavy and energy-intensive route, instead, incorporating state-of-the-art technology suitable for the local circumstances. City planners should develop more efficient public transportation, reemphasize the role of bicycles, and use incentives and regulations to encourage electric bikes, buses, and cars; to reduce burgeoning traffic and air pollution problems; and to save energy.

The rate of development of renewable energy in China is even faster than that of coal-fired power plants. The 2020 targets for hydroelectric, nuclear, biomass, wind, and solar power are 300, 40, 30, 30, and 1.8 GW, respectively (*12*). Even though China is a top manufacturer of solar heaters, solar panels and wind turbines, core technologies are often not available to them. As a result, the high cost hinders rapid deployment of the most efficient technologies.

Avoided emissions and active carbon sinks deserve credit on the international carbon market. Over the past three decades, the Chinese taxpayers have supported several massive ongoing reforestation projects, such as the northern China project to prevent desertification, with a total area of 60 million ha of new forests. As a result, the country's forest cover increased from 12% in 1980 to 18.2% in 2005 and is projected to increase to 23% by 2020 and 26% by 2050 (*11*). In contrast, only a handful of reforestation projects in China of roughly 10,000 ha have been funded through the Clean Development Mechanism (CDM) under the UNFCCC's Kyoto Protocol, because of a 1% limit on reforestation's share in meeting the Kyoto target of each developed country, the complicated accounting and verification procedures, and the current low carbon market price. About half of CDM investment projects are in China, but they have not been effective at cutting CO_2 emissions (*13*). The Bali climate conference in December 2007 started a new round of negotiations, and substantial progress will have to be made in order to effectively help developing countries like China reduce CO_2 emissions.

China has actively participated in UNFCCC and the Kyoto Protocol and played an important role in the Intergovernmental Panel on Climate Change (IPCC). China and other developing countries are not subject to emission targets under the Kyoto Protocol. For China, this makes coal attractive as an energy source because it is domestically abundant and cheap. To prevent continued reliance on inefficient coal power, developers need a clear market signal that a climate policy, be it international or domestic, is a certainty in the future policy landscape. Under such a policy, inefficient coal plants will become a liability. The Chinese government could set internal emission targets and devise strategies to meet them. For example, a carbon tax in China could be used to fund research in energy efficiency, renewable energy, carbon sequestration, and prudent urban design. Such voluntary efforts would protect China's energy security, create careers for the masses of young and educated Chinese citizens, and also earn China political capital in international climate policy negotiations.

Despite the recent surge of worldwide attention in the climate change problem, its enormous scale and urgency are often underappreciated. The Chinese challenge is arguably the most difficult, and coal is the leading stumbling block. If China can face the challenge and seize the opportunities with the help of the international community, it could lead the world in sustainable development in the 21st century.

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