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COMMENTARY

Sector-based Approaches to Measuring and Managing Greenhouse Gas Emissions: China's Cement Industry

By Angel Hsu, Neelam Singh, and Ranping Song

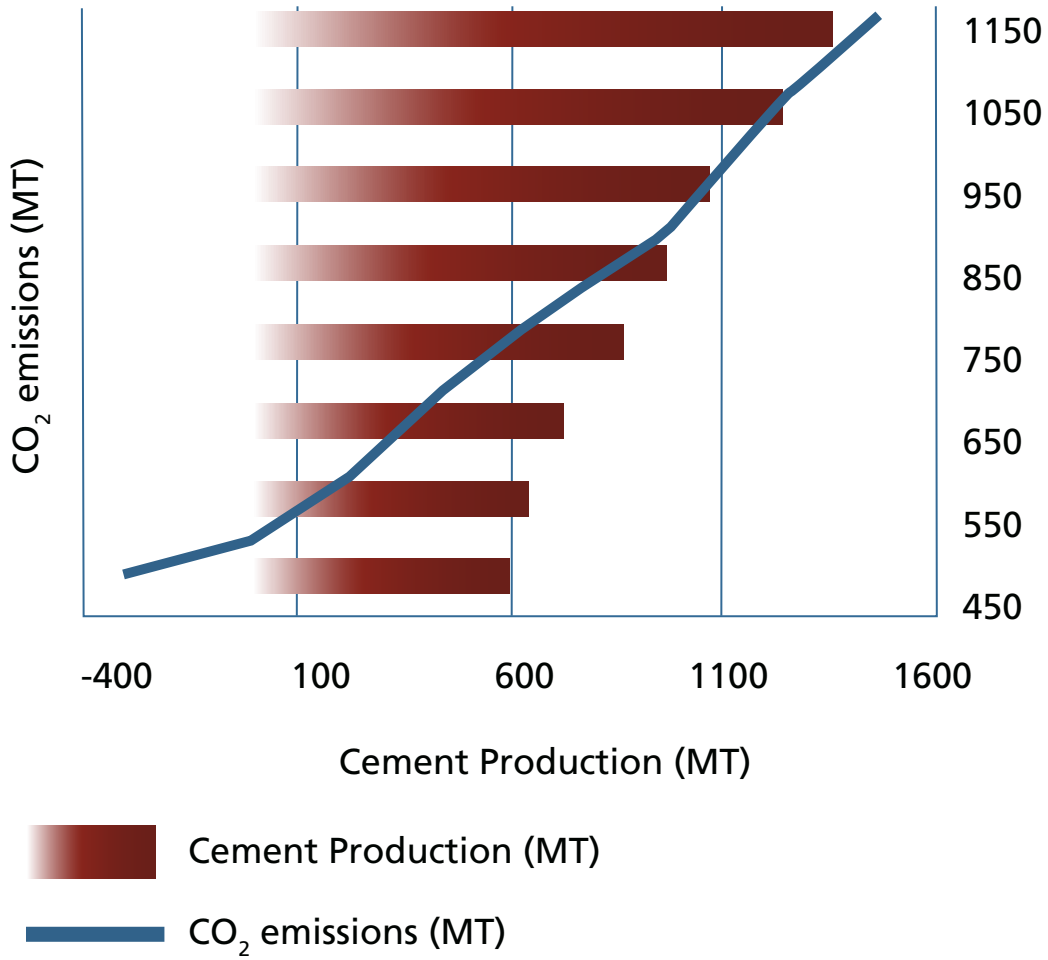
As China's cement industry is responsible for half of global cement production and five percent of total worldwide carbon dioxide emissions (Cho & Giannini-Spohn, 2007), greening Chinese cement companies would have a major impact on addressing domestic energy concerns and global climate change. However, this is easier said than done. Actors—both Chinese and international—have formed multilateral partnerships involving nongovernmental, governmental, and industrial stakeholders to transfer knowledge and expertise to build the capacity of Chinese cement industry. The goal of these efforts is to provide companies with customized tools to measure emissions and plan for key reduction measures following international standards, such as the World Resources Institute (WRI) - World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Protocol. This commentary examines the process by which Chinese cement companies are adopting internationally recognized best practices to take critical, practical steps toward reducing energy consumption and greenhouse gas emissions.

Sui Tongbo of the China Building Materials Academy giving instruction on how to use the Cement Sustainability Initiative Protocol at the Third Workshop on Energy Efficiency and Clean Energy Development in the Chinese Cement Industry, which was held on July 8-10, 2009 in Beijing. Photo Credit: World Resources Institute

CHINA'S CEMENT SECTOR

Increased production of cement has been a result of China's rapid economic expansion necessitating growing infrastructure needs. Over the last two decades, China's cement production has steadily grown over 10 percent per year (NBS, 2009). (See Figure 1). Globally, China has been the leader in cement production since 1986: 1.6 billion tons of cement were produced in 2009, and output is expected to grow to 1.8 billion tons for 2010 (CBMA, 2010). Already, China's cement output from January to May of 2010 was up 19.1 percent from last year during the same period (Cement China, 2010). Domestically, the cement sector is responsible for nearly 10 percent of total industrial energy consumption and more than half of industrial energy use in building materials (IEA, 2007).

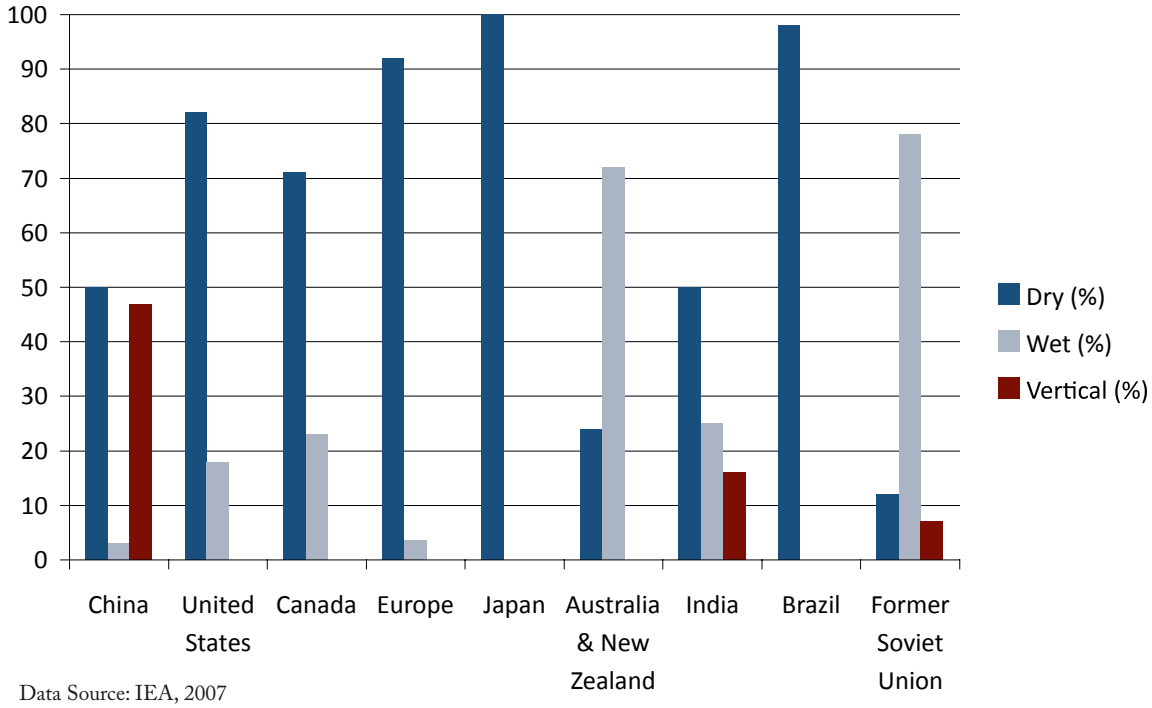
FIGURE 1. CEMENT PRODUCTION AND ASSOCIATED CARBON DIOXIDE EMISSIONS GROWTH (2000-2008)



Data Source: Tsinghua, 2008

Exacerbating these numbers is the overall size and structure of the Chinese cement sector. China's cement manufacturers are predominantly medium- (production totaling 2,000 tons/day) and small-sized firms—those with production less than 2,000 tons/day but still meeting a 5,000 Yuan sales threshold to qualify as a firm. In 2007 small-sized cement firms numbered around 4,670 (92.8 percent), while large firms only totaled 60 (1.19 percent) and medium-sized firms 146 (2.9 percent) (Lei, 2009). Compared to international standards for efficiency, the Chinese cement sector is more energy and resource intensive (Tsinghua, 2008). Almost 40 percent of cement production capacity is based on outdated or inefficient technologies (China Energy Group, 2009). Such outmoded technologies include the persistence of wet cement processes and vertical shaft kilns (see Figure 2), which are known for high energy consumption and severe air and water pollution.

FIGURE 2. CEMENT TECHNOLOGIES AS A PERCENTAGE OF TOTAL USED BY REGION



Data Source: IEA, 2007

Realizing the energy and environmental impacts of the industrial sector, the Chinese government in the Eleventh Five-Year Plan established an ambitious target to reduce energy intensity—energy consumption per unit of gross domestic product—by 20 percent, and environmental pollutants by 10 percent from 2005 to 2010. For the building materials industry, the government set an even greater target of 25 percent reduction in energy intensity; however, most Chinese cement companies lack the capacity to reach such targets, which require baseline energy assessments and continuous environmental monitoring (Price, et al., 2008).

One approach being used to reach these targets is the consolidation and modernization of the cement sector. In 2006 the Chinese government established a set of policies to shut down many of the smaller, less-efficient enterprises while updating the capacity of larger plants by 2010. Key milestones have included: [1]

- the number of cement producing enterprises dropped from 5,000 to 2,000;
- the average scale of corporate production of cement increased to 400,000 tons per company, up from 200,000 tons in 2005; and,
- the top ten cement companies now comprise 20 percent of industrial production, up from 15 percent in 2005.

In 2007, China's National Development and Reform Commission (NDRC)—the main policy implementing body responsible for energy and climate change regulations in China—ordered the shutdown of 1,066 cement plants, with Beijing moving out 13 of its 30 cement plants by 2010 (NDRC, 2007; CCTV, 2009). The central government also set targets for increasing the proportion of dry-process cement manufacturing to 70 percent, up from 40 percent in 2005, and for eliminating implementation of any new vertical shaft kilns (Alves, 2009; IEA, 2007). In the 12th Five-Year Plan, the government plans to continue increasing industrial concentration of cement production; eliminating 389 million tons of

backward cement capacity; and focusing on energy savings and emission reductions (APP, 2010).

The challenges facing policymakers in improving the cement sector led to the creation of a collaborative partnership between international and Chinese actors—described below—to develop the capacity of Chinese cement companies to meet the government's ambitious energy efficiency targets.

A STEPWISE APPROACH TO CAPACITY BUILDING

To address the gap between the government's goals and the low capacity of cement enterprises to meet these goals, a collaborative partnership involving international and Chinese actors emerged in 2007. Under the framework of the Asia-Pacific Partnership for Clean Development-Cement Task Force (APP-CTF), experts from Australia, the European Union, India, Japan, South Korea, and the United States cooperated to build the capacity of Chinese cement companies on greenhouse gas accounting and measurement. This paved the way for a comprehensive program integrating energy use and greenhouse gas emissions.

In 2008, the World Resources Institute (WRI), Lawrence Berkeley National Laboratory (LBNL), China Building Materials Academy (CBMA), E3M Inc., China Cement Association (CCA), and Cement Industry Energy Efficiency and Environmental Protection Evaluation and Test Center, created a comprehensive program in the Chinese cement sector to enhance energy efficiency, increase the use of alternative fuels and raw materials, and reduce greenhouse gas emissions. NDRC, the U.S. Environmental Protection Agency and the U.S. Department of State provided strong support for the program's implementation.

The program's strategy employs a five-step approach focusing first on large cement companies whose output comprises a substantial portion of overall industrial production, and then widely disseminating the results to encourage smaller plants to adopt similar tools and measures, therefore encompassing the entire sector. The first step includes workshops for 42 of China's largest cement plants to provide training in the use of tools to measure and benchmark energy consumption and greenhouse gas emissions. The second phase involves a joint U.S.-China effort to conduct on-site energy and greenhouse gas assessments, and database development for 12 cement plants. Subsequently, the remaining 30 facilities will be added for a total of 42 cement plants that represent over 30 percent of total Chinese cement production. After the development of facility benchmarks, the fourth step is to develop decision-making tools and guidelines for alternative fuels and raw materials and to demonstrate co-processing in six plants. Finally, the tools, activities, and results will be documented and disseminated to enhance capacity building of the entire Chinese cement industry.

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To achieve these reductions, three complementary tools are coalesced based on internationally most credible practices from the partnering organizations and multinational companies. When combined, these tools can help identify and implement energy-efficient technologies and measures, illustrate the benefits of using alternative fuels and raw materials, and allow companies to measure and track

greenhouse gas emissions and other pollutant emissions. These tools are:

(1) Companies can establish a baseline and track carbon dioxide emissions from calcinations process by using the *Cement Sustainability Initiative* (CSI) CO_2 Quantification Protocol—a cement-sector specific tool based on the WRI-WBCSD GHG Protocol that has been implemented in over 700 cement kilns worldwide (WBCSD, 2007).

(2) *The Benchmarking and Energy Saving Tool for Cement* (BEST-Cement)—developed by LBNL in collaboration with the Energy Research Institute, CCA, CBMA, and Shandong University—is used to benchmark cement plants to both Chinese and international best practices in terms of energy consumption and to provide up to 50 energy-efficiency options to be employed in any particular facility.

(3) *The Process Heating Assessment and Survey Tool-Cement* (PHAST-*Cement*) is an energy audit tool customized by E3M, Inc. for the Chinese cement industry from the widely used PHAST tool developed for the U.S. Department of Energy. PHAST provides a detailed process and equipment-level assessment of the cement plant combustion efficiency and is used to analyze effects of energy-saving opportunities.

Since the partnership began in January 2008 with a CSI training workshop in Beijing, NDRC has adopted the comprehensive program as a critical part of its energy and climate change mitigation strategy for the industrial sector. Furthermore, NDRC announced the implementation of the CSI Protocol based on the GHG Protocol as the industry standard for carbon dioxide emissions accounting for Chinese cement companies. Two other training sessions have been held since: November 2008 in Zhuhai, where 16 cement companies received training on the CSI tool, and on July 2009 in Beijing under the new comprehensive program, where 42 cement companies participated in a training workshop on energy and carbon dioxide emissions measurement and benchmarking using the three tools (CSI, BEST and PHAST).

LOOKING FORWARD

These efforts by the government and cement companies in China have led to tangible results and demonstrated "measurable, reportable, and verifiable"[2] actions toward addressing climate change. The program described above

A team of international and Chinese cement experts visits a cement plant in Shandong Province to conduct on-site training with plant representatives and to assist plant technicians in conducting GHG and energy assessments.
Photo Credit: World Resources Institute

represents a sector-based approach in which cement companies both in China and abroad have begun to collaborate to measure, manage, and reduce overall energy consumption and greenhouse gas emissions. Such an approach affords several advantages, not only locally in China but globally as well:

Faster technology transfer and adoption: The direct relationships forged between industrial, governmental, and nongovernmental partners allow for increased technology transfer between industrialized and developing countries. In the case of Chinese cement companies, which still rely heavily on wet-process manufacturing and vertical shaft kilns, technology improvements could make a substantial impact on energy savings and environmental pollution reduction.

Improved data availability and quality: The adoption of internationally recognized, consistent accounting, measurement, and assessment tools and standards in the cement sector will bolster domestic and international confidence in energy and emissions measurement, monitoring, and targets. The systematic calculation and monitoring of energy use and greenhouse gas emissions will enhance overall data quality in the Chinese cement sector, which can then better guide future national discussion regarding sectoral targets and national commitments, strategies, and policies.

Model for other industrial sectors: Based on the early successes and lessons learned from this program, other heavy-industrial sectors within China could adopt this capacity-building model. WRI and WBCSD have worked with many government and industry associations to develop sector-specific tools and protocols for energy and greenhouse gas measurement and management, including iron and steel, power generation, and oil and gas, among others. Similar capacity-building programs and voluntary greenhouse gas accounting and reporting registries have been implemented in other developing countries, including Mexico, Brazil, the Philippines, South Korea, and India through partnerships WRI and WBCSD have forged with local government and NGO partners.

Co-benefits: Limited resources and the absence of official commitments to reduce greenhouse gases under the Kyoto Protocol often prevent developing countries from investing in climate change programs and management strategies. However, this program adopts an integrated approach to reduce energy intensity, greenhouse gas emissions, and criteria air pollutants in cement manufacturing, which is more compelling and appealing for developing countries, where it is often imperative to invest in initiatives with co-benefits. Moreover, the program's focus on going beyond measurement and providing solutions through demonstration of alternative fuels and raw materials and through energy- and cost-saving technology options has help it gain wide acceptance.

Moving forward, the Chinese government could seriously consider adopting the model of the cement sector discussed in this paper for other heavy industrial sectors. In doing so, the country would reap significant benefits from applying internationally-adopted best practices, measurement standards, technology, and tools to its entire industrial sector, which comprised 76 percent of China's total energy consumption in 2006 and is expected to remain above 70 percent through 2030 (IEA, 2009). Such benefits include consolidated sector-based registries and programs that could measure and track progress toward energy intensity and greenhouse gas emission reductions over time and that could provide the basis for cap and trade programs.

While implementing similar approaches in other sectors could be potentially challenging, the early success of the cement initiative is encouraging. The steps that both the government and cement companies in China are taking to reduce their overall energy and greenhouse gas impacts are truly noteworthy and demonstrate a strong commitment to improving the global environment.

The authors would like to thank Pankaj Bhatia of the World Resources Institute for providing valuable comments on this article.

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ENDNOTES

1 These objectives are found in "Notice of Several Suggestions for Accelerating Structural Adjustment of the China Cement Industry," the "Special Planning for Cement Industry Development" and the "Policies for Cement Industry Development" of the Chinese government.

2 The Bali Action Plan, as adopted by the Thirteenth Conference of Parties (COP-13) of the UNFCCC, stipulates future negotiations for a long-term climate agreement should include considerations of "measurable, reportable, and verifiable" nationally-appropriate mitigation commitments or actions.

International Fund for Animal Welfare: Promoting Animal Welfare in China

By Grace Ge Gabriel

An elephant mother and a calf are walking into the sunset on the vast African savannah. The calf excitedly declares,

"*Mom, I got teeth.*"

The mother does not respond. The calf repeats:

"*Mom, I got teeth.*"

"*Aren't you happy I've got teeth?*"

The message further explains:

Babies having teeth should bring joy to a mother.

But what does it mean for elephant families?

Because of people's unnecessary want of ivory, hundreds and thousands of elephants are killed for the ivory trade.

If we don't buy, they don't die.

Say "No" to elephant ivory.

These messages are part of an educational campaign by the International Fund for Animal Welfare (IFAW) to reduce consumer demand for products derived from wildlife, in this case, elephant ivory. In spring 2009, travelers in Beijing's Capital International Airport and those riding subways in Beijing, Tianjin, Guangzhou, and Nanjing began seeing huge posters that featured this message.

In Chinese, elephant ivory is called "*xiang ya*" (meaning: elephant teeth). This nomenclature unfortunately gave people the impression that elephant ivory, like a baby's tooth, can fall out naturally and is, thus, a painlessly obtained, renewable product.

In a 2007 poll, IFAW found that more than 60 percent of the people did not know that the elaborately carved tusks displayed in store windows and the bracelets, signature seals and chopsticks sold on retail markets come from elephants which either died from natural causes or were killed by poachers. Encouraged by the finding that a majority (80 percent) of Chinese would not purchase ivory if they knew its source was a dead elephant, IFAW created the "Mom, I got teeth" poster, hoping that enlightened consumers would make animal-friendly choices. The elephant poster is the first of a series designed to reduce demand for wildlife and wildlife products by highlighting the kinship between animals and people.

Founded on a campaign to stop the brutal commercial hunt of white-coat harp seals in Canada forty years ago, IFAW (www.ifaw.org) has been working in China since the mid-1990s to provide direct care to individual animals, improve government conservation and animal management policies, and encourage wide adoption of the concept of animal welfare. Over the years, we have seen a significant shift in policies and attitudes due, in large part, to IFAW's numerous projects and campaigns in China.

IFAW promotes the adoption of the precautionary principal in conservation policies, international treaties and national laws. We work to enhance the effectiveness of wildlife law enforcement by building capacity through practical training and the provision of information and equipment. We also conduct educational campaigns to motivate the public to reject wildlife products and thus, reduce demand.

Photo Credit: IFAW

Over the years, IFAW has helped to protect species threatened by consumer demand in China such as bears, tigers, elephants and seals as well as the Tibetan antelope, a species endemic to China that is threatened by a demand from luxury markets in the West for "shahtoosh shawls," which are woven from their fur.

The growth of the Internet poses new threats to wildlife. The escalation in global Internet use increases the ease with which traders can fill burgeoning consumer appetites. The rules, regulations and laws governing the trade in endangered species are often complex, diverse and differ from country to country, yet the online trade has no boundaries. IFAW conducts investigations of online markets around the world and provides recommendations to site owners and governments that can enhance regulation and enforcement.

These investigations of online marketplaces in China are critically important because, by the end of 2008, China surpassed the United States as the country with the largest number of internet users (298 million) in the world. Based on the data gathered during online wildlife trade investigations, IFAW developed a routine information-sharing mechanism with law enforcement agencies and private companies involved in Internet commerce. IFAW has alerted enforcement agencies about illegal trade activities (both online and offline), identified emerging trends and helped provide evidence for prosecutions. As a result, online shopping sites promptly eliminated postings of illegally traded wildlife products. In partnership with these sites, we constantly update the list of "key words" to improve the product screening processes Internet companies use to block out illegally traded wildlife products.

IFAW has successfully persuaded major auction and shopping sites to ban the online trade in endangered species. Following their prohibition on offerings of live animals and endangered species, eBay banned the trade in all elephant ivory.

Taobao.com (Chinese for "*Treasure Hunt*"), the largest online shopping site in China, collaborated with IFAW in a public awareness campaign to combat online wildlife crime and set up an online IFAW store to enable users to report illegal wildlife trade activities. In addition to banning the trade of all endangered and protected animals, Taobao also led the industry in China in ending the online trade in shark fin products.

To save China's last Asian elephants, IFAW initiated the Asian Elephant Project in Yunnan in 1999. In the past ten years, the project has helped map out elephant habitat needs, enhance law enforcement to curtail elephant poaching and educate both locals and tourists about the importance of wild elephant conservation.

As an animal welfare organization, IFAW's mandate of care and protection includes

Photo Credit: IFAW

wildlife populations as well as individual animals. Several large seizures of Saker falcons by Chinese enforcement agencies, and a series of failed attempts to release these victims of the raptor trade in the mid-1990s, prompted IFAW to establish the first dedicated raptor rescue and rehabilitation facility in China.

Since opening in 2001, the Beijing Raptor Rescue Center (www.brrc.org), situated on the campus of Beijing Normal University, has received more than 4,000 birds of prey, of which 2,500 were successfully released back to the wild. Adhering to the latest scientific methods in the rescue, rehabilitation and release of birds of prey, and demonstrating the highest animal welfare standards in the care of wildlife, BRRC not only saves individual raptors, but also educates people about threats to wildlife and promotes policies and actions that advance the conservation and welfare of animals.

After the massive earthquake that devastated the lives of millions of people in Sichuan in 2008, IFAW provided a mix of humanitarian and animal aid, operating in five different areas. Field teams distributed food and supplies and provided veterinary advice, primary health care and rabies vaccinations to 18 villages in Zun Dao township, delivering aid to some 1,500 dogs and 8,000 pigs.

Driven by fears of rabies outbreaks, many townships in the disaster area executed an order to kill all dogs. The methods of killing—shooting or beating with a bat—are inhumane, unpopular with local people, and ineffective at achieving the objectives of preventing dog bites and the spread of rabies. In Zun Dao, IFAW worked with local veterinary officials to vaccinate dogs and provide animal care education and training in humane animal control methods.

To enhance the welfare for companion animals, IFAW assists municipal governments in promulgating humane dog regulations that mandate vaccination, encourage spay/neuter to control population and promote responsible pet ownership. In addition to supporting local animal rescue groups that provide care to animals in distress, IFAW established the Animal Resource Center website (www.ifaw-arc.org.cn) where Chinese animal lovers can discuss issues of mutual interest, from individual animal care and adoptions to the need for China to pass anti-cruelty legislation that covers all animals.

While China has a Wildlife Protection Law (1989) that protects endangered wild animals with utilitarian value, there is no law to prevent cruelty to animals. IFAW is supporting draft legislation which would govern the way wild and domestic animals are treated in all situations. A recent online poll of 63,000 people found that 89 percent support an animal welfare law for China.

It is encouraging to see public rising

support for animal welfare in China. Over a decade ago, when IFAW first started working in the country, we intentionally translated the organization's name as "*guo ji ai hu dong wu ji jin hui*," which means "international fund for love and protection of animals." The intention was to emphasize human responsibility toward animals and to address the concern that "animal welfare" might not have been readily acceptable in China.

However, public attitudes toward animals are changing in China. One indication of this change is the number of young people across the country who participate in IFAW's annual animal welfare education campaign—Animal Action Week.

Stepping into its 11th year in China, this campaign is carried out every year in colleges, middle and elementary schools. Animal Action Week fosters compassion, empathy and kindness toward animals. Hundreds of thousands of students embrace animal welfare and take action to benefit animals, from participating in beach clean-ups and organizing petition drives, to putting on school plays and entering art competitions. In sixth-grader Gai Yue's winning entry to his school's composition contest, he questions the quality of life for the turtle his mother bought from the market. He writes, "The turtle's new 'home' is no comparison to the immense ocean environment it was used to." He vows to return the turtle back to the wild, "That's where he really belongs."

For more information about IFAW activities in China, please visit www.ifaw.org or for Chinese www.ifaw.org.cn

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NRDC: Leading the Way Towards Climate Solutions for China

By Li Yang

LAST STOP BEFORE CANCUN—TIME FOR ACTION

Action speaks louder than words. This was truer than ever in the lead-up to the United Nations Framework Convention on Climate Change (UNFCCC) conference in Tianjin, China in October, 2010.

After the December 2009 United Nations climate change conference held in Copenhagen failed to live up to the world's high expectations and after many rounds of international negotiations produced limited substantial progress, it has become very hard to see a clear picture of how the global climate agreement will move forward. Without some renewed momentum, optimism is not high about the December 2010 climate conference in Cancun, Mexico.

This Copenhagen pessimism has made the Tianjin conference—the last "stop" before Cancun—so crucial. Despite, or perhaps because of, the perceived lack of progress on a global climate agreement, there actually has been considerable momentum on country-level actions. Under the Copenhagen Accord, the countries accounting for over 80 percent of the world's emissions have committed to specific actions to be undertaken at home to reduce their carbon emissions. This is a crucial next step in international response and these stories and actions will be a major topic of focus at the intercessional climate meeting in China.

It is notable that the Tianjin meeting was the first time that China is hosting a UNFCCC conference. However, unlike other similar global climate forums, there was not much international or Chinese press coverage about the event. This was a missed opportunity by the Chinese news media, for such stories could have expressed pride in China for hosting a significant international conference and for taking the lead on an issue of global importance. However, keeping such a low profile might have been due to expectation management—the Tianjin conference was supposed to be a pragmatic, problem-solving meeting and not a flashy event.

CHINA'S LOW-CARBON EFFORTS

By the time this publication comes out, NRDC (Natural Resources Defense Council) will have held a side event at the Tianjin conference. As a highly effective environmental advocacy group in the United States and the first international environmental organization to establish clean energy and green building programs in China, NRDC has been actively fostering China-U.S. cooperation on clean energy, energy efficiency and other efforts to fight climate change. At the side event, NRDC's climate experts and Chinese partners offered a detailed look into specific actions that China and other key countries have taken to reduce carbon emissions. In addition to discussing recent progress on efficiency and renewables in China, India, and Mexico, NRDC experts will be releasing reports analyzing China's carbon intensity target and the country's efforts to strengthen its renewable energy legal framework, as well as the carbon emission reductions possible through smart grid

development in the United States and China.

China's rapid development has created urgent environmental and energy challenges, but it also presents a unique opportunity to help shape a low-carbon, sustainable development pathway for China that would have significant benefits for both China and the world.

Since the passage of the Renewable Energy Law in 2005, China's wind, solar, biomass, micro- hydro and other renewable energy sectors have been growing at an incredible speed. China's installed wind power generating capacity has been doubling every year for the past 5 years. The rapidly expanding production of solar photovoltaic products now accounts for 40 percent of the global total. According to the European Photovoltaic Industry Association, 4 of the top 10 global solar battery corporations are Chinese companies. The Chinese government has made great progress on meeting the self-imposed targets to reduce energy intensity (energy used for generating per unit of GDP) by 20 percent by 2010 compared with the 2005 level. In the last few months of 2010 there will be some final aggressive actions to meet the energy intensity goals.

URGENT NEED TO DEVELOP LOW CARBON CITIES

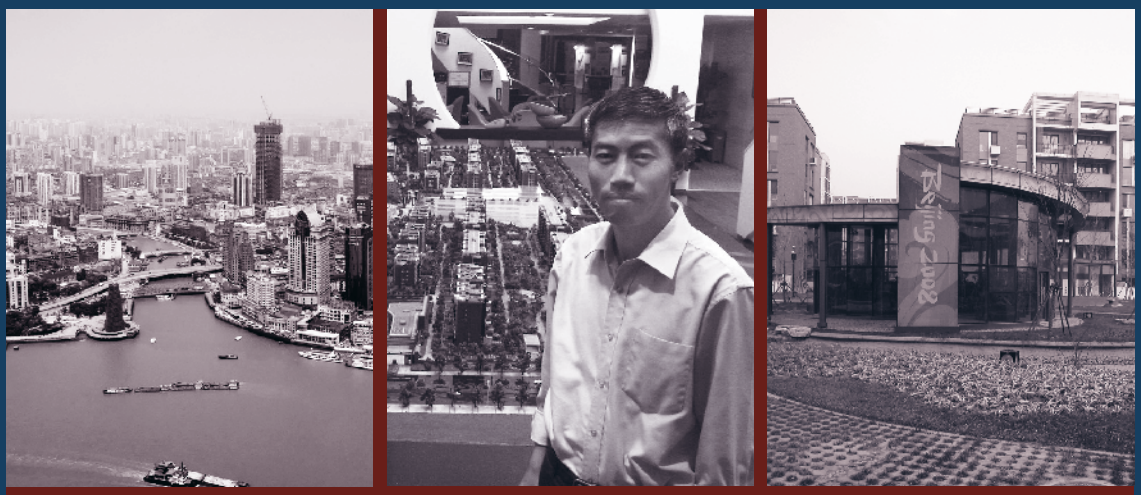
In the wake of the Copenhagen commitments to lower CO_2 intensity as a percentage of GDP by 40-45 percent, dozens of Chinese cities have announced low carbon development plans. Fifteen years ago when NRDC first began doing energy work in China the country had an energy surplus and there was no political agenda to lower CO_2 emissions or progressive energy efficiency policies. In the early 1990s no city planners talked about low carbon growth or even had heard of the concept of a "green building." Given that half the world's 4 billion square meters of new buildings built every year are located in China, the country holds enormous potential to harnessing the power of sustainable construction and helping curb greenhouse gas emissions. If China's urbanization boom creates inefficient buildings, the lock-in effect will cause huge energy waste in the coming decades.

NRDC has spearheaded the promotion of green buildings in China, helping the central government craft national energy codes for commercial and residential buildings and develop green building standards. NRDC's green building experts also have provided technical assistance on several flagship green building projects in China, including the Agenda 21 building in Beijing, which is the first in China to earn a LEED (Leadership in Energy and Environmental Design) certification. Built with just 5 percent additional cost, this building uses 74 percent less energy and 64 percent less water compared to conventional office buildings in China.

In 2008, NRDC worked with Olympic officials to green the Beijing Olympic Village, a 160-acre complex with 42 buildings housing athletes during the Olympics that has since been converted into residential apartments. Through more than 20 advanced green technologies, including heating and air-conditioning from solar and geothermal heat pumps and electricity from rooftop wind turbines, the buildings are at least 50 percent more energy efficient than average Beijing residential buildings, and reduce carbon dioxide emissions by 67,000 tons per year. The Olympic Village was awarded with a LEED-Neighborhood Development Gold certification. From individual green buildings to green neighborhoods, NRDC is now bringing these successes onto a larger scale of sustainable city planning and low carbon city development.

EFFICIENCY POWER PLANTS

With some 350 million more people moving from China's rural areas to its cities in the next two decades, the country is facing an unprecedented challenge in meeting its roaring energy demand. Efficiency is actually



1-The city of Shanghai and Huangpu River, Credit: (c) istock; 2-Professor Jin Ruidong, Director of Green Buildings Project of NRDC-China, is one of the most senior green buildings experts in China. Credit: (c) NRDC China; 3-Buildings in the Olympic Village are over50 percent more energy efficient than the average Beijing residential buildings, and reduce carbon dioxide emissions by 67,000 tons per year. Photo Credit: (c) NRDC China/ Jin Ruidong.

the cheapest, fastest, cleanest and most reliable energy resource. NRDC is adapting lessons learned through 25 years of experience as the top Demand Side Management (DSM) policy advocate in the United States to help China's cities and provinces develop large-scale DSM programs to fund investments in energy efficiency. The goal of these initiatives is to help provinces enact policies that will provide incentives for businesses to improve their efficiency. Together with improvements in end-use energy efficiency, these virtual "efficiency power plants" can satisfy energy demand rather than building conventional power plants. In 2005, NRDC partnered with the government of Jiangsu Province and the State of California to establish China's first large-scale provincial DSM program. As a result of this partnership, the Jiangsu DSM program currently provides 100 million Yuan (approximately $ 15 million) in annual government incentives for industrial enterprises to improve their energy efficiency. These investments in energy efficiency have already helped to reduce the province's peak load by 580 megawatts, which saves 2 terawatt hours of electricity and reduces carbon dioxide emissions by 1.8 million tons each year.

All these on-the-ground projects and demonstrations that NRDC has been carrying out with Chinese partners are aimed at exploring and showcasing the concrete solutions for combating climate change in China and in other developing countries. How to further enhance these concrete actions, among other things, is the main substantial issue that world leaders should look at during the upcoming Tianjin conference. These action and not words will be among the key steps towards a more fruitful conference in Mexico.

NRDC's Switchboard Staff Blog contains many articles on the global climate dialogues and China's energy/climate policies: www.switchboard.nrdc.org/blogs. Jake Schmidt, the international climate policy director of NRDC will be blogging on the key steps on global warming that will need to be agreed to in Cancun at: http://switchboard.nrdc.org/blogs/jschmidt/key_steps_on_global_warming_in_mexico.html.

For more information on NRDC's energy and climate in China and beyond see: www.nrdc.org and www.greenlaw.org.cn.

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COMMENTARY

Averting Another Toxics Disaster in China

By Arlene Blum

Rarely does a week go by in China without a report of a serious chemical pollution problem—melamine in baby formula, workers with lead poisoning, or fish die-offs from industrial effluents. Chinese authorities closed several metal smelters in 2009 over community outrage when thousands of children were diagnosed with excessive lead levels in their blood. The Chinese government is increasingly concerned how to mitigate the environmental and health costs of toxic chemicals and the growing citizen unrest linked to toxic pollution. However, lowering toxic chemical pollution is a major challenge for China, which has become the factory of the world.

TUG-OF-WAR OVER HALOGENATED FLAME RETARDANTS

Nearly one thousand scientists from around the globe gathered in Beijing from 23-28 August 2009 at the Dioxin 2009 meeting on persistent organic pollutants (POPs) to present their research findings and discuss toxics problems in China and worldwide. POPs are chemicals that are persistent (they do not break down into safer chemicals in the environment for many years); bioaccumulative (they accumulate in plants and animals, becoming more concentrated as they move up the food chain); and toxic. All of the 21 chemicals currently designated as POPs by the Stockholm Convention belong to the family of halogenated chemicals, where carbon is bonded to a halogen such as fluorine, chlorine, bromine or iodine. The Dioxin 2009 meeting included numerous research reports about halogenated flame retardants, a class of chemicals that are being found at increasing levels in humans and animals throughout the world. When certain toxic flame retardants are banned, companies often switch to using other chemicals of similar structure and toxicity, the health impacts of which have not yet been identified.

Dioxin 2009 affirmed China's commitment to reducing such toxics and working towards a POPs-free world. During an opening ceremony worthy of the Olympics, a dozen welcoming speeches were heralded with trumpets and drum-rolls. Talented young singers and dancers clothed in vibrant red and gold silk performed environmental songs and skits. A dynamic rock group, singing about protecting the environment, was flanked by two large screens with images of environmental devastation, flaming oil wells, and deforestation.

Yet only a month later in Shanghai, at a much larger event, a scenario for further worsening toxics problems from flame retardants began to unfold. A multitude of flame retardant chemical producers and buyers thronged the Shanghai Expo Centre for the Fourth International New Flame-Retarding Technology and Flame-Retarding Material Industry Exhibition from 23-25 September 2009. The expos are one of many strategies to promote the use of flame retardant chemicals in China. (See http://www.flameexpo.com/en/). When it comes to the

production and use of flame retardants, China is in a tug-of-war with the protection of the citizen health and environment pulling in one direction and profit-seeking foreign companies pulling in the other.

GLOBAL HEALTH AND ECOLOGICAL THREATS

The increasing production and use of halogenated flame retardants in China poses a threat to the health of China and the world. These compounds are ubiquitous and have been detected in human tissues, marine mammals, house dust, soil, air, water, and most biological or environmental media collected from all over the planet. In lab animals, they can cause neurological and reproductive impairments; cancer; attention-deficit/hyperactivity disorder; infertility; reduced sperm count and endocrine disruption; cryptorchidism (undescended testicles); and hypospadias (a penile deformity), among other health disorders. In humans they have been associated with reduced IQ; increased time to pregnancy; changes in thyroid hormones; undescended testicles in infants (a condition associated with a higher cancer risk later in life); decreases in sperm quality; and function and alterations in the levels of male hormones.

The increasing production and use of halogenated flame retardants in China poses a threat to the health of China and the world.

In addition to being hazardous during production and use, halogenated flame retardant chemicals often return to China and pose a threat at the end of their life as e-waste. For example, plastic cases of electronics and other consumer products laced with flame retardants are sent to China from around the world for disposal. When burned, they convert to highly toxic dioxins and furans, which can remain in the human body and the atmosphere for decades. It has been estimated that the primitive recycling of thousands of tons of pentaBDEs contained in e-waste releases tons of brominated and brominated-chlorinated dioxin/furans into the environment. In open burning e-waste areas in China, the measured levels of dioxins in soil exceeded allowable soil standards. Worldwide, pentaBDE flame retardants have been shown to be the major precursor chemicals for this severe environmental contamination from dioxins.

In China's e-waste disposal regions, the air, soil, and water as well humans and animals contain some of the highest levels of halogenated flame retardants and their combustion products in the world. Researchers have reported that flame retardants blood levels in workers in the electronics dismantling center of Guiyu—China's biggest e-waste city in Guangdong Province—are, on average, nearly 600 parts per billion, some of the highest amounts reported in humans. Remarkably, in the flame retardant production area of Laizhou Bay, residents have recently been found to have levels comparable to those found in Guiyu. The Guiyu and Laizhou Bay levels are 10 times higher than average levels in the United States and more than 100 times higher than levels in Europe and parts of China not impacted by the chemical or e-waste industries directly.

Not only are halogenated flame retardants associated with health risks to production and recycling workers, and consumers, the overall benefit of flame retardants in increasing fire safety has not been proven for use in furniture and other consumer products. While halogenated flame retardants may somewhat reduce the time for a material to ignite and the heat released, at the same time they considerably increase the carbon monoxide, toxic gases, and soot emitted once the fire has begun. Most fire deaths and fire injuries result from inhalation

of these gases and soot. More effective and less dangerous ways to increase fire safety include reducing smoking; using smoke detectors and/or sprinkler systems; and better enforcement of fire safety standards.

Since smoldering cigarettes are the major cause of fire deaths, the United States and the European Union now require "fire-safe" cigarettes. Bands of thick paper in these self extinguishing cigarettes reduce the flow of oxygen. If left unattended or if the smoker falls asleep, the cigarette will extinguish itself when it burns to one of these "speed bumps," rather than smoldering long enough to start a fire. China, with the largest number of smokers in the world, could reduce fire hazard by requiring fire-safe cigarettes rather than by adding chemicals to all the potentially flammable items in homes and public places.

… plastic cases of electronics and other consumer products laced with flame retardants are sent to China from around the world for disposal.

SHIFTING MARKET FOR HALOGENATED FLAME RETARDANTS

Given the health and environmental hazards and lack of proven fire safety benefit, many scientists, environmentalists and even the International Association of Fire Fighters oppose the use of chemical flame retardants unless there is a proven need and alternative methods are not effective. Nonetheless, their use is being actively promoted in China by the three major flame retardant producers: Albemarle, Chemtura, and Israel Chemicals Ltd. As the European Union and the United States are reducing their use of halogenated flame retardant chemicals—the most toxic variety—these three companies are turning to China for both manufacturing and sales The market share for halogenated flame retardants is estimated to be 20 percent and declining in the European Union and the United States, while it is 55 percent and growing in China. The production capacity of flame retardants in China has gone from 50 kilotons in 1993 to 350 in 2006 and continues to grow rapidly.

The production of brominated flame retardants—the most toxic and persistent of the halogens—has a 30-year history in China. About 70 different varieties of brominated flame retardants are produced, primarily in Shandong and Jiangsu provinces. In 2010, the demand for brominated flame retardants in China should reach approximately 200,000 tons. In addition, in China the manufacturing of chlorinated paraffins as flame retardants and for other uses is growing exponentially. About 60,000 tons of chlorinated paraffins, currently under review to be listed as a POP under the Stockholm Convention, were produced in China in 2007. The growth in production of brominated and chlorinated flame retardants is expected to further accelerate as the major producers of these chemicals work to expand their manufacturing and markets in China.

Chemtura recently moved its Asia-Pacific headquarters from Singapore to Shanghai and has opened a new Application Development Center in Nanjing. Albemarle entered into a joint venture in December of 2008 with Sinobrom, extracting bromine directly from the Shandong brine fields. One motivation for this investment is the high profitability of these chemicals. Albermarle's profits rose 377 percent in 2009 compared to 2008, powered by an increase in the sales of brominated flame retardants. These three bromine producing companies have a history of proposing and supporting flammability requirements that would increase their sales, independent of whether a fire safety benfit has been established

When a regulation for a flammability standard for public places in China was promulgated by the Ministry of Public Security in July 2008,

prior to the Olympics, the advertising literature for the Annual Flame Retarding Expo in Shanghai proclaimed, "The enforcement of such a requirement will definitely bring a bright prospect to China's flame-retarding industry." Not surprisingly, the potential adverse health and environmental impacts are not discussed in the promotional literature.

Seeking Less-Toxic Alternatives

One potentially positive trend is that China could take the lead in the production of safer alternative non-halogenated flame retardants based on phosphorus. China has the largest supply of the basic phosphorus raw material in the world, located in Yunnan and Sichuan provinces. Chinese scientists are working to develop new phosphate flame retardants as safer alternatives to those currently on the market. It would be beneficial for the Chinese ministries of environment and commerce to discuss opportunities to work together to speed the development and use of phosphate flame retardants, while discouraging the production and use of the more hazardous halogenated flame retardants. This shift to safer flame retardants would benefit China and the world.

A TOXICS DÉJÀ VOUS

Decision-makers in China need to be informed about the history of adverse impacts of such chemicals to prevent a repeat and amplification of problems in the past. This unfortunate history began with poisoning in the state of Michigan, where in 1973, one ton of a brominated flame retardant called polybrominated biphenylether (PBB) was inadvertently mixed with animal food being produced in the state. The toxic chemical moved from farm animals to milk, eggs and meat, ending up in humans. Millions of farm animals that had consumed the toxic mixture had to be killed and humans with high levels of exposure had increased risks for some cancers. This situation evokes parallels to the recent food safety scandal in China caused when melamine, a flame retardant, was added to dog food and infant formula.

The addition of the fire retardant pentabromodiphenyl ether (pentaBDE) to polyurethane foam in furniture and baby products in the United States is another example of a case where the potential harm far exceeded the fire safety benefit. After pentaBDE was found to be highly toxic and persistent, the United States ceased production in 2004. Production in China continued until May 2009, when pentaBDE was listed as a POP under the Stockholm Convention. The primary replacements are from similar chemical families that share similar properties and likely adverse impacts.

Although the flame retardants are only required for California furniture, all Chinese furniture being exported to North America contains flame retardant chemicals. In addition, leftover foam treated with chemicals is exported to North America for use in bonded carpet cushion insulation. To meet the demand, thousands of small foam and furniture factories throughout southern China produce flame retardant foam and furniture for export to North America. Workers wearing little protective gear add chemicals to the foam before cutting and producing the furniture. The chemicals are also a threat to the health of villagers who live adjacent to these small factories and to farmers who grow rice and vegetables nearby.

Clearly driving the use of these chemicals in products made in China is the lack of regulation of them by importers, like the United States. For example, why have toxic pentaBDEs been replaced with other toxic flame retardants (such as chlorinated tris and Firemaster 550) without government oversight? One problem is that the U. S. Environmental Protection Agency does not currently have the authority to regulate such potentially toxic chemicals. The Safe Chemicals Act of 2010, recently introduced into the U.S. Congress, proposes

to solve this problem by amending the Toxic Substances Control Act of 1976 (TSCA), to require industry to test industrial chemicals before they are used in consumer products. If passed, this new legislation should help protect American consumers well as Chinese workers and citizens who live in the manufacturing and waste disposal regions of China from toxic and untested chemical flame retardants.

Primarily used in North America, pentaBDE and its replacement flame retardants are now found in high levels throughout the world in creatures at the top of the food chain such as marine mammals, birds of prey and humans. These chemicals can persist for a very long time. Retardants, such as PBBs, banned more than three decades ago, are still present and problematic in sediments and wildlife.

The Beijing Dioxin 2009 meeting included research showing brominated flame retardants in both giant and red pandas, in fish on the Tibetan Plateau, in dolphins and porpoises in the Pearl River Delta of South China, as well as in frogs, birds of prey, and human breast milk throughout China.

CHOICE FOR POPS-FREE WORLD

Given the potential dangers an important question is whether the production and use of toxic halogenated flame retardants should continue to increase in China. As the flame retardant industry works to expand its scope, government decision-makers are pulled in

On the bridge at the Western Academy of Beijing, a pre-K-12 international school in Beijing China where the Green Science Policy Institute Fire Retardant Dilemma meeting was held in August 2009.

From L-R: Mike Bilan (IB Biology instructor), Erika Helms (Executive Director, Jane Goodall Institute, China), Michael Crook (Founder, Western Academy of Beijing), Arlene Blum (Executive Director, Green Science Policy Institute), Seungmin Cho (Student), SooJin Yim (Student), Trish Smith (Director of Development, Western Academy of Beijing)
Photo Credit: Arlene Blum

conflicting directions. Will they listen to their scientists' research as presented at the Dioxin 2009 meeting in Beijing and strive for a POPs-free world or will they listen to the chemical industry as at the Flame-Retarding Industry Exhibition in Shanghai and build more plants to produce halogenated flame retardants with the potential to pollute China's land and people? Their decision could have a major impact on the health of China and the world.

To share information about health and environmental impacts of halogenated flame retardant chemicals, the Green Science Policy Institute hosted a workshop on 22 August 2009 at the Western Academy of Beijing. Distinguished U.S. and Chinese scientists presented information about the dangers of increasing production and use of halogenated flame retardants in China. Their lectures, some of which informed this article, are posted in both Chinese and English at: http://greensciencepolicy.org/flame-retardant-dilemma-beijing-22-august-2009

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COMMENTARY

Will China Emerge Greener from the Global Economic Downturn?

By Leo Horn-Phathanothai

Dreadful as their consequences are, economic downturns are not always all bad news. For one, they tend to be good for the environment, as economic bustle is strongly correlated with energy consumption and environmental pollution (whether in one's own backyard or that of someone else). And economic recessions give pause for thought, and cause for healthy self-questioning. They offer that most precious of gifts for policymakers: the chance for a fundamental change of tack. As Rahm Emmanuel put it: "you never want a serious crisis to go to waste."

The current global economic downturn presents China with an historic opportunity to reorient its economy onto a more stable and sustainable path. It has exposed the structural imbalances that are at the root of China's current economic vulnerabilities and its profound social and environmental malaise. At the same time the crisis calls for a counter-cyclical boost that could potentially unleash massive resources for a transformative green push to the economy. In other words China's stimulus package could serve as a crucial lever in nudging the economy on to a greener trajectory.

GREEN STIMULUS GOALS

There are grounds for optimism. The Chinese government won much praise for its bold and speedy response to the unfolding global crisis, announcing its largest ever stimulus program as early as November 2008, well ahead of other major economies. A March 2010 Pew report noted that in 2009 the green investment from the stimulus along with other programs led China to become the global leader in clean technology investment, at a rate nearly twice as much as the United States invested. And the Chinese government has made laudable progress towards reaching the ambitious environmental targets it has set itself. In April 2009, China joined other G20 leaders in pledging to "make the best possible use of investment funded by fiscal stimulus programs towards the goal of building a resilient, sustainable, and green recovery."

The stimulus package is impressive in its sheer scale: 4 trillion Yuan ($586 million)—equivalent to 16 percent of China's gross domestic product—has been committed as part of the package. This has been accompanied by an unprecedented expansion of credit: in the first quarter of 2009 Chinese bank lending increased to more than 5 trillion Yuan, which is almost triple the credit level reported during the same period in 2008.

The signs are that China's economic rescue package is working. The World Bank and the International Monetary Fund revised their 2009 growth forecast for China upwards by 0.7 and 1 percent, respectively from the 6.5 percent predicted at the beginning of that year. Macroeconomic analyses indicate that China's economy had returned to a stable track by the end of the second quarter. China's economy seems to have bottomed out.

What is more difficult to assess at this point, is how sustainable these early 'successes' are, and at what cost they may have come.

HOW GREEN?

Whether or not China will emerge greener from the current economic downturn will depend on the following, in increasing order of importance: (1) the proportion of the stimulus package earmarked for environmental purposes; (2) how the different components of the stimulus package stack up in environmental terms (i.e., the overall environmental implications of the stimulus package); and (3) the extent to which the stimulus is being used to support a broader shift towards to a more environmentally sustainable growth path. The emerging evidence is discouraging on all three counts.

Of greater concern there are signs that, in its 'all-but-the-kitchen-sink' approach to stimulating the economy, the government has systematically placed environmental concerns as the lowest priority.

There are some notable green features to the economic stimulus package, but these have been modest in size. Initially, 9 percent of the investment package—amounting to 350 billion Yuan ($51 billion)—was set aside for "biological conservation and environmental protection." When the details of stimulus package were approved by the People's Congress and announced in March 2009 however, this amount was cut down to 210 billion Yuan ($ 31 billion) or just over 5 percent of the total package. In contrast to the speedy disbursement of funds for infrastructure projects, as of June 2009, only 10 percent of that amount had been disbursed.

There are broader environmental opportunities within the package however. The environmental benefits that would result from directing the much larger spending for infrastructure and technology toward clean and energy-efficient solutions would far outweigh those that can be achieved through the 5 percent allocation alone. For example, the 280 billion Yuan ($41 million) allocated for housing projects could be a major boost for improving energy and water efficiency in buildings. Likewise, the 1.8 trillion Yuan proposed for the transportation sector and the power grid could deliver strong environmental benefits if focused on public transit systems and linking renewable energy sources to transmission lines. A recent report by HSBC estimates that 37.8 percent of China's stimulus package may be considered 'green' if such opportunities were realized.

To date, however, the bulk of the stimulus spending is being funneled into energy-intensive sectors and large infrastructure projects, many of which have been on the books for years but slowed or halted by negative environmental assessments that are now being overridden in the interests of salvaging the economy. A similar story can be told of the massive injections of credit: because of the way the Chinese financial system is hard-wired, much of this new lending is channeled into the highly polluting construction, manufacturing and infrastructure sectors, the latter two of which are already plagued by overcapacity.

So far the main beneficiaries of the stimulus seem to have been cement, iron and steel producers. This is hardly surprising for an economy that invests over 40 percent of its GDP in infrastructure. Crude steel output in China rose to a record 266.6 million tons in the first half of 2009, as the stimulus spurred demand from the construction and automobile sectors.

Of greater concern there are signs that, in its 'all-but-the-kitchen-sink' approach to stimulating the economy, the government has systematically placed environmental concerns as the lowest priority. The roll back of Environmental Impact Assessments—through the establishment of a fast-track system, ironically called the green passage—is a surface sign of deeper power shifts within the Chinese government.

BATTLEGROUND LINES

Just as the Songhua River chemical spill in northeast China brought to the boil simmering tensions between 'pro-environment' and 'pro-growth' lobbies four years ago—culminating in the forced resignation of the then environment minister—so is the stimulus proving to be a battleground for diametrically opposed visions and policy programs.

The fault lines are broadly the same this time round.

On one side are those who recognize that the current mode of growth is socially and environmentally unsustainable and economically unsound and advocate for a response to the crisis that would address fundamental imbalances in the economy. I would call this the 'rebalancing' camp. The Ministry of Environmental Protection (MEP), the National Bureau of Statistics, the People's Bank of China and many prominent academicians, policy advisors and think tanks seem to fall in this camp. They have all voiced concerns that the current stimulus package may be exacerbating Chinese imbalances.

On the other side are those who maintain that the overriding priority is to safeguard jobs and that the only proven way to do so is to expand infrastructure, and prop up manufacturing and exports by throwing money at those same polluting and energy-hungry industries that have been the powerhouse of China's economy over the past two decades. Call this the '8 percent' camp, as that is widely taken to be the minimum rate of growth needed to prevent spiraling unemployment and ensuing social unrest. Eight percent is also, unsurprisingly, the target rate of growth that Prime Minister Wen Jiabao has vowed to reach. Municipal leaders, the Ministry of Commerce, the Ministry of Finance and the State Council at large seem to fall squarely in this camp.

This crisis should have strengthened the hand of the 'rebalancing' camp. It threw in to sharp relief the structural weaknesses and vulnerabilities that the 'rebalancing' camp had been cautioning against long before the crisis occurred. The need for a robust counter-cyclical boost to the economy offered the opportunity of marshalling resources on an unprecedented scale towards stimulating new, 'greener' sources of economic dynamism and growth. Spurring green innovation would not only create green-collar jobs but also strengthen economic competitiveness. The crisis provided an occasion for cash-rich China to purchase state-of-the-art environmental hardware at rock-bottom prices from developed economies in disarray, to speed up its industrial upgrading, build its technological capabilities and strengthen its competitive edge.

However, all the signs are that the '8 percent' lobby is getting the upper hand. MEP appears to have been sidelined once again: in June 2009 China's Environment Minister Zhou Shengxian, publicly voiced concern about the escalating environmental risks and impacts of the economic stimulus plan. Environment Vice-Minister Pan Yue—once the government's most outspoken environmental champion—has been stripped of his responsibilities as environmental enforcer and has been conspicuous by his absence from the political scene since the beginning of the crisis. The new vice-minister in charge of environmental assessments, Zhang Lijun, has announced that most stimulus projects will be eligible for fast-track environmental approvals.[1]

Meanwhile, Finance Minister Xie Xuren has reiterated Beijing's commitment to continue with the current policy response. Michael Pettis, a finance professor at the Beijing university

lamented in a recent blog that: "policy is still being managed largely by policymakers who are far more worried about rising unemployment in the short term than about asset bubbles and an exacerbation of the unbalanced development model."

China is certainly to be commended for its bold and swift response to the unfolding global financial crisis. Yet, as Gandhi once famously said: "speed is irrelevant if you are going in the wrong direction." Unfortunately, China's response so far seems to be reinforcing the structural imbalances that are at the root of its economic vulnerabilities and environmental ills.

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ENDNOTES

[1] According to MEP only infrastructure and public welfare projects would be able to obtain fast-tracked environmental reviews. But infrastructure account for about half of the spend, while many other items—such as rural development, health care and post-earthquake reconstruction—are also subject to exemptions as they are classified as 'improving public welfare.'

COMMENTARY

Facing Five-Year Delay in New Water for Beijing: A Catalyst for Officials to Limit Growth?

By Wang Jian and Jonathan Aloisi

Beijing has long been a thirsty city. The rapid growth of this booming metropolis has sparked four water crises dating back to the 1960s. So far, the city has managed to cope, but only by first marginalizing its surface resources, then by overexploiting subsurface supplies, and finally by using political clout to control water from similarly dry neighboring provinces. The environmental, economic and social costs of these strategies are enormous. The latest plan to boost water supply and subsidize Beijing's further growth, the South-North Water Transfer Project (*nanshui beidiao gongcheng*), was supposed to bring significant new water to this dry city from the Yangtze River by 2010. Recently, however, officials have announced that no new water will reach Beijing via that channel before 2014. This ensures that Beijing's current water crisis will extend into the new decade, even if the ten-year drought ends in 2010.

City leaders have responded to the delay of water transfer from the Yangtze by promising further reductions in industrial and agricultural water use and expanded treatment and reuse of wastewater. These efforts will help, but will barely compensate for the now postponed transfer of 10 billion liters of Yangtze River water annually. Technical difficulties and the general lack of water in North China will limit the capital's ability to expand purchases from neighbors to fill the gap. This leaves Beijing facing tough choices. Continued over-exploitation of subsurface water is inevitable, at least for the next five years, even if the city grows little. The shock of this reality could help Beijing's leaders to take steps limiting Beijing's further population growth. If they do, it will be the first time over 50 years that they match such rhetoric, a staple in planning documents for decades, to resource constraints.

BEIJING'S DILEMMA

Decades of population growth and water-intensive economic development choices have left hundreds of millions with insufficient access to water across North China. The impact of overuse of limited water resources on the environment is obvious and well documented. Over the past 20 years, reservoir levels have fallen and rivers have dried up across the North. In 2007, estimated per capita water resources for Beijing residents stood at about 200 cubic meters per year, only one-tenth of China's national average (which itself is only one-fourth of the global average). Worldwide, Beijing is dead last in estimates of per capita water resources among the world's approximately 120 national capitals ("World and Chinese water crises," 2009). [1]

Chinese authorities are aware of the consequences of unsustainable growth, and formal plans for future development since the 1950s have included resolute statements on the need to limit future population growth in Beijing. [2] In practice, however, authorities have never once adhered to these guidelines and population growth has always exceeded stated limits. Beijing's official population figure has risen from 4.14 million in 1949 to over 17 million in 2007 in a fairly constant expansion. The

city's built-up urban area has correspondingly increased from 346 square kilometers (km²) in 1949 to 1,254 km2 in 2006.[3] Beijing planning documents have estimated the city's urban area will extend to 1,650 km2 by 2020, despite projecting only modest population growth.

In addition, Beijing residents' per capita water usage increased steadily over the past 50 years. In 1949, the figure stood at an estimated 14 liters per person per day. By 2000, that figure had increased 18 times to 259.6 liters per person per day ("Geology," 2000). What has driven Beijing's increases in water consumption? One critical factor has been the creation and expansion of the city's industrial sector. In 1949, Beijing was an administrative and commercial center. By 1963, driven by explicit policies to make the city a showcase of heavy industry, Beijing had become one of China's largest centers of metal refining, power generation, chemical production, machinery, textile and papermaking industries. Beijing's agricultural development also contributed to city's first two water crises. In 1949, agriculture in Beijing involved minimal non-rainfall water use. By 1958, the area of irrigated farmland increased almost seven times to 95,000 hectares. By 1965, irrigated land area reached 229,000 hectares. [4]

THE WATER CRISES BEGIN

During the drought year of 1960, demand far exceeded supply, sparking Beijing's first water crisis. The Guanting reservoir system, built in the 1950s primarily to prevent local flooding, became an important resource for addressing Beijing's short-term problems. As demand for water continued to increase, Guanting, and later Miyun reservoir, became important regular sources of supply. Over time, increases in demand greatly exceeded the capacity of Beijing's two reservoirs to maintain water levels, eventually leading to their marginalization as a source of additional water ("Geology," 2000). [5]

When rainfall again dropped in 1972, Beijing met demand by initiating a massive well drilling campaign enabling total water consumption to continue rising. Beijing's water usage peaked during 1980 at approximately 4.78 billion cubic meters per year.[6] When rainfall fell below average again from 1980-1984, Beijing faced its third water crisis. Municipal leaders greatly intensified pumping of subsurface water. In order to ensure household supplies, they also severely limited water use by agriculture, and supplies to many industrial enterprises were restricted to four days per week for a period. During this time, Beijing permanently ceased providing water to Hebei and Tianjin, which it had consistently helped supply in the past. The 1980s crisis finally resulted in serious moves to increase the efficiency of water use. While Beijing achieved significant increases in efficiency of water use in agriculture and industry, and total consumption dropped from their 1980s peaks, the continued rapid expansion of the city's economic base and population ensured that total water use stayed well above sustainable levels.[7]

Matters came to a head again as Beijing's current drought, which began in 1999, extended into the current decade. The year 2008 was Beijing's ninth straight of below-average rainfall. Beijing leaders formally announced that the city was in an "emergency situation" with regard to water supplies and the municipality has sanctioned emergency pumping of subsurface water resources. In addition to further exploitation of underground water resources, Beijing successfully lobbied for permission to purchase water from the neighboring, equally water-short provinces of Shanxi and Hebei. Controlling these new resources helped Beijing survive in the years before the 2008 Olympic Games, but technical problems, including the loss of up to one-third of water released upstream as it flows toward Beijing, limit the amount of help Beijing can expect from such purchases. In late 2008, a channel specially built from reservoirs near Hebei's provincial capital Shijiazhuang began supplying some additional water to Beijing, but far from enough to allow for decreases in usage of subsurface water

(Chinese Government Website, 2009).

The stark fact is that Beijing has consistently overexploited its subsurface water resources over the past 30 years. Water tables have had no opportunity to recover, even in times of above average rainfall. This has several obvious, negative effects. Official measurements indicate that subsurface water resources under Beijing in 2009 were 10.6 billion cubic liters less than in 1960. As a result Beijing's many natural springs have either dried up or seen their water output drop considerably. Sinkholes and the settling of land affect some areas, creating costs in repairing infrastructure and loss of use of affected land. Around concentrations of wells, underground funnel shaped depressions have formed, affecting 2,600 square kilometers. Building foundations and roads in this area risk damage from settling. Of course, wells are drying up as the water table drops.[8]

THE NEXT-LEVEL STRATEGY

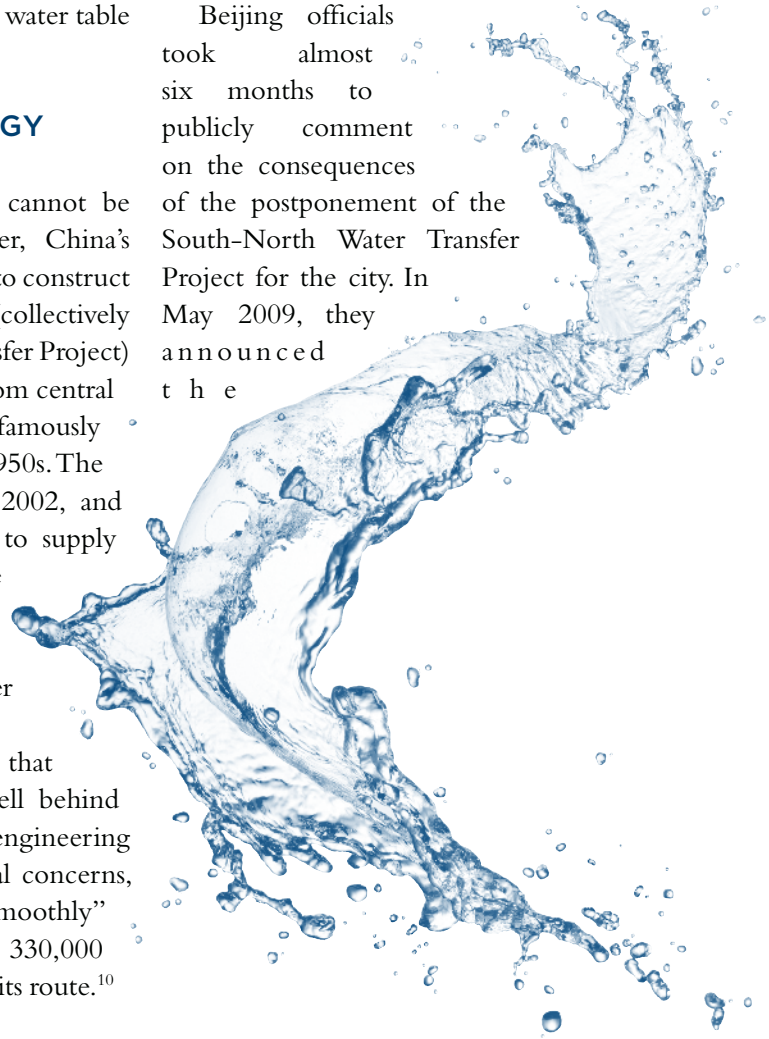
Understanding that North China cannot be sustained without additional water, China's government began serious planning to construct major infrastructure projects (collectively termed the North-South Water Transfer Project) to divert huge quantities of water from central China to the dry north, an idea famously suggested by Mao Zedong in the 1950s. The State Council approved plans in 2002, and construction on the central route to supply Beijing began in late 2003, with the goal of beginning the initial supply of 10 billion cubic liters of new water annually to Beijing and other areas along that route in 2010.[9]

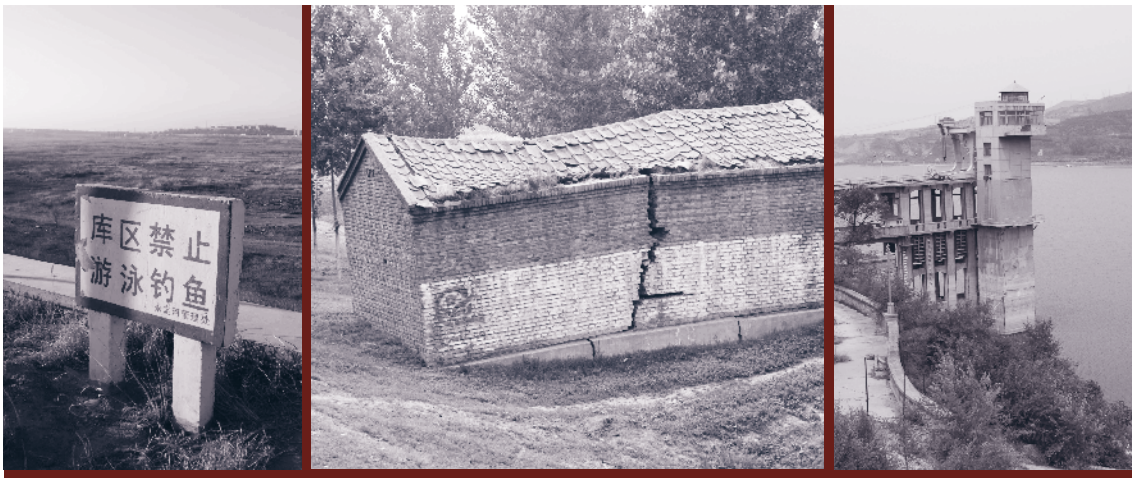
In late 2008, officials announced that work on the central route was well behind schedule due to complications in the engineering design of the project, environmental concerns, and the need for more time to "smoothly" arrange the relocation of well over 330,000 people affected by the project along its route.[10] The costs of the project increased an estimated 150 percent, both due to price increases for materials and a major increase in the calculation of the size of payments to dislocated families, a measure designed to ensure social stability in the areas affected (Mu & Ryder, 2008).

BEIJING'S REACTION

While the Beijing will probably continue to be able to purchase some water from neighboring, equally water-poor jurisdictions, technical issues and these neighbors' own shortages will limit Beijing's ability to increase this source as a short-term fix. Municipal authorities will need to address the shortfall largely within the current capability of Beijing to supply its own additional water needs.

Beijing officials took almost six months to publicly comment on the consequences of the postponement of the South-North Water Transfer Project for the city. In May 2009, they announced the





1-No Fishing or Swimming sign on the "bank" of Daning reservoir.; 2-Building in the outskirts of Beijing destroyed due to settling caused by falling water table.; 3-Guanting Reservoir now holds only a fraction of its capacity. Photo credit: Wang Jian.

establishment of a "rigorous water resource management system," which will "strictly implement total volume control and quota management so that the water consumption needed to produce every 10,000 Yuan of GDP will decrease by five percent." The city will urge forty enterprises with high water and energy consumption and causing heavy pollution to close or move out and will also "promote the use of non-conventional water sources," for example capturing rainwater. In addition, Beijing will expand the utilization of reclaimed water for areas such as golf courses, suburban parks, large-scale green land and agricultural irrigation. Furthermore, the area of green land that is irrigated by reclaimed water will be increased by 2 million square meters, and the amount of annually utilized reclaimed water is targeted to reach 650 million cubic meters.[11].Some modest gains will be easy. An article published in the hot summer of 2009 indicated that local authorities were actually operating only 180 of 5,000 rural water treatment plants, probably to save the cost of electricity *Beijing Youth News*. (2009). While initial 2010 reports indicate some success in utilizing unconventional sources of water, building new infrastructure to capture rainfall and to treat and distribute waste water, will be very costly and cannot serve as a fundamental solution of Beijing's problems.

SHIFTING THE DEVELOPMENT MODEL?

Beijing officials did not list increased pumping of groundwater as a stop-gap solution to the current situation, reflecting perhaps a growing awareness of the serious damage done to the environment by pumping over past decades. Continued "emergency" pumping will be impossible to avoid, however, unless municipal authorities take bold steps to take seriously the rhetoric in planning documents and actually limit growth. This will mean moving away from the exclusive "engineering solution" approach to increase both water supplies and water use efficiency.

Beijing's response to today's water crisis may prove to be more constructive than in the past due to the realization by officials that they cannot count on receiving Yangtze basin water until 2014. Further delays are possible as the nation grapples with the huge engineering, pollution, social and environmental issues of the South-North Water Transfer Project. Neither can municipal officials count on a

return to "average" rainfall levels. Also the social and environmental costs of over exploiting subsurface resources are more visible and better understood today, both by increasingly sophisticated municipal experts and leaders and the general population. In addition, while still limited in their ability to influence policy and public opinion, increased access to data on resource use has allowed outside experts and activists to constructively highlight the problems created by continued rapid growth and the need to cease over exploitation of heavily depleted water resources. For all these reasons, Beijing authorities are now more likely to adopt more science-based and comprehensive approaches toward managing the relationship between growth and the sustainable use of the area's water resources.

Much can be done. While much of Beijing's growth reflects welcomed enhancements in residents' standards of living, many developments are poorly planned and some are irrationally placed in areas designated as protected. Many projects lack water treatment facilities and hookups mandated by regulation. Cracking down on corruption and rigorous, transparent implementation of existing regulations could go a long way toward reducing the impact of expansion.[12] Beijing leaders could also do even more to speed the city's transformation away from its previous, and very costly, focus on industry and water-intensive agriculture.

Most importantly, Beijing's leaders could in all their actions take seriously the reality that constraints on growth cannot be ignored or resolved exclusively through "engineering solutions." New thinking is needed, even after the eventual arrival of Yangtze Basin water. Now, when public understanding of the challenge facing Beijing is at a peak, would seem to be a good time for decisive action. We hope Beijing's leaders agree.

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[1] Statistics are from Chinese official sources and from calculations based on these by author Wang Jian.

[2] Beijing's 2004-2020 formal development planning document *Beijing Municipal Comprehensive Plan* contains good examples of the priority of containing population growth in the face of resource constraints. The 2004-2020 plan anticipates minimal population growth before 2020, yet posits a huge increase in the urban footprint of the city. In no previous case have such statements translated in actual limits on population growth. For the Chinese text of the 2004-2020 plan, see the Beijing Municipal Government Website: www.bjpc.gov.cn/fzgh/csztgh/ght/200508/t249.htm. For a Chinese official's prediction that Beijing's 2020 population will reach 21 million (not 18 million as posited in the plan cited above), see *Chinanet*. (2008, December 5).

[3] The 2006 figure appears in the 2007 version of the *China Urban Statistics Yearbook*.

[4] Current statistics, compiled by author Wang Jian, indicate crop patterns have changed and the efficiency of irrigation with regard to water use has significantly increased as wasteful practices are abandoned. Changes in cultivation patterns are in large part explicitly driven by officials to reduce water use in agriculture and move farmers into other pursuits. A good assessment of water use for agriculture over past decades can be found in Wolf, J., et al. (2003).

[5] By 2007, Guanting reservoir water amounts had fallen to only 1/40th of its capacity. Miyun's useable water resources stood at only 25 percent of its capacity.

[6] Author Wang Jian's calculation based on official statistics.

[7] Numerous official statements and statistics document Beijing's overuse of groundwater. For one recent example of such a report see *China Net*. (2009, May 9).

[8] The drop in water tables is well documented in Chinese press and academic writing. For example see: "Beijing's predicament" (2004). For an English-language review of the consequences of Beijing's water shortage, and some statistics that parallel, but do not match precisely with, those calculated by author Wang Jian for this article, please see Welford (2010). For an official statement on China's over reliance on subsurface water resources, see *Chinanet* (2004).

[9] The statements of leading officials of the South-North Water Transfer Project give the official justification and basic information on the scheme. For English see: http://www.mwr.gov.cn/english1/20040827/39304.asp. Wiki entry on the project contains links to a large number of related English-language sites with project details. See: http://www.ritchiewiki.com/wiki/index.php/South-North_Water_Transfer_Project. The official Project website is: http://www.nsbd.gov.cn/.

[10] Statistics from Chinese sources on the number of people forced to move to make way for the project vary. 330,000 is often cited, but some sites, such as official Chinanet (2005, April 6), which cites "nearly 400,000" will need to be moved.

[11] For Chinese language text see: *Xinhuanet*. (2009, May 11).

[12] A Chinese official is quoted in December 2008 saying: "In the first six month of this year, about 5.05 sq km of the 8.8 sq km of newly acquired land was illegally developed in 14 districts and counties of Beijing, taking up 57 percent of the newly acquired land area." and "The major reasons for this was illegal occupation of land by county governments and property developers." See *Chinanet*. (2008, December 5).

COMMENTARY

Persistent Pollution in China: It's Not the Economy, Stupid

By Elizabeth Balkan with assistance by Michelle Lau

ECONOMIC SLOWDOWN = POLLUTION SLOWDOWN?

When a country experiences economic slowdown, industry slackens in response to waning demand. In countries where industrial activity is energy-intensive, energy use typically decreases as well. But, in these conditions, it may not necessarily follow that air quality improves, particularly in countries such as China where heavy and light industry contribute significantly to air pollution. It is an important question to understand the relationship that exists between economic activity and pollution in Chinese cities during an economic slowdown. For if a downturn does not yield better air quality as logic might lead one to expect it will be important to understand why not.

The recent global financial crisis slowed China's economic growth to its lowest annual rate in almost a decade.[1] In the fourth quarter of 2008, real GDP growth slowed to 6.8 percent. It dropped further to 6.1 percent in the first quarter of 2009. Though still impressive compared to stagnant growth rates elsewhere, it was China's lowest rate of growth since 1992, when quarterly data recording began (Reuters, 2009). By the second and third quarters of 2009, growth increased to 7.9 percent and 8.9 percent, respectively. In the fourth quarter of 2009 and first quarter of 2010 China's recovery was robust with real GDP growth of 10.9% and 11.9% respectively (Kitchen, 2010).

Though China's slowdown now seems like a flash in the pan, individuals and industry alike fully felt its impact. Reports of factory shutdowns following sluggish foreign demand studded newspapers for most of 2009, and left an estimated 20 million migrant workers jobless, according to government figures (gov.cn, 2009).

Environmentally, there are conflicting reports on whether the deceleration had a positive or a negative impact. On one hand, the mainstream media ran numerous variations of this article, "Slowdown's Gift to Beijing: Cleaner Air," suggesting that slowed economic growth has led to improved air quality in Chinese cities. On the other hand, some headlines have claimed that the economic slump has tilted priorities of industry to neglect pollution control efforts.

GRIM AIR POLLUTION TRENDS

For about a decade, particulate emissions have been gradually declining in China, despite increasing coal consumption. In contrast, SO_2 emissions have been increasing at roughly the same rate as coal consumption (Ni, 2009). In China, industry accounts for the lion's share of SO_2 and soot emissions.[2] Thermal power production, classified under industry, constitutes the largest single source of industrial emissions, and roughly half of China's total SO2 emissions (Sinton, 2004). The dominant fuel source used in primary energy production is coal, used in approximately three-fourths of the country's primary energy production (*China Energy*

Databook, 2008). Because of the makeup of China's energy landscape, trends in power production carry considerable potential to impact air quality.

A year-long study conducted by MIT researchers explored the environmental performance of power plants throughout China. They visited and collected data from 85 power plants (with a total of 299 generating units) across 14 provinces in China, carrying out a survey of plant managers and specialized personnel. The survey results indicated that several plants were emitting SO_2 at levels exceeding the legal limit. A correlating and somewhat surprising finding, however, was that many of the non-compliant plants were newer and equipped with state-of-the-art stack cleaning equipment (Steinfeld, 2008).

The pervasiveness of expensive and advanced environment equipment within the sample merits mention. Almost 80 percent of the plants studied had installed "clean coal" SOx scrubbers on at least one of their power generating units. The non-compliant emissions levels were due, the study concluded, to two primary factors, neither of which was outdated equipment.

First, though flue-gas desulfurization (FGD) systems were being installed, they were not being consistently or properly operated. The large expense of operating the environmental equipment, energy penalty, and inadequately trained personnel were believed to explain its misuse and disuse. Lax monitoring allows this practice to occur. Second, the authors believed many plants were substituting sub-standard coal in the generating units. Doing so places stress on the system as a whole and degrades FGD capacity, contributing to larger emissions.

Financial reasons explain much of why lower quality coal is being used. In recent years, China has experienced rising fuel costs, government-set feed-in pricing, and then economic slowdown. These factors combined have strained power producers considerably, prompting them to seek cost-cutting measures. Since fuel constitutes the largest operational expense in power generation, it is an obvious place to cut costs.

Emissions "depend almost entirely on the quality of the coal they use," according the report's lead author, rising when low quality, high-sulfur coal is burned (Steinfeld, 2008). The substitution of sub-standard coal offers a way to contain rising operating costs. Based on this argument, it follows that an economic downturn and the financial concerns it introduces, might actually result in increased emissions if this trend occurs at the aggregate level.

The dearth of quantitative data supporting this argument served as the basis for this statistical inquiry. In order to determine the presence and degree of correlation between economic activity and pollution in China as well as whether it was positive or negative, I conducted statistical analysis of economic and pollution data in China during the recent slowdown, as well as the period proceeding it.

OVERVIEW OF THE METHODS

An environmental indicator derived from the Ministry of Environmental Protection's (MEP) daily Air Pollution Index (API) data (available via http://datacenter.mep.gov.cn/) served as the dependent variable. For the economic indicator, and independent variable, I used the monthly industrial value-added (VAI) figure taken from official municipal reports. I obtained the monthly incremental change in VAI by working backwards from the cumulative data. In order to compare the two indicators, the air quality figure was aggregated to a mean monthly figure (measured in 100,000 Yuan).

China's API is derived from measurements of five pollutants (sulfur dioxide, nitrogen dioxide, coarse particulates, carbon monoxide and ozone) taken at various monitoring stations throughout the day. Particulates smaller than 10 micrograms (PM_{10}), and particularly particulates smaller than 2.5 micrograms ($PM_{2.5}$), are most commonly associated with the negative health

effects of air pollution on humans and animals (Andrews, 2008; 2008/2009). China's MEP does not include measurements of particulate matter smaller than 10 micrograms in the API.

The recorded daily API figure is calculated, based on a set pollutant-specific formula, using only the concentration level of the day's major pollutant. As such, API data aggregated on a monthly, seasonal or yearly basis would yield statistically less indicative data, given the mix of pollutants that make up the API over time. To overcome this obstacle, I sorted the data according to the dominant daily pollutant, as reported by MEP. Because PM_{10} was the dominant pollutant for over 97 percent of recorded figures, quantitative analysis examined only how PM_{10} trended. I used the government-reported formula[4] to calculate PM_{10} concentrations from reported API (measured in micrograms per cubic meter).

One unavoidable and admittedly limiting factor of using PM10 in this analysis was that PM_{10} can be any suspended solid or liquid larger than 10 micrograms that are emitted directly or formed in the atmosphere as other pollutants react (Particulate Matter, 2009). Both organic (sand, dust) and inorganic materials may be classified as particulates, and organic particulate matter may be either volatile or nonvolatile. Analysis of only PM_{10} disallows the formulation of conclusions about sources of pollution specific to industry, like sulfur dioxide and nitrogen dioxide. Thus, the correlation between PM_{10} levels and economic activity does not tell the entire story of how industry slowdowns affect air quality.

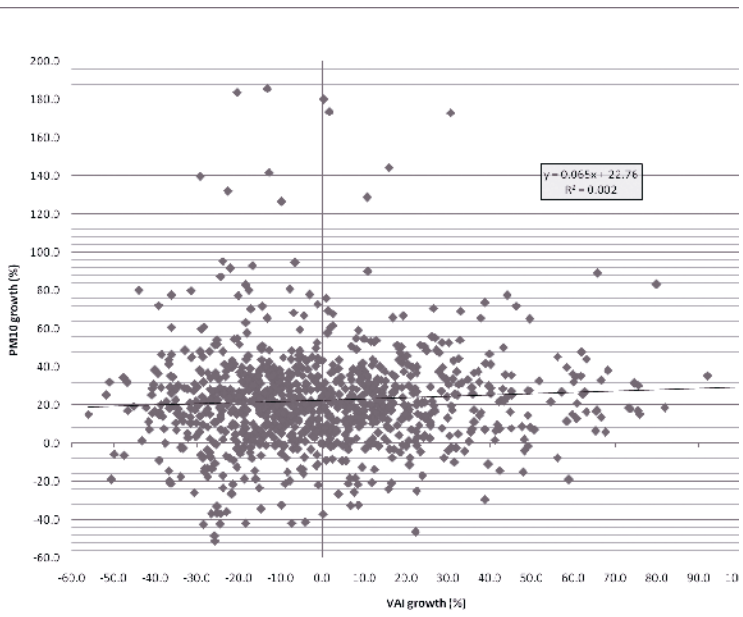
The sample set comprised 36 of China's major cities, both industrial and nonindustrial, and spanned over the 40-month period from March 2006 to June 2009. I generated year-on-year growth rates for each of the variables, in order to avoid skewed results, thus returning 28 data points per variable, per city. This yielded a total of 1,008 observations. Among the factors the year-on-year growth rates corrected for was seasonal trends: in all regions of China, pollution levels are lower in the summer and fall, while economic activity tends to be most robust in the summer months.

POST-CRUNCHING RESULTS

I conducted a simple linear regression on the dataset, testing the assumptions that the variables are normally distributed; a linear relationship exists between the independent and dependent variables; the variance of the errors are the same at all levels; and that the sample size is random, normal, and representative. My hypothesis was that the relationship between economic and pollution variables is negative.

All assumptions held true, and the P- value was less than one percent, yielding statistically significant relationship between the pollution and economic growth at a 99 percent confidence interval. The line of best fit generated from the regression was:

$y = 0.065x + 22.76$



This means that, for every unit increase in pollution growth, economic growth increases by .065. The relationship was positive, but not a very dramatic one. Moreover, the r-squared statistic was only 0.002, meaning that economic activity explains only two percent of pollution trending. Because of the weak predictive value and small coefficient of the independent variable (x), the results were not very robust and the hypothesis was incorrect.

CONCLUSIONS

Though the results indicated only a minor positive relationship between pollution and economic activity, they clearly demonstrate that, when it comes to the factors affecting air quality, a lot more than the economy is at play. Among these relevant factors are the role of policy and strength of the regulatory environment, as well as the level of environmental transparency and monitoring.

From a regulatory standpoint, expectations of local officials to deliver growth (in order to raise provincial revenues) directly undermines central mandates on environmental compliance. During an economic slowdown, the primacy of growth over environmental protection is heightened. Thus, as the MIT study demonstrated, despite centrally mandated technological upgrades, a lack of enforcement permits local, financially constrained industrial users to bypass advanced, but expensive modes of fuel consumption. Improvements in standards and progressive policies will not deliver results unless coupled with on-the-ground capacity building and use of incentives.

Also, improvements in environmental performance depend on not just the development and implementation of policy, but on achieving compliance through transparency. In the United States, an environmental organization's 1985 op-ed in the *The New York Times* catalyzed the development of the Environmental Protection Agency's Toxics Release Inventory (TRI) Program, active since 1988. Today, the TRI contains a publicly available database with information on toxic chemical releases and waste management activities of certain industries and federal facilities. While the data is self-reported, many credit the public disclosure requirement as having done a great deal to promote industrial entities to mitigate pollution. On the EPA website, both the Sierra Club and Monsanto, entities with very disparate interests, are quoted praising its effectiveness. This kind of environmental transparency does not exist yet in China. However, the potential and momentum for its development do. In mid-2009, the U.S.-based Natural Resources Defense Council and China-based Institute of Public & Environmental Affairs released the first ever Pollution Information Transparency Index (PITI; available in Chinese via http://www.greenlaw.org.cn/blog/?p=1191). PITI evaluation includes disclosure of polluters environmental rule violations, any remediation action taken, and assessment results of enterprises' environmental impact, and is available online. Built on the belief that "environmental transparency is a critical tool in the fight against pollution," this index gives hope for significant improvements in air quality, as well as the systemic underpinnings affecting it (Wang, 2009).

No sooner did China's economy rebound than articles about increasing pollution resurged. But as the numbers indicate, persistent pollution in China has a lot more to do with institutional shortcomings. In other words, it's not the economy, stupid.

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ENDNOTES

[1] According to World Bank Development Indicators: GDP growth (annual %)

[2] Around 80 percent of SO2 and soot emissions came from industry in 2000 (World Bank 2007)

[3] Environmental equipment accounts for upwards of one-third of total plant expenses (Steinfeld 2008)

[5] For API 0-51: PM10 concentration = API/1000, For API 51-200: PM10 concentration = (API – 25)/500 For API 201-300: PM10 concentration = (API + 300)/1429, For API 301-400: PM10 concentration = (API + 225)/1250, For API 401-500: PM10 concentration = (API + 100)/1000

COMMENTARY

Pulling the Plug on Water Wastage in Beijing's Bathhouse Industry

By Hu Kanping (Translated by Zhu Sha)

Chinese cities are big and thirsty—and growing bigger and thirstier. With the built area equivalent of one New York City popping up each year, China's urban growth rate will move 350 million more people to cities between 2010 and 2030—a migration unrivaled in human history. The water and energy required to fuel this growth and satisfy an increasingly wealthy population are mind-bogglingly huge. While agriculture currently uses 50 percent of China's water, cities will be demanding more of this share to address current and growing water shortages. No city in China feels the pinch of water shortage more acutely than Beijing, China's capital in the dry north.

For many years Beijing has relied on emergency water transfers to quench its thirst; recently this practice has become increasingly expensive and contentious *(Editor's Note: For more insights on these problems see Wang and Aloisi Commentary in this volume)*. In 2006, Beijing's *Water Resource Protection and Utilization Plan* for the 11th Five-Year Plan period indicated that the city would begin prioritizing conservation and demand-side management goals to be met by 2010, such as: raising public awareness of water saving, broadly implementing water saving technology and standards, and optimizing the allocation of water resources. The plan intended to begin modernizing Beijing's water management by enhancing the legal framework and improving water administration. The overall goal of the plan is balance resource protection and development in order to establish a water-saving society.

The plan identified several specific industries—including skiing, golf, public baths, and car washes—as targets for stricter water regulation. By issuing water withdrawal permits, the municipal government aims to immediately control water usage and eventually implement a comprehensive industry-specific water pricing scheme.

Progress on meeting water-saving goals set out in the 11th Five-Year Plan was initially slow, which is why 2009 was a crucial year. Government data indicated that in 2009 Beijing witnessed a constant decline in per capita household water consumption, due to significant cuts in agricultural water use and a noticeable upward trend in the use of reclaimed water by industry. However, a deeper examination of specific water saving scores for each special industry reveals that there is much more progress to be made, particularly in Beijing's bathhouse industry.

BATHING IN A MOUTHFUL OF WATER

Beijing has one of the lowest levels of per capita water availability among the world's major cities. The international definition for water scarcity of per capita water share is 1,000 m3 per person; Beijing (based on the 2005 population level) only has 248 m3, which ranks the city less than one-eighth of China's national average and one-thirtieth of the global average. To visualize

the point:, if the global water average per person is a pitcher, the average Chinese has a glass and Beijingers only get a mouthful.

Successive years of drought in northern China have intensified the water shortage situation. In the past decade, Beijing's annual precipitation average was only 450mm, which is only about 77 percent of the historical level of 585mm and was lower than other major Chinese cities. Strikingly, in the midst of this prolonged drought several highly water-dependent industries boomed in the heart of Beijing; at the forefront of which stands the bathing industry.

The water used during one individual's public bath can supply one household in Beijing for 3 days

Beijing's city planning bureau has labeled the bathing industry as one of the few special industries that are critical to citizens' quality of life. Bath centers have a long history in Beijing, but it is been only recently that the city has witnessed a boom of several thousand new spas, public bath centers, and hot spring clubs—some of which are huge, encompassing over a hundred thousand square meters. Bath centers are equalitarian in their distribution, spreading into every district and the suburbs that have expanded with each subsequent ring road.

In 2009, the Beijing SpaView hot spring hotel claimed the title of world's largest indoor spa in the Guinness World Records, a recognition that was lauded by Beijing media as "another world-renowned Chinese achievement." Located in a townhouse complex in the northeastern corner of the fourth ring road inside Chaoyang District, SpaView contains 96 hot spring pools and can host 5,000 clients. The area covers 130,000 square meters and the pools are supplied by a spring that is 3,500 meters below ground and discharges 4,000 cubic meters of water everyday. SpaView dwarfed former leaders of the city's bathhouse market. However, a source close to the industry revealed that SpaView will not enjoy the title of largest bathhouse for long, as an even larger successor is likely to take over both its market share and the Guinness record in 2010.

Along with the advent of bath giants, small players are also actively crowding the scene. According to the city government, at the end of 1989, there were only 39 bath centers in Beijing, but by 2009 the number jumped to over 3,000. Yet, given the city government's inclination to underestimate market capacity and overlook the role of bath centers when calculating the city's water use, the 3,000+ number could be a massive underestimate. Responding to a journalist's request a few years ago to estimate the industrial water usage, the Beijing Bureau of Industry and Commerce answered that no accurate number of those centers was ever available due to the fast proliferation of new facilities, compounded by the fact that numerous hotels and restaurants had begun bath services as well.

WHY ARE BATH CENTERS SO POPULAR?

In the mid-1980s, ordinary Chinese paid less than 1 Yuan to shower at either a public bath or a bathhouse located in their work place. When electric water heaters became an affordable home appliance, people could enjoy the convenience of showering at home. There was a resurgence of popularity in public bathhouses in the 1990s as the bath industry began attracting customers by offering other leisure services, which not only included sauna rooms and hot spring pools, but also stage shows, restaurants, hair salons, gyms, and game rooms.

Special packages for group events have attracted business people who use bathhouses as a form of entertainment for their clients. Every evening, people pack the rooms at the Jinsha Hot Spa Club, which is located in western Beijing; this is only a snapshot of what is happening every evening at the large number of high-end bath centers around Beijing.

Exuberant popularity and rising customer demand make this industry highly profitable. Most flagship companies express confidence in continued growth of their business with a steadily expanding clientele pool (pun intended!). Undoubtedly, the bath industry is experiencing a bubble supported by domestic and international investors who wish to tap into a novel consumer market. The average cost of establishing a luxurious bath center in Beijing can reach hundreds of millions of Yuan, yet these high startup costs have not slowed the growth of spas and water therapy centers within the city and on its outskirts. Some spas even upgrade to operate in chains. For example, Gwongeumseong International Holding Group has opened more than 20 chain bathhouses in Beijing alone.

Taking into account the economic impact and government revenue bathhouses provide, it is easy to understand why municipal governments enthusiastically support the industry. In 2009, the district government of Changping in northwestern Beijing gave out over 100,000 free spa tickets worth a total of 15 million Yuan to residents of Beijing and neighboring provinces in order to promote business for its 17 local bath enterprises. As a result, daily client visits at some sites exceeded 10,000, a stunning number that should have sounded alarm bells about the likely huge water consumption. Unfortunately, the government, enterprises, and the news media were silent on the issue of water consumption during the promotion. A second large round of ticket distribution, this time at a major discount, hit the market in May 2010 and was greeted with fanfare in the news media but again there was silence on the issue of city water-saving needs.

INVISIBLE COST

The first China Hot Spring Economic Forum was held in 2008 at which delegates voiced warnings about the excessive exploitation of hot spring resources in China and cited an urgent need to establish water use rules for the industry. There was also a consensus that an industrial association needed to be created to enhance standards and sustainability associated with the growth of spas and bathhouses. A marked lack of a nationwide legal framework to guide the use of hot springs has led to massive over extraction of water resources, particularly in Beijing where the instant commercial benefits are driving development of new hot spring tourism sites.

Spas in Beijing are developed with little attention to ecological or geological impacts, which can be severe. For example, in Beijing a good number of spa centers that market themselves as hot springs actually drill for regular groundwater and then heat it for pools and baths, rather than tapping into true hot springs that push up to the surface through long cracks in the rock stratum.

According to a joint announcement made by Beijing Municipal Bureau of Land and Resources and Beijing Bureau of Geology and Minerals Exploration and Development, each year Beijing exploits 100 million square meters more groundwater than is environmentally sustainable. This massive extraction of groundwater has resulted in serious ground subsidence that is particularly severe in many areas of the city. In March of 2005, ground subsidence caused an underground water pipe to burst and turned the San Yuan East Bridge road into a water reservoir within 10 minutes.

BLIND SPOT ON THE ROAD TO A WATER-SAVING SOCIETY

Because water is not always well metered in Chinese cities and such data is rarely easily accessible, it is difficult to know how much water any specific industry is consuming in Beijing. The per capita water consumption in Beijing is approximately 110 liters per day. According to some estimates, each individual bath center visit equals 3 to 5 times of that amount and the use in hot springs is even greater. To help understand the scale, the water used during one individual's public bath can supply one household in Beijing for 3 days. If

the 17 million people of Beijing visit a bath center once a month and each uses 400 liters per visit, then it will cost Beijing an extra 8.16 million tons of water every year. Simply put, this lifestyle entails a water price that is too expensive for this thirsty capital to pay.

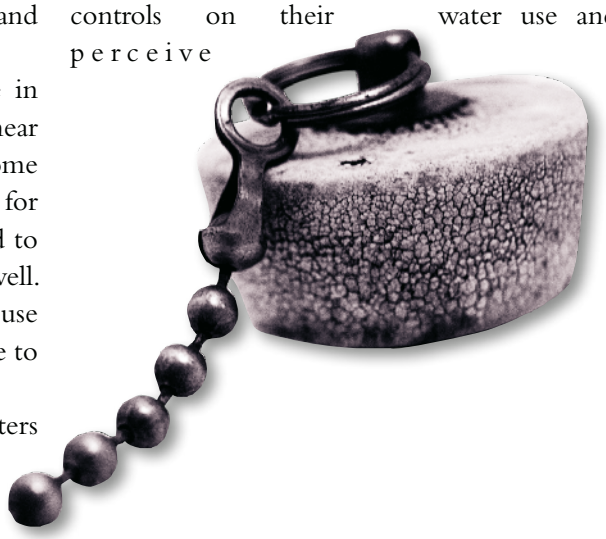
Since the Chinese version of this article expressing my concern with the Beijing bath industry was published in the March 2010 issue of *China's Environment Green Paper (zhongguo huanjing lü pishu)*, my estimate of 8.16 million tons of water annually was widely quoted in many media outlets, with some of them describing it as the equivalent of "41 Kunming Lakes" (of the Summer Palace) in their reports. On April 8 2010, the Beijing Municipal Water Saving Office hosted a press conference in an effort to clarify misunderstandings and to replace the so-called "non-factual" number that I proposed with its own calculation of 5 million tons. This new number does not hold up to scrutiny. In interviews with numerous bathhouse managers in Beijing, the consensus is that on average a male customer uses 300 liter water whereas a female bather averages about 500 liters. Thus, we can estimate that each Beijinger uses 400 liters on average with each visit. Dividing the estimate by Beijing water officials of 5 million tons by 3,000 bath centers would mean that each establishment will get 4.56 tons water per day, which could only suffice 10 individual visits each day. Regardless of the size of the center, such a daily consumer volume would not keep these businesses profitable and growing in number.

Without many policy tools to leverage in slowing the expansion of bathhouses in the near term, it will be crucial for water saving to become a key corporate social responsibility concept for this industry. Moreover, customers will need to voluntarily reduce their consumption as well. Without such awareness among bathhouse managers and customers, water will continue to be wasted at a stunning rate.

Random interviews at bath centers across Beijing resulted in candid admissions that customers had limited awareness of the amounts of water used per shower. Some even argued that they have already paid the price to use more water, which gives them the right to ignore posted signs that request individuals to shut off water while applying shampoo. One interviewee commented bluntly: "why would I pay for the service here and then try to save water?"

Managers have their side of story to tell when challenged about water saving efforts. One manager responded that "clients come to the bath center for relaxation and unrestrained leisure. It would appear that saving water is to our own interest, but if we try to tell clients to save water, they may simply take offense and stop visiting our center." Another facility owner told the author that their 168 Yuan price rate is set to target mid- to high-end consumers and it includes swimming, spa, performance tickets, and three buffet meals. Therefore, the majority of patrons try to get the most out of the money spent by showering longer and eating more, neither of which favors water conservation. Needless to say, Beijing's water saving campaign has a long way to go in this water-squandering industry.

For the time being, one immediate and practical solution is to install water-saving equipment such as low-flow shower nozzles. Surprisingly, such equipment is rare in Beijing; one explanation being that customers dislike controls on their water use and perceive



companies using the equipment as skimping on service

REFORMING WATER PRICE: A LIMIT ON HIGH-WATER CONSUMPTION INDUSTRIES?

To cope with the astonishing reality of water shortage, Beijing implemented new pricing mechanisms for non-household water consumption on December 20, 2009. The readjusted water price for the bath industry increased from 61.50 Yuan per cubic meter (Y/m^3) to 81.68 Y/m3. On the following day, Beijing also announced a price increase for residential water, from 3.70 Y/m^3 to 4.00 Y/m^3.

People who are concerned with water conservation welcomed these two moves. But for the bath industry and its effects on water supplies, the real impact of these policies remains to be seen. The change in water price will not substantially drive up operational costs for high-end bath centers, since their services are more diverse and not necessarily water intensive, including fitness centers, entertainment, and business clubs. To the contrary, the rising water resource price could trigger more wasteful behavior. As one customer pointed out, as people become more sensitive to household water consumption they may spend more time in bath centers.

Beijing could take more aggressive action in regulating this high-water-use industry, which will be important for controlling water consumption in the city. Three possible agendas for the city include:

1) Learning from Changchun's example by adopting water-saving regulation for this industry as early as possible. In July 2001 the city of Changchun approved and implemented a "Provincial Measure for Bath Industry Administration." The People's Congress of Beijing had expressed similar intention for such regulation in 2005, but a draft is yet to be seen.

2) Urging bath centers to follow the example of universities in Beijing, Tianjin, and Nanjing that successfully upgraded public shower space with water-saving technologies and modern shower equipment to be a "pay as you use" system. The results of which have been encouraging.

3) Recommending the citizens of Beijing as well as residents of other water-scarce cities to learn from the example of Australian tennis players. In making "water saving" a theme for 2009 Australian Tennis Open, the organizer called upon the athletes to shower for less than one minute after training and competition. All participants viewed it as "a simple yet significant move." To make the goal more realistic for ordinary citizens, we could start by showering for one less minute each time. This very small change could benefit Beijing's water thirst in the long run.

There are likely many more strategies, but real action will not start until the silence on water wastage in Beijing's bath industry ends.

This article was adapted from one the author published in Chinese in The China Environment Yearbook in March 2010. Hu Kanping is an editor of the Environmental Protection magazine. He also participated in the China Environment Forum's first U.S. study tour in 2000 that included Chinese environmental NGOs and green journalists. He can be reached at: hukanping@gmail.com.

SPOTLIGHT ON NGO ACTIVISM IN CHINA

Green Earth Volunteers

By Jon Aloisi

Green Earth Volunteers (GEV) is one of China's oldest indigenous environmental NGOs. Founded in 1996, GEV serves as a vehicle for grassroots participation, both by organizing educational trips to raise consciousness on environmental issues and by helping to generate press coverage about pollution, energy and climate change policy. Today, GEV's monthly journalist salons in Beijing routinely bring key environmental journalists and specialists together to discuss breaking issues. Many benefit from the Internet transcripts of lectures and discussion among participants at each session.

In a related project, GEV supports contributors in Beijing and 18 other cities who forward local stories on environmental issues for inclusion in its daily news digest. On average, each digest includes 15-20 items and is sent to over 700 recipients. These stories document matters related to pollution and health, enforcement and justice, and climate change. Through its salons and this digest, GEV has helped to create a nationwide network of concerned journalists, which now constitutes a potent force in China's indigenous environmental movement.

The effectiveness of GEV's work is demonstrated by its continuing impact on policy, especially in recent years. GEV's multi-year focus on the Nu River dam "development" controversy, for example, has helped keep the issue fresh in the minds of Chinese policymakers and the public. More broadly, seeing articles on pollution problems in print reassures individuals that they have the "space" to raise their specific concerns, which in turn helps increase public willingness to engage on local environmental issues.

GEV's founder, Ms. Wang Yongchen, is a prolific writer and award-winning journalist. Wang's media credentials and reputation as a crusading reporter, and her ability to take on special interests and the government when necessary, help explain GEV's effectiveness to date. But GEV's road is not an easy one. All indigenous NGOs operate within strict constraints on advocacy, organizing and fundraising, and GEV's key volunteers admit that they face daunting challenges in transforming the organization from a small, project-driven group into something more substantial. GEV formally registered with a local branch of the Ministry of Civil Affairs as a citizen-run nonprofit organization in December 2007 as the "Green Earth Environmental Scientific Research Centre." Friends are now working with GEV to create a stable and professional management staff as a foundation on which to consolidate and expand the NGO's activities. With a modest injection of management talent, they believe GEV can capitalize on its success in attracting committed volunteers and become a more substantial channel to disseminate environmental information and constructively influence policy.

Specifically, GEV looks forward to further expanding its outreach and training for interested journalists in provincial capitals around China. GEV also wishes to increase its educational activities to encourage thousands more influential Chinese to actively participate in the indigenous environmental movement. In addition, GEV is working on ways to translate into English and disseminate key articles included in GEV's Chinese-language digest. Given the

Participants celebrate during their 2005 Green Earth Volunteers study trip. Photo Credit: Green Earth Volunteers.

pool of talented volunteers already associated with GEV, and its significant track record to date, prospects are good that the organization can continue to play an important role in China's nascent environmental movement.

To date, GEV has subsisted largely on volunteers' contributions, but has also received funding from overseas groups, including small grants from the Blue Moon Fund, Canon, and the Natural Resources Defense Council. Interested readers can visit the group's website at www.greensos.cn.

Jon Aloisi is a retired U.S. Senior Foreign Service Officer who has been studying and living in China off and on since 1979. Based in Chengdu, he is currently teaching, writing and lecturing throughout China. He can be reached at: aloisijm@gmail.com.

COMMENTARY

Grassroots Groups Catalyze Sustainable Community Agricultural Efforts in Chengdu

By Jiong Yan, Hongyan Lu, Lei He, Jun Tian, and Yu Luo

China is a country with a long tradition of organic farming. Despite thousands of years producing crops, careful cultivation has helped much of China's land maintain fairly good productivity to feed the 1.3 billion population. However, soil quality has been dropping precipitously over the past twenty years, due to pollution, erosion, and a rapid increase in chemical fertilizers, trends that threaten to undermine China's food security.

As China's economy has boomed the demand for food for domestic consumption and export has increased considerably. To meet this demand, Chinese farmers have rapidly expanded the use of chemical fertilizers, which has helped them produce more out of the country's limited arable land and to farm very marginal lands. In 1978, China's total chemical fertilizer consumption was 8.8 million tons and by 2007 the use increased six-fold to reach 51 million tons.[1] Approximately one-third of the world's nitrogen fertilizer was used in China in 2006,[2] the highest use of any country. Although the use of chemical fertilizers has helped ensure food security for China, these chemicals cause severe non-point pollution exacerbating the country's already severely degraded waterways. Chemical fertilizers also contribute to China's greenhouse gas emissions. While China's CO_2 emissions are the largest in the world, it also leads in greenhouse gas emissions from chemical fertilizers—such as nitrous oxide (N_2O), nitric oxide (NO) and ammonia (NH_3).

In recent years, a handful of grassroots environmental groups in China have promoted organic farming and community-supported sustainable agriculture. Such projects were initiated to deal with the harmful health and ecological impacts caused by heavy chemical fertilizer use, as well as work to improve the livelihood of farmers, whose poverty rates are increasing. Chengdu, the capital city of Sichuan Province—one of China's breadbaskets—is attracting a number of organic farming projects supported by Chinese nongovernmental organizations (NGOs). Such projects are a striking new trend, for few Chinese environmental groups focus on rural issues. This article provides a quick overview—like a dragonfly touching the water (*qingting dianshui*)—of three organic food projects, two of which were initiated by local NGOs—Chengdu Urban Rivers Association and Weeds Culture—and one by a private business—the Guoyuanxiangzhu Farm. Strikingly, while each project differed in origin and goals, all three came to prioritize similar strategies of directly involving and building trust with farmers and local consumers. All three projects stimulated a renewed interest in China's organic farming tradition and therefore represent important models for other regions in China.

ANLONG VILLAGE MODEL: A COMPREHENSIVE SYSTEM FOR SUSTAINABLE DEVELOPMENT

Located in the northwest outskirts of Chengdu's city center, Anlong is a typical Sichuanese rural village with a rich agricultural tradition. Anlong

is situated along the Zouma River, a tributary feeding into the Funan River that flows through the center of Chengdu. The non-point chemical fertilizer, livestock, and household waste pollution (e.g., cesspits and public toilets) runoff from Anlong and other neighboring villages are major pollutants degrading the Zouma River. China's water pollution laws regulate pollution emissions from industries and wastewater treatment plants, but there are no standards regulating agricultural runoff. Moreover, challenges in enforcing existing water pollution regulations in China's vast rural areas are beyond the capacity of many environmental bureaus. In an effort to protect the rivers in this area, since 2005 the Chengdu Urban Rivers Association (CURA) has been carrying out a demonstration project to help promote more sustainable agriculture and better livelihoods for farmers in Anlong Village.

CURA was founded in the summer of 2003 and was officially registered as an environmental NGO by the Chengdu Bureau of Civil of Affairs. CURA's aim is to protect rivers and environment, and promote sustainable development in urban and rural areas. With a strikingly large staff of 19, this Chinese NGO has been able to take on long-term projects to promote sustainable agricultural production. CURA's projects engage villagers in pollution control work through integrating organic farming with resource recycling and sanitation improvements. For example, in Anlong CURA assisted the farmers in building household biogas plants, urine-diverting toilets, and ecological wastewater treatment plants. CURA also has been training Anlong farmers in organic farming, an activity that links all the recycling and sanitation work into a closed-cycle eco-farming system. The key components of CURA's integrated agricultural initiatives are outlined below.

Household Biogas Plant

Biogas plants were the first project that CURA started in Anlong, which exposed the farmers to the idea of changing Anlong into an eco-village. The success of this project became the foundation for more ambitious sustainable development initiatives. In the past, villagers used straw, wood and grass for cooking, which generated greenhouse gases—particularly black carbon—and had very low energy efficiency. In 2005, CURA organized experts and working teams to assist farmers in constructing the first household biogas plant, which then provided one family with clean energy and high-quality organic fertilizer. The biogas plant uses manure and urine from livestock and organic residues and straw from agriculture activities as the input materials. After the anaerobic fermentation, the generated biogas can replace straw and wood as energy and the digested residues are used as organic fertilizers. This first plant helped CURA to demonstrate the basic concept of a recycling economy village and encourage other households to build their own and accept other practices and technologies that protect the watershed.

The Eco-Toilet Project

Starting in 2006, CURA began a second project that helped 108 households construct urine-diverting toilets. Previously, farmers used cesspits or very simple toilets that were connected to pigsties—both very unsanitary practices that spread disease and contaminate local water sources. This project employed urine-diverting toilet technologies from Sweden that collects urine and flushed water separately so they can be applied to crops directly. Excrement is not flushed by water, rather covered by plant ash. After 6 to 8 months of naturally decomposing, the waste turns into organic fertilizers that are free from viruses and can be used for agriculture. This toilet combined with biogas ultimately promotes much better sanitation and living conditions in the village.

Ecological Wastewater Treatment Facilities

Helping the farmers create an ecological wastewater treatment facility was CURA's important third project because the 420 Anlong village households had long discharged untreated wastewater directly into the Zouma River. CURA helped many of the households build a small wetland area made up of local vegetation that filtered domestic wastes through a three-step purification process. The final treated water can be used for growing fish. The wetland wastewater facility also became a beautiful landscaped area for each of the households.

Organic Farming

The organic farming initiative has become the key that links all of CURA's projects in Anlong together. Following the expansion of the household biogas plant and urine-diverting toilet, CURA encouraged Anlong farmers to stop using pesticides, herbicides, and fertilizers and begin shifting toward organic farming. Previously, Anlong farmers used around 600 kilograms per hectare (kg/ha) of chemical fertilizers. Since 2006, nine families joined the organic farming project. Today, these farmers use traditional farming methods, such as composting, duck-rice farming, and organic fertilizers from urine-diverting toilet and biodigested residues. During the transition all families experienced a significant decrease in vegetable and grain production. After two years the situation improved considerably for the farmers who not only increased their income through selling organic vegetables and but also saved money because they do not have to buy chemical fertilizers. The price of organic vegetables in Anlong village averages approximately 8 Yuan/kg (~$1.17/kg) including delivery service charges (7 Yuan/kg without delivery); the price is around 30 to 100 percent higher than the non-organic vegetables. To help these farmers expand their market, CURA helps advertise and build direct supply-consumption chains between the farmers and urbanites in Chengdu.

Farmer Gao's family takes part in organic farming after CURA training in Anlong Village.
Photo credit: Chengdu Urban Rivers Association

Farmers As Implementers

Central to CURA's success in Anlong was its emphasis on empowering the farmers as implementers and as proud stewards of their land. For example, in the process of constructing the facilities, CURA did not hire any workers. Instead, CURA staff worked with the first farmer family to set up the demonstration models and opened them up to the other farmers for inspection, which encouraged other farmers join the project. CURA provided materials that farmers could not buy locally and trained farmers how to construct these facilities. Farmers worked on the construction with their own money and labor. They could also change and improve the design based on their needs and expertise. The building process became a learning and competitive process among the farmers. For the urine-diverting toilet project, CURA assessed and awarded each household 800 to 3,000 Yuan (~$117-$440) based on the investments and quality of the toilets.

The participatory process helped the farmers to understand the design and technologies of these facilities, which was key for them to use the facilities appropriately. Moreover, farmers learned how to solve any problems that arose themselves and maintain the facilities without relying on outside experts. With low costs and successful implementation the participating farmers also acquired a strong sense of ownership of the projects.

With the improved sanitation and biogas facilities, Anlong farmers now have safe and environmentally friendly energy and fertilizers that are generated from animal and human waste. But even more important has been how the projects have helped the farmers look at their work, life and land with a new perspective and pride.

WEEDS CULTURE: ECO CITY AND COUNTRY 1+1

Eco City and Country 1+1 is a community-supported agricultural project led by Weeds Culture, an NGO founded in Chengdu in 2004 and formally registered in 2007. The 10 fulltime staff working at this NGO undertakes projects to promote public participation in environmental protection and integrate environmental protection into citizens' daily lives.

Eco City and Country 1+1 began as a urine-diverting toilet project that Weeds Culture undertook in areas affected by the 12 May 2008 earthquake in Wenchuan, Sichuan Province. This eco-toilet project was launched to address the severe pollution being caused by sanitation facilities damaged after the earthquake. Even before the earthquake, primitive toilets that were combined with pigsties were a sanitation hazard, as well as a major source of soil and water pollution. In the first year of work that began in July 2008, local farmers helped Weeds Culture construct 500 urine-diverting toilets in 15 regions of Wenchuan.

A New Option To Combat Crushing Poverty

During the implementation of the eco-toilet project, Weeds Culture staff realized that local farmers were extremely concerned with securing a stable livelihood—many of them survived on 2,000 Yuan/person each year (~$294), which was less than one-third of what most rural farmers in China earn each year. In order to understand how they could help, the Weeds Culture staff surveyed farmers to identify development strengths and obstacles in each village. In the process, Weeds Culture staff discovered that many local farmers still used the traditional farming methods, forgoing fertilizers because of the expense. However, due to the difficult transportation out of these remote rural areas, these agricultural products were mainly consumed by the farmers instead of sold in the cities. In one case, villagers in Mao County who grew apples without chemical fertilizers ended up feeding them to pigs because they lacked market networks to sell them in cities. When

vendors do make it to the more remote villages, local farmers can only sell some livestock, such as chickens, ducks or pigs at very low prices.

Organic products have a high potential to bring in significantly more income for local farmers, in great part because Chinese urbanites are increasingly concerned about food safety. There are, however, two major challenges for organic food sales in China: high cost and doubts regarding the credibility of certified organic food or "Green Food." Weeds Culture designed the Eco City and Country 1+1 project to get more organic food to markets through building new farmer-consumer networks.

Organizing Farmer and Consumer Associations

In the first step to build farmer-consumer networks, Weeds Culture did surveys in three nature reserves in the earthquake region and three urban communities in Chengdu. Working together with local farmers, over 100 agricultural products were selected as "local specialty foods" to be grown organically and marketed to urban areas. Key in facilitating the urban-rural links were efforts by Weeds Culture to organize farmer associations in three villages located in or near the Wanglang, Heshuihe, and Wolong nature reserves and to establish three consumer associations in three middle-class urban communities (Zhongyanghuayuan, Shuduhuayuan, and Zhixinhuayuan) in Chengdu. As the first big advertising push, Weeds Culture marketed the organic food products to women, stressing the benefits of these products for children and pregnant mothers. The farmer and consumer associations greatly improved information dissemination for these new organic markets and greatly increased the sales.

Cultivating Trust and Mutual Benefits

In China farmers and consumers often are isolated at both ends of the food production and consumption chains. Urban consumers are skeptical of the food quality and farmers are unhappy with the low prices they receive from vendors. One of the first activities Weeds Culture organized were trips for urbanites to the farms, for during surveys, the NGO's staff discovered that many retired urbanites wanted to visit the countryside more often and many urban women wanted to buy food directly from farmers they knew personally. Urbanites visited farms and learned how the products were grown and then were able to put in orders for regular purchases. Many consumers have their own cars, which helped the consumer associations organize visits to the 100 organic farms participating in the network. The prices that consumers paid to farmers are no more than 30 percent higher than the market prices for conventional vegetables in Chengdu and the direct link to consumers also means farmers do not lose money to middlemen vendors. The direct trade also brings the information that urban consumers prefer products without using fertilizers and pesticide to the farmers, encouraging them to continue the traditional farming methods. Weeds Culture plans to organize 6 visits each year to the villages, which could generate an extra 2,000 Yuan (~$294) per year for each of the participating 100 farmer households in three villages. This added income nearly doubles the household's yearly income.

GUOYUANXIANGZHU FARM: CATALYZING NGO-BUSINESS COOPERATION

In contrast to CURA and Weeds Culture, Guoyuanxiangzhu Farm (hereafter the Farm) is not an NGO, but a privately run organic farm. Mr. Yu Luo, a former bond dealer, was motivated to establish the farm in 2001 due to his strong personal interest in organic farming and Chinese traditional farming methods. He began by contracting around 3 hectares of land in Shuangliu County near Chengdu to start experiments in organic agriculture. After 8 years practice the farm is planning to expand to 12 hectares and Mr. Luo has become the leading

organic farming practitioner in Chengdu. The impact of the Farm was enhanced by partnerships with many farmers, companies and NGOs, who have been key in the Farm's three core areas of work to promote organic food markets in the Chengdu area, namely: (1) trainings for farmers, (2) creating initiatives to protect local biodiversity, and (3) demonstrating how organic standards can be met.

Linking Farms to Markets

Over the years, the Farm has developed multiple strategies to publicize organic farming and products in order to raise the awareness of both farmers and consumers on how their food choices impact the environment and their own health. Since 2006, the Farm has provided organic farming training to over 500 farmers, as well as staff at NGOs and companies. Mr. Luo also works as the chief agro-technician for an earthquake recovery project that the Chinese NGO Global Village of Beijing is carrying out in Daping Village in Sichuan. He also acts as the chief agro-technician for WWF Chengdu office and organic farming trainer for CURA's Anlong village project. Although the prices for the Farm's organic products are 2.5 times more expensive than conventionally farmed products, there are 120 households in Chengdu ordering products each week from the Farm. To further expand the market for the Farm's products, in October 2009, Mr. Luo and some of his long-term customers invested to open the first organic restaurant in Chengdu. The restaurant closed after one year, but helped him gain insights in how to open another in the future.

Another important information dissemination activity began in 2006, when the Farm joined with local NGOs, companies, and farmers in Chengdu active in organic food production to organize a platform called the Chengdu Organic Food Market (COFM). COFM promotes information sharing and education on organic food through public lectures, product exhibits and sales and cooperation and resource sharing among the area's practitioners. Mr. Luo is the secretary of COFM.

Protecting Local Agricultural Biodiversity

Over the years the Farm has identified traditional crops, vegetables, and livestock species that need to be protected. Many animals have been eliminated from production due to the rise in intensive factory farms or CAFOs (confined animal feeding operations). While few farms in Chengdu raise traditional species of hens, pigs, and ducks, the Farm still has them, as well as 6 different types of radishes and 4 types of sweet potatoes.

1-Mr. Luo trains farmers and NGO staff how to make an insect-catching bottle Photo Credit: Su Su
2-The Chengdu Organic Food Market. Photo Credit: Yayuan Yang

Notably, the Farm also selects species that become part of they cycle of organic farming. For example, the pigs raised on the Farm are one of its most well-known and marketable livestock. The pig species was selected from an ethnic minority area in Sichuan that has cultivated it for nearly 20 years. These pigs only grow to about 50 kg and take twice as long to reach maturity than pigs typically used in factory farms. These pigs do not do well being raised in confined spaces, but are a very hardy breed that thrives being raised outdoors. Pigs and chickens are fenced in an area for ten months so their waste can fertilize the soil, which later is planted with crops.

The Farm has developed a well-working and balanced agriculture ecosystem over the past eight years and has become an important model for local farmers to learn and be inspired how to strictly follow organic farming requirements, forgoing chemical fertilizers, pesticides, and herbicides.

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ENDNOTES

[1] National Bureau of Statistics China. (2008). China Statistic Year Book 2008.

[2] Food and Agriculture Organization of the United Nations. (2008). FAOSTAT 2008.

Native pigs in the Farm. Photo credit: Hongyan Lu

COMMENTARY

Corporate Environmentalism in China: An NGO – Corporate Partnership to Improve Energy Efficiency in Chinese SMEs

By Gwen Davidow

The World Environment Center (WEC) is an independent, nonprofit, non-advocacy organization whose mission is to advance sustainable development through the business strategies and operations of its member companies. In this capacity, WEC is in a unique position to work with corporate partners, governments, and other nonprofits to further both sustainable environmental and economic goals—a combination of mission and incentive that is exemplified in WEC's Greening the Supply Chain strategic initiative.

This Greening the Supply Chain initiative is one of WEC's keystone programs and is proving the significance of collaborating with industry and governments to achieve improved performance across global supply chains. This approach combines the purchasing power of large multinationals (incentivized by their own stakeholders to address their global footprint) with the market drivers of their supplier base, which continues to grow in developing nations, particularly China. Chinese businesses have been feeling the pinch as the Chinese government pushes energy efficiency and pollution control in its national and municipal environmental regulations and corporate customers increasingly use their purchasing power to demand better environmental performance. While the Chinese government has struggled to enforce its many clean energy and pollution control laws, pressure from global markets to demand more energy efficiency and less pollutions from suppliers has begun to "green" the production of some of the larger Chinese exporting industries. This market-driven approach to green suppliers can trigger a domino effect of better environmental stewardship farther upstream in the production chain and influence the harder-to-reach small enterprises. With the potential of influencing the vast number of small Chinese suppliers, even small energy or pollution control improvements in operations and facilities can have a significant impact on protecting human health and energy security in China.

BUILDING A KEY PARTNERSHIP WITH SHANGHAI GENERAL MOTORS

Over the past five years, WEC has been fairly successful in building a large green supply chain (GSC) collaboration in China in partnership with Shanghai General Motors (Shanghai GM) and 127 of its suppliers. WEC and General Motors launched the GSC pilot project in 2005 with General Motors-China; Shanghai GM (a joint venture between GM and Shanghai Automotive Industry Corporation); the Society of Automotive Engineers- China; and a number of first-tier suppliers to GM-China. The success of the pilot project resulted in continued GSC projects carried out by WEC and Shanghai GM, working with a hand-picked group of 40 suppliers in 2008 and a total of 127 suppliers in 2009.

The project has since been incorporated in Shanghai GM's Drive to Green initiative, which promotes sustainable development throughout the company's national supply chain by working with suppliers to improve their manufacturing

processes by lowering consumption of raw materials and energy sources.

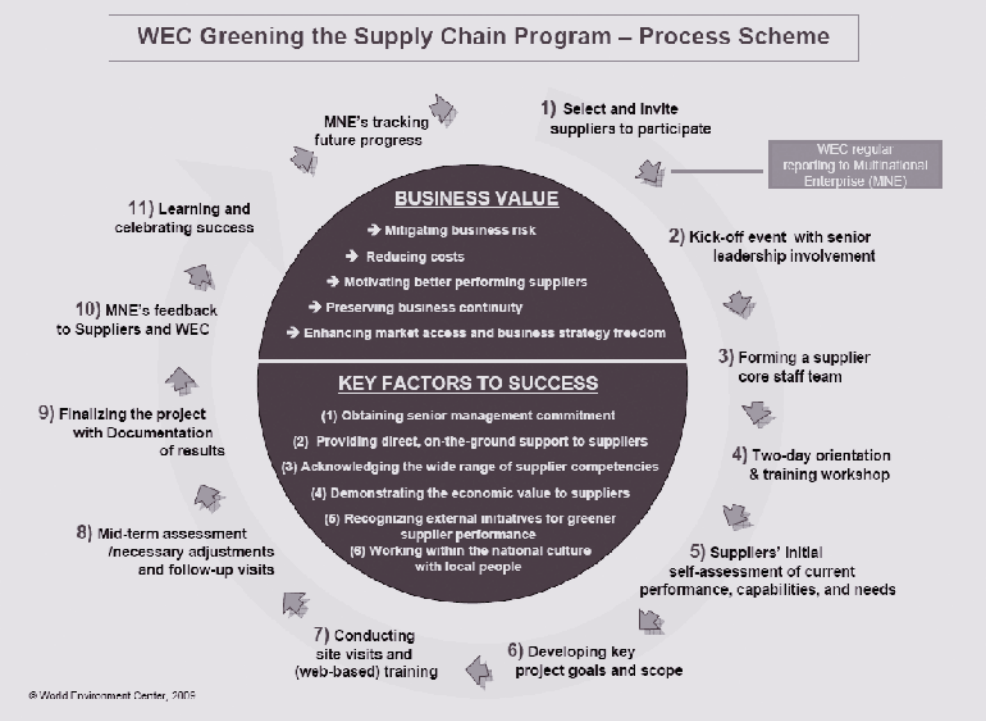
GSC Project Goals

The GSC project in with Shanghai GM aims to enhance performance in small and medium enterprises (SMEs) in the areas of clean production and energy efficiency, while simultaneously creating economic results that will further motivate continued "green" improvement. Specifically, the processes and facilities for each SME are assessed to see where improvements can be made in health/safety practices, efficient use of energy and natural resources, reduction of emissions, and the impact of the company on its community. In achieving these goals, the suppliers are often able to maximize efficiencies, cut costs and increase savings—results that will incentivize the suppliers to not only continue the cycle of assessing and improving energy and environmental performance after the project is over, but also passing the lessons learned to their own suppliers.

Global corporations devote increasing amount of attention to clean production in their supply chains, particularly in developing nations, because (1) the focus of concerns among stakeholders of corporate responsibility has changed to include the full value chain; (2) the countries where many companies operate continue to develop stronger policies to regulate industrial energy and environmental issues; and (3) these efforts with suppliers can serve to strengthen performance and benefit the corporation from more efficient suppliers.

Project Approach

The GSC project is a tool to address environmental and economic performance in SMEs through incentives and best practices. The incentives are spurred by the multinational corporation, usually a WEC member company, reaching out to a select group of suppliers to participate in a drive to improve manufacturing processes in their facilities by adopting cleaner production and energy efficient practices. These activities are funded either by a government entity or the corporation itself. The current GSC project in China is funded by Shanghai GM,



Source: World Environment Center

who works with WEC to approve the overall direction and provide access to the suppliers. It is Shanghai GM's initial responsibility to bring in the selected suppliers, choosing to work with those that are both willing and capable to commit to the full project term.

Once Shanghai GM selects a set of appropriate suppliers, WEC works with them to create timelines and deliverables, establish baselines, train staff in the supplier's company in the methodology, and draft action plans for cleaner production and energy efficiency goals. Shanghai GM's relationship with these suppliers and their visible support for this work is—and has been—pivotal to the project's success. Throughout this process, WEC consistently monitors supplier progress and communicates with Shanghai GM, among the suppliers, and with the local team. (See Figure 1).

As the project expands to new participating suppliers, the previous green suppliers carry on by applying the continuous improvement principles to a wider range of their practices and operations, thereby ensuring the greatest reach of the project among Shanghai GM suppliers.

ENVIRONMENTAL AND ECONOMIC RESULTS

In 2008, Shanghai GM announced that the progress made by the 40 suppliers involved in the second phase of the GSC project provided a total savings of 22 million Yuan ($3.2 million) in one year in energy costs; over 18 million Yuan ($2.6 million) in one year in raw material savings; reductions of over 6 million tons of solid waste and 4.3 million tons of waste gas, among other noteworthy achievements. At the completion of the third phase of the project in early 2010, the 79 newest participating suppliers undertook 187 projects that focus on cleaner production, material savings and production efficiency, as well as 175 energy efficiency initiatives. The results of these projects provided a strong environmental and economic rationale for continuation of the GSC initiatives:

- Total annual cost savings of 69,910,000 Yuan ($10.2 million) was realized with a total investment of about 48,758,000 Yuan ($7.1 million);

One of the greatest project results has been the institutionalization of consistent energy and environmental monitoring efforts throughout Shanghai GM's supply chain.

- The average payback period for 78 percent of the cleaner production projects implemented was less than one year; and,
- Reductions of more than 36,700 tons per year of greenhouse gases;
- Annual reductions of 370,600 tons water usage; 7,600 tons of solid waste; and,
- Decrease in annual wastewater by 136,600 kiloliters.

One of the greatest project results has been the institutionalization of consistent energy and environmental monitoring efforts throughout Shanghai GM's supply chain. The next phase of the project was inaugurated in Shanghai in the summer of 2010 for 80 new suppliers, as the graduates from the program in past phases now focus on maintaining results through continuous improvement efforts.

KEY FACTORS TO SUCCESS

As summarized above, WEC's work with Shanghai GM has led to the participating SMEs to mitigate waste, improve air and water quality, and practice stronger public health and safety practices, all while increasing productivity and efficiency. There remains much more work to

do, but the successes thus far are attributed to four key factors:

Senior Leadership Commitment. Commitment is necessary from the senior levels of the multinational corporations, as is the communication of that commitment to their suppliers. The role of developing, customizing, implementing, measuring and managing the project is a joint effort between the WEC global team and the multinationals, but the primary role of the latter is to provide visible and consistent support of the activities throughout the project term. Equally important is the commitment from the executives of the participating suppliers. Their visible support is essential to encourage the in-house teams to devote the resources necessary for a successful project.

WEC's Local Team. WEC's local experts and partners are able to navigate cultural, language, and business issues that might otherwise present barriers. The local team, in conjunction with WEC global and Shanghai GM leadership, worked with the selected suppliers from initiation to understand each company's unique capacities and opportunities. Although WEC's activities and operations are global in scope, this project and providing direct, on-site support to suppliers.

SGM Senior Executives, WEC Team members, and Suppliers on stage at a 2008 Green Supply Chain Recognition Ceremony in Shanghai
Photo Credit: World Environment Center

Actionable and Measurable Results. The action plans are customized to each supplier, using self-audits as a baseline, incorporating WEC technical guidance for process improvements, and measuring the improvements in terms of savings in energy, natural resources, waste and money. WEC trains the participants in this full process, from assessment to final results, providing tactical and strategic direction throughout the project term.

Communication. A consistent level of communication is imperative among the suppliers, WEC team, and SGM throughout the project. The suppliers provide baseline assessments, annual plans, and monthly reports to the WEC team, who then are able to collate the information into monthly progress reports for Shanghai GM.

INCENTIVES AND CHALLENGES FOR PARTICIPATING STAKEHOLDERS

The Chinese government has been very active in encouraging businesses to focus on reducing their environmental and energy footprints. While there are incentives for large and small enterprises to meet and even go beyond the government's goals, capacity and clear guidance on how to operate sustainably are often lacking in China, particularly within SMEs. Shanghai GM has been instrumental in guiding its suppliers through its "Drive to Green" initiative (under which the GSC project is managed), which establishes clear targets and capacity building to promote greener growth.

Even if SMEs do not take government goals into account, becoming part of a greener supply chain provides a focus on processes that create more efficient production systems, greater savings, and a reduction of resource usage and waste. So while the incentives might initially be regulatory, companies will take more action

when green business practices help promote economic savings.

Challenges for Participants

In addition to China, over the past eight years, the World Environment Center has implemented "Green Supply Chain" projects in Australia, Brazil, El Salvador, Guatemala, Mexico, and Romania through a combination of government and corporate funding. In the course of this work, WEC has discovered many challenges that suppliers face in participating in GSC projects. The challenges summarized below highlight the kinds of challenges suppliers face in trying to green supply chains.

Competing Priorities. It can be challenging to integrate the GSC project into the business operations of SMEs when there already are competing priorities for the financial and human resources of the company. WEC addressed this in China by emphasizing the support and expectations of Shanghai GM's senior management; clarifying the role of WEC and the on-the-ground team (not to scrutinize, but rather to evaluate and assist); and enlisting the buy-in of the senior levels of the suppliers.

Credibility. There might be an initial concern that GSC is a way for the corporate customer—or possibly the government—to impose greater scrutiny on a supplier's operations. As a nonprofit, mission-based organization, WEC's management of the project provides an unbiased margin between supplier and customer.

Project Expansion. As the project continues to succeed, WEC has focused on the challenge of the costs associated with managing the growing number of participants. One of the solutions has been relying on web-enabled communication: a member-only site for participating suppliers to centrally post their reports, plans, and results so that the local experts and administrators can review and collate en masse. The web solution continues to evolve as the project does, and is expected to be one of the strongest cost equalizers WEC will employ.

FINAL THOUGHTS

In the three-plus years that WEC has worked on the Greening Supply Chain project in China with local partners and Shanghai GM, the team has found ample opportunity to discern the factors that strengthen the project, and to underscore key lessons learned. The key success factors—local, on-the-ground implementation; senior-level buy-in from both the suppliers and the corporate customer; measurable goals; and consistent communication—apply to this project across the globe. As do the lessons learned, such as:

- Results are maximized when the stakeholders with vested interest can assume a level of economic incentives, whether it be the continued loyalty of their customer base (Shanghai GM, in this case); the potential for greater returns and savings garnered from better practices; or the creation of efficiencies in the process;
- These activities can be applied successfully in parallel with government mandates, and indeed be strengthened by them; and,
- Management by a mission-driven NGO is necessary to assure participants that, although the results do tend to provide economic benefits, the underlying purpose is always a drive toward cleaner production and energy efficiencies.

The strength of this project relies on WEC's team taking these lessons and threading them through the next iterations, in China and elsewhere.

In her current capacity as Global Director of Corporate Programs for WEC, Ms. Davidow manages several membership-based projects, such as the Greening the Supply Chain initiatives in Shanghai and Australia, and government-funded projects in Central America. She can be contacted at gdavidow@wec.org.

SPOTLIGHT ON NGO ACTIVISM IN CHINA

The Keystone of Nanjing's Environmental Movement

By Samantha L. Jones

In the university-filled city of Nanjing in southern Jiangsu Province, it is perhaps no surprise that students and recent graduates are spearheading the environmental NGO movement. Jiangsu is a major economic powerhouse in central China that is plagued by many water pollution challenges—most notably the serious toxic algae blooms in Lake Tai, but many rivers in the province contain undrinkable water—polluted by agricultural runoff, municipal waste and untreated industrial emissions. Water has thus been one issue that inspired a particularly notable green group to emerge amid the famous tree-lined streets of Nanjing—Green Stone Environmental Action Network.

The organization, which was established in 2000, acts as an information exchange platform for the university students of Nanjing and surrounding cities. In this role, Green Stone routinely conducts environmental training sessions throughout Nanjing's many universities to foster the next generation of environmental leaders, both to join the organization and to improve management in other environmental organizations. In addition, Green Stone volunteers conduct environmental educational seminars at local primary schools and online. As one of China's first youth volunteer organizations, Green Stone serves as a structural model for younger environmental organizations across the nation.

While Nanjing is normally considered one of China's "greener" cities, Green Stone does not lack environmental issues about which to raise public awareness. Through a variety of small-scale projects, Green Stone acts as a community advocate for improving the public sense of environmental responsibility. These small projects include efforts against Siberian Musk Deer poaching and the establishment of a Tiger-butterfly protection program around Purple Mountain, the city's primary scenic area.

One of the biggest issues that Green Stone has brought to the public eye is the pollution of the Qinhuai River, often referred to as the "mother river" of Nanjing, which is a tributary of the "mother river" of China—the Yangtze River. The Qinhuai River has always played a pivotal role in Nanjing's identity as a city—making the city's fengshui ideal for locating the Ming Tombs and running straight through the classic Nanjing cityscape of traditional architecture around Confucius Temple.

Beginning in the 1980s, industrial pollutants released into the river caused, among other things, reports of a "green mud" along the river banks. The "recipe" for making this mud begins with a variety of agricultural pollutants entering the river in its path from the suburb of Lishui to downtown Nanjing. Once inside Nanjing proper, chemical, textile, paper, and pharmaceutical industries released further pollutants into the river.

In 2002, environmentally-minded university students petitioned the Nanjing government to take action. Throughout the remediation efforts, Green Stone continually documented the problem and created an informational pamphlet that led this NGO to win the "Ford Motor Environmental Award" in 2005. The Nanjing

government responded to public outcries about the pollution by expanding and raising river banks, constructing a flood wall, and increasing waste management systems with pipelines to keep all effluents directed at new treatment plants away from the river. UN-HABITAT's Water for Asian Cities Program worked with the city to improve its water and sanitation systems with a U.S. $100 million Asian Development Bank loan. In 2008, immediately prior to hosting the 4th United Nations World Urban Forum, the Nanjing Municipal Government won the UN Habitat Scroll of Honour Special Citation for its revitalization effort along the Qinhuai River, in no small part due to the work of Green Stone.

Throughout the rehabilitation process, raising awareness about the Qinhuai River remained an important part of Green Stone's work. The organization executed a community water savings program with the goal of minimizing water usage through small, everyday measures and focused its 2008 annual environmental mapping project for Green Map Systems (a New York-based organization that has similar projects in Beijing, Dalian, Ningbo, Hangzhou, Taiwan, and Hong Kong) along the banks of the Qinhuai that charts for communities the vital aspects of Nanjing's ecological, social and cultural resources, for example the location of vital habitats. In its role as an environmental advocate for Nanjing's mother river, Green Stone is at the forefront of China's environmental movement, in which the urgency of water pollution issues is becoming increasingly evident.

Samantha graduated from Wellesley College in 2008 with double majors in Environmental Studies and East Asian Studies. She was a CEF research intern twice in 2008, conducted the Wellesley-Yenching Fellowship in Nanjing from 2008-2009, studied at the Johns Hopkins Nanjing Center for Chinese and American Studies in the 2009-2010 academic year, and is now working in Shanghai. She can be reached at samanthalaurenjones@gmail.com.

A view of Nanjing along the banks of the Qinhuai River, a river that Green Stone is working to protect.
Photo Credit: Samantha L. Jones