

**China Issues White Paper on
Science and Technology to
Address Climate Change**

Future historians of the 21st century may one day look back at 2007 and identify it as a critical year in the understanding of and response to anthropogenic climate change. In April, the Intergovernmental Panel on Climate Change (IPCC) released its fourth annual report, which concluded that there is a 90% probability that human activity since 1750 has warmed the Earth. In May, the U.S. Administration appeared to shift its position on climate change, and called for international goals on reducing carbon emissions. And in October, the Nobel Peace Prize was awarded to the IPCC and former U.S. Vice President Al Gore for their work on understanding and communicating human-induced changes to climate. Yet despite these significant events, any long-term solution to climate problems depends in part on the actions of developing nations, and especially on China, because of its increasing role as an emitter of greenhouse gases.

This June, 14 Chinese ministries and scientific bodies issued a White Paper entitled *China's Scientific & Technological Actions on Climate Change*, which gives some insights into the thinking and possible policy directions of China on climate. The White Paper begins by acknowledging that human activities have led to global warming that will adversely affect the ecosystem and human society, noting that China has experienced 21 warm winters in a row and has suffered agricultural losses and threats to economic development as a result. It then establishes principles and targets for scientific and technological responses to global warming. Among these principles are that businesses ("enterprises") should be encouraged to participate in research and development (R&D) that is relevant to climate, through market mechanisms—a notable statement for a nominally communist nation. The targets include improving China's scientific contributions to international work on climate, coupled with enhancing its domestic research capabilities in order to achieve "internationally recognized" competence and results in climate science.

The White Paper establishes technology-development goals for reducing greenhouse gas emissions and mitigating climate-change effects. These fall into three general categories, the first of which includes energy-efficiency technologies that will affect industrial sectors such as electricity generation, metallurgy, and petrochemicals; and renewable energy technologies such as solar power, fuel cells, biomass, and ocean power. The sec-

ond set of goals includes a focus on developing clean-coal and advanced nuclear-power technologies, including coal liquefaction and gasification, the sodium-cooling cycle, and participation in fusion R&D through ITER, an international project to design and build an experimental fusion reactor; and also improved technologies for the exploration and extraction of oil, natural gas, and coal from geologically complex environments. The final set calls for work on technologies to capture and sequester carbon dioxide, particularly in biological systems such as forests, and to reduce greenhouse gas emissions from agricultural production.

While most of the scientific aspects of climate research from China's viewpoint are identical to those of other nations, such as improved climate modeling and prediction, the White Paper specifically notes the importance for China of better scientific understanding of the impact of climate change on the Asian monsoon system, and the potential impact of changes in snow cover of the Tibetan Plateau on the lower reaches of the Yangtze River.

The White Paper concludes with a set of measures and recommendations to ensure the implementation of the goals and principles it has laid out. These measures involve improved coordination and integration of Chinese climate science and technology work, improved research infrastructure, and strengthened international cooperation on science and technology. Notably, they also include a recommendation that financial and capital markets and venture capital should be tapped for investment in technology to mitigate climate change, a call for programs to increase public awareness of climate issues, and an endorsement of efforts to recruit scientific talent from overseas to enhance China's human resources for climate research.

COLIN MCCORMICK

**NRC Advocates U.S. Policies that
Promote Open Exchange of
Research**

To strengthen the essential role that science and technology (S&T) play in maintaining national and economic security, the United States should ensure the open exchange of unclassified research despite the small risk that it could be misused for harm by terrorists or rogue nations, according to a report recently issued by the National Research Council. Because science and technology are global pursuits, U.S. universities and research institutions must continue to welcome non-U.S.-born

science and engineering students, said the committee of former national security leaders and senior university researchers and administrators who wrote the report.

Extreme measures to curtail the flow of essential information or people would significantly disrupt advances that are critical to U.S. military and economic security. Meeting the challenges of future technological or biological threats depends upon developments that can only come from long-term academic research.

"In the years following the Sept. 11 attacks, research institutions have established policies and procedures that address concerns about security," said committee co-chair Jacques S. Gansler, former U.S. undersecretary of defense and vice president for research at the University of Maryland, College Park. "However, both the security and scientific communities agree that losing our leading edge in science and technology is one of the greatest threats to national security. Unnecessary or ill-conceived restrictions could jeopardize the scientific and technical progress that our nation depends upon."

Although National Security Decision Directive 189 (NSDD 189) was enacted to assure that basic research remain open to publication and non-U.S. participation, many government policies and practices have effectively reversed this in recent years, the report said. To ensure that both security and scientific interests are protected, the federal government should establish a standing entity, preferably a Science and Security Commission, that would review policies regarding the exchange of information and the participation of non-U.S.-born scientists and students in research. The report suggests that the commission be co-chaired by the national security advisor and the director of the White House Office of Science and Technology Policy, and include representatives from academic research institutions and national security agencies.

"The U.S. security and research communities need to work together to weigh the latest information about potential threats and ensure the continuation of scientific research that could help mitigate them," said committee co-chair Alice P. Gast, president of Lehigh University, Bethlehem, Pa. "Establishing this standing body would allow the nation to strike the appropriate balance between science and security."

After holding a series of regional meetings on university campuses with a broad range of officials from security and academic research institutions, the National Research Council committee identified specific actions that should be

taken to foster open exchange of scientific research—all of which could be addressed by the proposed Science and Security Commission. They include:

- **Ensuring that grants and contracts awarded to U.S. universities and research institutions do not restrict the publication of unclassified research.** Although the principles and much of the wording of NSDD 189 is incorporated into federal acquisition regulations, contracting officers and universities sometimes overlook them, the report said. In addition, federal funding agencies should make clear to industrial grant recipients that restrictive clauses governing publication or the participation of non-U.S.-born scientists should not be passed down to universities subcontracted to conduct basic research.
- **Reviewing the number of research projects that are categorized as “sensitive but unclassified.”** Numerous concerns have been raised about the increasing use of this designation, which limits the scientific community’s right to publish the results of basic research and restricts participation of non-U.S.-born researchers. A survey that examines the frequency of these restrictions and other restrictive clauses should be performed annually.
- **Working with the U.S. departments of Commerce and State to conduct regular, governmentwide reviews of export-control policy.** Both agencies maintain lists that bar the export of certain technologies and information to other countries. However, many of the restricted items are technologically outdated, widely available, or not controlled in other countries, the report said. In addition, reviews are needed to justify limits on “deemed exports,” which refers to the transfer of information to a foreign national within the United States, such as a non-U.S.-born scientist in a research laboratory or a graduate student.
- **Fostering a productive environment for international science and engineering scholars in the United States.** Non-U.S.-born researchers are significant contributors to U.S. science and technology endeavors, the report said. In fact, between 1990 and 2004, more than one-third of all Nobel prizes in the United States have gone to non-U.S.-born recipients. The success of many U.S. universities and research institutions depends on attracting the best and brightest students both at home and abroad. After tighter visa restrictions were enforced following the Sept. 11 tragedy, international student enrollment decreased dramatically. Although some visa restrictions have been lifted and foreign enrollment is again on the rise, the visa clearance process should continue to be monitored, the report said. In addition, the government and Congress should consider extending temporary visas for those working in high-demand research areas and creating a new nonimmigrant visa category for doctoral and postdoctoral scholars. And the Technology Alert List—which restricts some non-U.S. students and scientists from working on legitimate technologies that could be misused to threaten national security—should be revised to include only areas of study that have explicit implications for national security.
- **Developing policies and procedures for international oversight of biological and life sciences research that could be used for harm.** The government must continue to develop policies and procedures for the oversight of

dual-use life sciences research that fosters international collaboration and control. Local monitoring mechanisms should also be coordinated.

To improve relations between the scientific research and national security communities, universities and federal agencies should create opportunities for university scientists to participate in government security fellowships, and for members of the national security community to participate in university fellowships, the report said. In addition, university leaders must continue to educate administrators, faculty, and students about security, export controls, and other relevant policies and procedures and ensure that they are in compliance.

The report also calls on the National Science Foundation, the departments of Defense and Homeland Security, and intelligence agencies to increase funding for the social sciences, particularly languages and area studies. Such research could improve understanding of the social, cultural, and political bases of terrorism and identify potential responses. The agencies also should fund additional research in security risk assessment and cost-benefit analyses of security strategies affecting university research.

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Copies of *Science and Security in a Post-9/11 World: A Report Based on Regional Discussions Between the Science and Security Communities* are available from the National Academies Press; tel. 202-334-3313 or 1-800-624-6242 or can be accessed at www.nap.edu. □

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