CSIS REPORT

Water and Energy Futures in an Urbanized Asia

Sustaining the Tiger

A Report of the Global Strategy Institute
Center for Strategic and International Studies

Edited by
Erik R. Peterson
Rachel Posner

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Preface

Urbanization is taking the world by storm. In the last 107 years, the proportion of humanity living in cities has skyrocketed from 13 to 50 percent—with 2007 marking the inflection point at which for the first time ever more people on Earth live in urban rather than rural areas. This trend can be expected to continue. The United Nations predicts that 60 percent of the global population will live in cities by 2030.[1] This implies major shifts in how we govern, allocate natural resources, manage infrastructure, conduct business, and much more.

Pacific Asia—the region encompassing China and its neighbors in East and Southeast Asia—is a key driver of this global urban transition. During the next couple of decades, the region will account for about one-third of the world's urban population growth, increasing by about 750 million people in absolute terms. By 2025, the world is expected to have an urban population of five billion people, of which 30 percent will reside in Pacific Asia's cities.[2]

Inherent tensions between rapid economic development and poverty alleviation on the one hand and environmental sustainability on the other are widely acknowledged. As we look to the future, how these critical issues intersect in China will have enormous significance for developments in that country as well as around the entire world. With this white paper, we hope to contribute to the exploration of the complex simultaneous phenomena of rapid urbanization, resource management (with a focus on water and energy), and the broader public policy challenges and opportunities in Asia. A number of compelling questions arise: What are the most promising technological innovations to promote environmentally sustainable economic growth? What factors are most significant in driving change? How are priorities assigned, and how are those priorities changing? How are the players changing? What kinds of policies, regulations, and other governance tools help identify trajectories that at once promote economic development and address environmental degradation? To answer these and other related questions, we sought out experts—from nongovernmental organizations and academia—on dynamics in the region and on water and energy issues more broadly. Each of their submissions helps us to understand the opportunities and challenges that lie ahead; together, these essays begin to paint a more comprehensive picture of what is to come.

The structure of this report follows a thematic path. We begin with a discussion of China's strategic plan to lead the world in science and technology, as innovation will play a critical role in resolving the region's resource management conundrum.

1. Please see figure A-1 in the appendix for a regional breakdown of urbanization trends across the world.

2. Mike Douglass, "Mega-Urban Regions and World City Formation: Globalisation, the Economic Crisis and Urban Policy Issues in Pacific Asia," *Urban Studies* 37, no. 12 (July 2000): 2315–2335.

Contributions from energy and water experts come next, continuing to focus on China and outlining the implications of increased energy and water consumption in an urbanized Pacific Asia. We then transition to a discussion of the technological innovations that could potentially help China cope with its environmental challenges. We close with contributions from our field experts who lay out new modes of environmental governance that could be implemented in both China and its neighboring developing countries.

We would like to offer sincere thanks to the individuals who contributed to this report: Gerrit W. Gong; Jan Lundqvist; David Pumphrey, Sarah Ladislaw, and Matthew Frank; Jennifer L. Turner; Michael Totten; Terry Foecke and Chris Plante; and Gene M. Owens. We would also like to express gratitude to Laura Keating, Emily Poster, Philipp Behm, Kartik Akileswaran, and Jennifer Cassell for their assistance.

This report was made possible with generous support from Sandia National Laboratories.

CHAPTER 1

Introduction

Erik R. Peterson and Rachel Posner

The March of Urbanization and Economic Development

Urbanization and economic growth are interconnected and mutually reinforcing. Economic growth drives up the standard of living, which triggers migration from rural areas to cities (as citizens search for better employment opportunities). This movement of human capital concentrates production, thus attracting foreign investment and spurring further economic growth. Many of the major cities in Pacific Asia are reportedly generating up to half of the gross national product of their national economies already. This should come as no surprise because, for example, one-fifth of Thailand's population lives in the Bangkok region, nearly one-third of Japan's population is concentrated in the megalopolis of Tokyo, and almost half of the population of South Korea lives in the urban region of Seoul.[1] China is no exception to this trend. With 30 percent of its inhabitants residing in cities, China now plans to relocate 400 million people to newly developed urban centers between 2000 and 2030.[2] Figure A-2 shows urbanization trends for a sample of countries in the Asia Pacific region.

In parallel with rapid urbanization, the region as a whole is undergoing unprecedented economic expansion. Figure A-3 shows the rise in gross domestic product per capita across a number of countries in the Pacific Asia region—from more developed economies like Japan and South Korea to those less developed like Vietnam and Thailand. According to the World Bank, since initiating reforms and an open policy, China alone has lifted more than 400 million people out of poverty and has seen incomes nationwide increase more than sevenfold, from $280 to $2000 during the past 25 years. Thanks in part to China's rapid rise, exports from its neighbors in East and Southeast Asia are also increasing, lifting 50 million people across the region out of poverty in each of the past five years.[3] Figure A-4 illustrates the trend of poverty reduction in China compared with the Pacific Asia region as a whole.

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1. Mike Douglass, "Mega-Urban Regions and World City Formation: Globalisation, the Economic Crisis and Urban Policy Issues in Pacific Asia," *Urban Studies* 37, no. 12 (July 2000): 2315–2335.

2. Elizabeth C. Economy, "The Great Leap Backward?," *Foreign Affairs* 86, no.5 (September/October 2007): 40.

3. "East Asia and Pacific Update—Ten Years after Asia's Financial Crisis," World Bank, Washington, D.C., April 2007.

In the face of this remarkable economic dynamism, we need to ask whether the developing countries in Pacific Asia are hurtling down an unsustainable course that could be derailed by any number of factors. Will short-sighted environmental stewardship become a destabilizing force in the long term, ultimately slowing growth in the whole region? Such a scenario should be a concern for the West. We learned from the 1997 East Asia financial crisis that U.S. exporters, mainly manufacturers and some other industrial firms, can suffer significant losses as a result of economic downturns in this region. Moreover, the West is increasingly affected by overseas environmental degradation when we consider global climate change as well as the effects of depleting freshwater and energy resources.

Energy: Fueling Development

Fossil fuels (coal, oil, and gas) dominate the energy market in Pacific Asia, and the demand for energy is continuing to grow along with the economy. According to the Asian Development Bank, energy consumption has increased by 230 percent during the past 30 years across all of Asia. China is responsible for a large share of this dramatic jump as its per capita energy consumption has more than doubled since 1980, according to the UN Statistics Division. And this rising demand is expected to continue as the World Bank estimates that between 2002 and 2020 one-third of total global energy demand will be due to the rate of economic expansion in East and Southeast Asia.[4]

Such a trajectory has profound implications for the environment and human health. In China, for example, where coal accounts for more than 60 percent of net energy consumption, air pollution causes between 300,000 and 500,000 premature deaths annually.[5] Pollution from Chinese coal-fired plants induces acid rain over Japan and South Korea, and aggregate carbon emissions from China and other developing countries in the region contribute significantly to global climate change. (Figure A-5 illustrates global carbon emissions broken down by region.)

Meanwhile, as countries attempt to bring other, less carbon-emitting power sources online, the concern for water is often neglected. Thailand, Vietnam, Laos, and China have erected dams along the Mekong River to generate hydroelectric power, but these projects impact the river's ecosystem, harm fish, alter silt levels, and thus jeopardize food supply for rural areas downstream.[6] The nexus between water and energy will be ever more important in the decades ahead as consumption continues to grow and available resources decline.

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4. "Energy and Mining in East Asia and Pacific," World Bank, Washington, D.C., www.worldbank.org/eapenergy.

5. C. Fred Bergsten et al., *China: The Balance Sheet: What the World Needs to Know Now about the Emerging Superpower* (New York: Public Affairs, 2006).

6. Fred Pearce, *When the Rivers Run Dry* (Boston: Beacon Press, 2006), p. 103.

Water: A Scarce and Vital Resource

In Pacific Asia, the need for water is on the rise across sectors, further increasing the disparity between water demand and availability. Water quality has deteriorated particularly in urban areas, destroying ecosystems, killing wildlife, and spreading waterborne diseases to communities downstream as well. Sewage or industrial effluents discharged from cities are likely to pollute and therefore limit the future potential uses for surface or ground water. Since 1950, water availability per capita has already decreased by 60 percent in North Asia and by 55 percent in Southeast Asia.[7] China's urban areas typify this trend as more than 75 percent of urban river water is unsuitable for drinking or fishing and 90 percent of urban groundwater is contaminated.[8]

But not all of the damage can be attributed to cities exclusively. According to the Food and Agriculture Organization of the United Nations, 79 percent of water withdrawal across East and Southeast Asia is still used for agriculture (for both irrigation and livestock to feed growing populations). Only 14 percent goes to industry and 7 percent to domestic water supplies.[9] Agricultural overexploitation is depleting fisheries, eroding soils, and drawing down other natural capital. The economic consequences of such activities equate to reducing gross national savings by almost one-third in China, the Philippines, and Cambodia, and by almost half in Mongolia and Malaysia.[10]

Looking Forward

Despite these various potential impediments to growth over the long term, the contributors to this white paper see many opportunities in the context of urbanization for actualizing sustainable development in the region, specifically in the realms of technology and governance.

Looking forward to 2020, China plans to undertake a strategic shift away from low-cost manufacturing toward becoming a major innovator—an owner of cutting-edge science and technology to resolve and manage its environmental challenges. Already, three provinces across the country are beginning to adopt regulations to enable "efficiency power plants" (EPPs) to compete in the integrated resource planning (IRP) process. If taken to scale across all of China in the next 30 years, enormous savings could result from manufacturing with high-efficiency motors, pumps, and compressors; from constructing energy-efficient buildings in China's growing cities; and from consumers operating energy-efficient appliances.

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7. Yatsuka Kataoka, "Overview Paper on Water for Sustainable Development in Asia and the Pacific" (paper presented at the Asia-Pacific Forum for Environmental and Development, Bangkok, Thailand, January 12–13, 2002).

8. Bergsten et al., *China: The Balance Sheet.*

9. "General Summary Asia: Water Withdrawal," Aquastat, Food and Agriculture Organization of the United Nations, 2007, http://www.fao.org/nr/water/aquastat/regions/asia/index4.stm.

10. Paul Steele and Sergio Feld, "Asia's Smart Growth: Resourceful Strategies for Asia," *Far Eastern Economic Review,* April 2007, pp. 53–56.

IRP-EPP could save some $5 trillion in power plant construction and operating costs, not to mention the countless environmental and health benefits. Similarly, a mandated IRP for water in China could finally bring an end to the country's inefficient industrial, agricultural, and domestic use of water.

The actual implementation of such reforms across China's massive utility regulatory system will be a major challenge for Beijing. The Chinese market will need stricter efficiency standards as well as effective enforcement mechanisms for ensuring compliance with such standards. It is hoped that the current social unrest resulting from poor resource management will lead to stronger environmental governance in China, and such necessary standards will begin to be enforced on a broad scale.

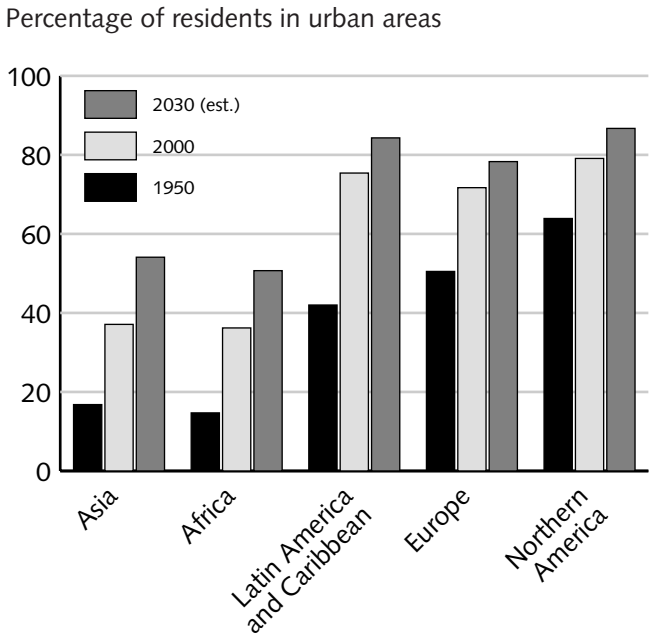
Beyond China, the mature economies in the region may be able to reduce energy consumption and emissions intensity as they transition from industrial-based to service-oriented economies. At the other end of the development spectrum, many of the countries in Southeast Asia are currently in the midst of rapid industrialization. If these governments adopt clean and efficient energy and water regulations (and incentives) and share relevant information as they continue to urbanize and build up industry, greenhouse gas emissions could be curbed while economic growth is sustained. Dirty development is not preordained, and many countries in Pacific Asia are poised on their development curve to make profound changes during the coming decades.

When we look at the interplay of water, energy, and urbanization trends in the region, we cannot ignore the significant populations remaining in rural areas. Life in rural communities is dramatically affected by urban activities—availability of energy and freshwater resources decrease when limited resources are diverted for city (and industrial) use. A number of new intellectual approaches to environmental governance programs have arisen to incorporate local priorities in decisionmaking. These innovative methods could prevent future instability in rural regions inflicted with energy and water problems.

Leaders in developing countries often assign a higher priority to economic growth than to other objectives (like environmental sustainability). Therefore, resource management programs are more promising when they use market-driven approaches that help realign economic incentives and encourage collaborative public policy. Programs are also more likely to endure the test of time if they involve a range of stakeholders, including public, private, and nongovernmental organization sector representatives.

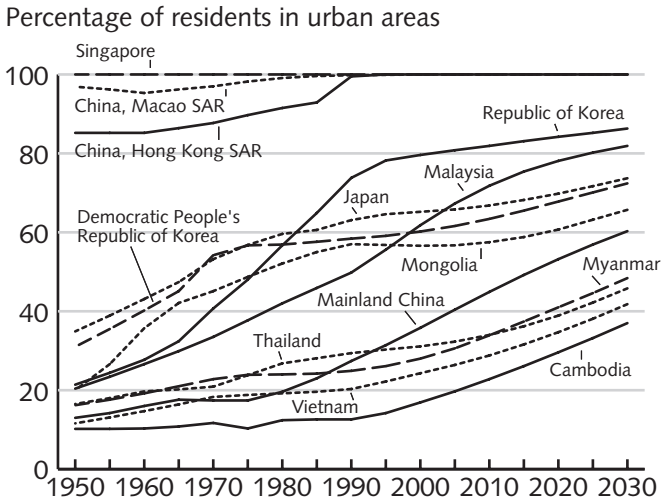
Appendix

Figure A-1. Percentage of the Population Living in Urban Areas in Selected Regions of the World, 1950, 2000, and 2030 (estimated)



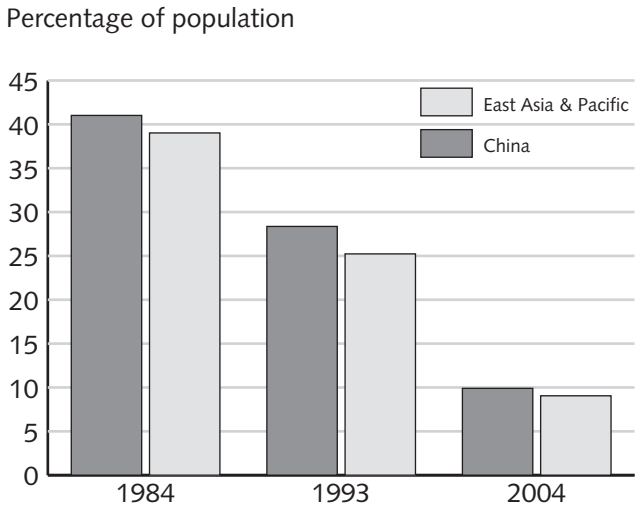
Source: *World Population Prospects: The 2006 Revision* (New York: United Nations Population Division).

Figure A-2. Percentage of Population Living in Urban Areas in Selected Countries in East and Southeast Asia, 1950–2030 (estimated)



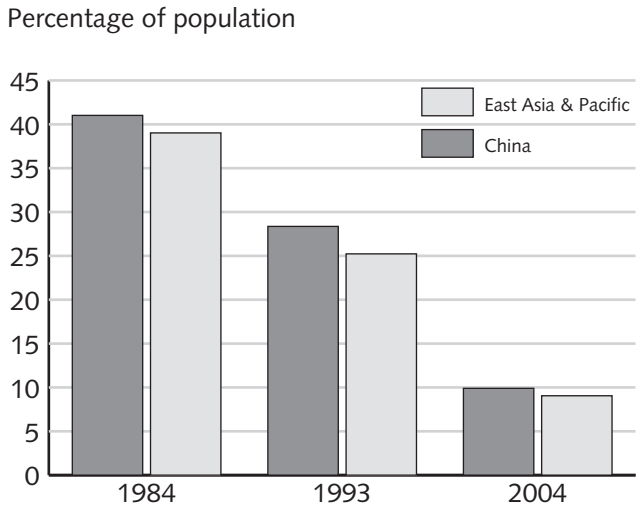
Source: *World Population Prospects: The 2006 Revision* (New York: United Nations Population Division).

Figure A-3. Gross Domestic Product per Capita in Selected Countries in East and Southeast Asia, in Constant 2000 U.S. Dollars, 1960–2006



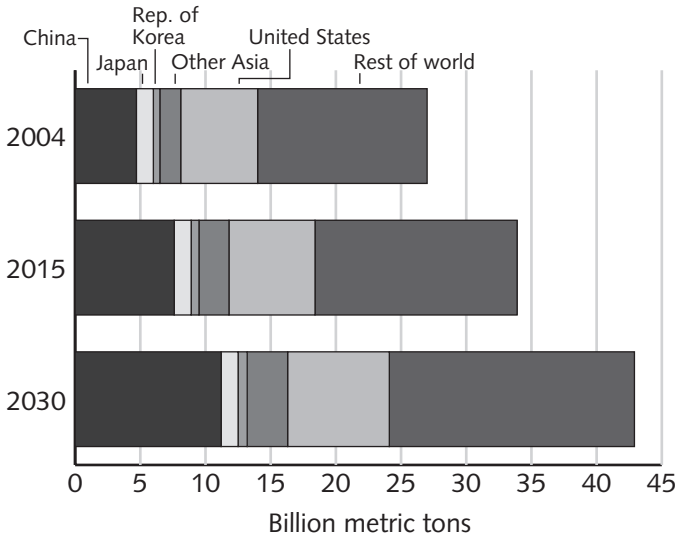
Source: "World Development Indicators" database, World Bank, Washington, D.C., 2007.

Figure A-4. Poverty Reduction in China Compared with the East and Southeast Asia Region as a Whole, 1984, 1993, and 2004



Source: "World Development Indicators" database, World Bank, Washington, D.C., 2007.
Note: This is the poverty headcount ratio at $1.00 per day.

Figure A-5. Worldwide Carbon Dioxide Emissions, 2004, 2015, and 2030 (estimated)



Source: Figure prepared by the CSIS Energy Program from data in *International Energy Outlook 2007* (Washington, D.C.: U.S. Department of Energy, Energy Information Administration, May 2007).

CHAPTER 2

China: A Clash of Innovation and Natural Resource Imperatives?

Gerrit W. Gong

Trends in the use of water and energy in an urbanized Pacific Asia provide a major opportunity for using technology for mitigating risks associated with environmentally unsustainable development in the region's industrializing countries. Gerrit W. Gong provides a high-level view of the region through the historical context of shifting regional centers of gravity and dominant modes of production in the world. Zooming in on China, which is now pushing itself toward the center of both such movements, Gong explores China's strategic plan for transforming into an innovation society and points out the many challenges that lie ahead, especially in the realm of resource management.

A provocative two-by-three matrix anticipates a twenty-first-century "sweet spot" by predicting a convergence between shifting regional centers of gravity and shifting dominant modes of production over time.

For the shifting regional centers of gravity, the matrix postulates the ocean of the nineteenth century was the Mediterranean, the ocean of the twentieth century was the Atlantic, and the ocean of the twenty-first century is the Pacific. For the shifting dominant modes of production, the matrix postulates the main mode of production in the nineteenth century was agriculture, in the twentieth century it was industry; and in the twenty-first century it is knowledge or information.

A major country at the twenty-first-century intersection of the Pacific region and a knowledge-based economy is—of course—China.

But here is the twist. In China's conscious, strategic shift toward knowledge and capital intensity consistent with projected twenty-first-century trajectories for optimum economic and financial value creation, Beijing faces intensifying challenges in nineteenth- and twentieth-century means and modes of production—namely, intersecting concerns for water, energy, and self-sufficient or self-reliant agricultural production within larger patterns of urbanization and a sustainable environment.

Thus, a question arises: Is there a clash of innovation and natural resources imperatives for China as it moves into the twenty-first century? To what extent can Beijing simultaneously successfully focus national strategies for innovation while it deals with national concerns for natural resources procurement and distribution?

China's National Innovation Imperative

In January 2006, President Hu Jintao of China put his country and the world on notice. Looking toward 2020, President Hu declared, "China will achieve more science and technological breakthroughs of great world influence, qualifying it to join the ranks of the world's most innovative countries."

Put another way, China says it intends to make a strategic shift from mass manufacturer to global innovator. China is currently the world's most successful low-cost manufacturing platform. But Beijing's export growth is still significantly dependent on imported technology and foreign direct investment. In the future, Beijing says it wants to become a major innovator and owner of core intellectual property and processes vital to global knowledge economies.

The State Council of the People's Republic of China in early 2006 issued guidelines for China's medium- and long-term national science and technology development program for the years 2006 through 2020. The guidelines allow a glimpse into the underlying reasons and some of the potential implications for Beijing's stated strategic shift:

> Faced with the new international situation, we must heighten our sense of responsibility and urgency; act more consciously and steadfastly to make S&T (science and technology) progress a primary driving force in economic and social development; regard the improvement of independent innovative capabilities as the centerpiece of our efforts to adjust our economic structure; change our growth mode, and improve the country's competitiveness; and view the construction of an innovative country as a future-oriented major strategic choice.[1]

In a sense, each modern Chinese top leader has provided his country a national slogan as focus and rallying cry.

> Under Mao Zedong, it was "Serve the people."
> Under Deng Xiaoping, it was "Reform and opening to the outside."
> Under Jiang Zemin, it was the "Three represents."
> And, under Hu Jintao, it is "Harmonious society" and "Independent innovation."

China's campaign-style approach contributes to an element of techno-nationalism in China's competitive determination to succeed at globally comparable innovation. One Chinese professor articulated a now familiar Chinese aspiration:

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1. People's Republic of China State Council, "Preface" of the "Guidelines for the Medium- and Long-Term National Science and Technology Development Programme (2006–2020)" (Beijing: State Council, 2006), as reported by Xinhua Domestic Service, January 9, 2006.

> Science can be like the Olympics. Twenty years ago, at the Los Angeles Olympics, China got very few medals. But in Athens, we got 32 golds, compared to 35 for the U.S. Who knows what we will achieve in 2008 in Beijing? And what is true on the sports field is also true in the laboratory.[2]

Indeed, since 1999, China has increased research and development (R&D) 20 percent each year.[3] R&D investment rose from 0.7 percent of China's gross domestic product (GDP) in 1998 to 1.3 percent of GDP in 2005. And, in a development many saw as significant, in December 2006, China surpassed Japan to become the world's second-highest R&D investor after the United States.[4]

The focus on innovation is of course aimed at moving China up the knowledge and capital-intensity value ladder by Beijing's creating, owning, and deploying intellectual properties and processes central to modern knowledge and information economies.

But China's strategic shift toward becoming an innovative society has a twofold mission.

The first part of the mission of China's strategic shift toward becoming an innovative society is to bring cutting-edge innovative science and technology to resolve and manage ongoing current sustainable environment challenges. This is not a small task given the rapidly growing needs and wants of a 1.3 billion population that may rise to 1.5 or 1.6 billion total population before it plateaus and then tapers off toward the middle of this century.

A former Chinese premier was once asked about his country's biggest challenge. He laughingly replied that it was providing enough toilet seats each year.[5] What he was playfully describing in shorthand was the relentless year-by-year need to provide water, sewage treatment, housing, energy, transportation, and many other accoutrements of a modern lifestyle to a rapidly urbanizing and sophisticated population with increasing expectations for a continually rising standard of living.

The second mission of China's strategic shift toward becoming an innovative society is to change—dare it be said—the very paradigm of China's modernization. It is to position the world's most populous country away from nineteenth- and twentieth-century agricultural and industrial natural resources dependence and to focus on new, innovative twenty-first-century possibilities more centered on knowledge and less demanding of constrained natural resources.

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2. James Wilsdon and James Keely, *China: The Next Science Superpower?* (London: Demos, 2007), p. 15, http://www.demos.co.uk/files/China_Final.pdf.

3. Ibid., p. 6.

4. Organization for Economic Cooperation and Development (OECD), *OECD Science, Technology and Industry Outlook 2006* (Paris: OECD, 2006).

5. Personal recollection of the author.

Innovation and Sustainable Environment in China

Given the above, it is no surprise to find energy, environment, agriculture, and water well represented among some 68 priority goals across 11 key areas in China's medium- and long-term plan for science and technology development.

China's ability to achieve its priority goals must be viewed within a broader dynamic of central and provincial authority. In general, the central government's authority in China to impose national political, economic, or natural environmental priorities is relatively weak. In general, the provinces' ability to do what local leaders want, sometimes with little regard for larger environmental concerns or national environmental priorities, is relatively strong.

Still, China's interlocking challenges in water, agriculture, and energy are receiving increasing attention.

For example, in China, one estimate is that "more than 300 million rural citizens, about a quarter of the country's total population, lack access to clean drinking water."[6] A public health implication of lack of access to clean drinking water is evident in China's child mortality rates. One World Bank policy research working paper "found that access to safe drinking water could potentially cut the number of under-five child deaths from diarrhea by over 50 percent, and the number of deaths from acute respiratory infection by almost 40 percent."[7]

In another example of interlocking water, agriculture, and energy causes and effects: "lax enforcement of municipal and industrial discharge into water bodies left three-quarters of China's lakes and one-third of the rivers too polluted for use in agriculture or industry."[8] A clear target for China's coming innovative drive will be the need for "investment in wastewater treatment facilities, industrial effluent monitoring, and protection of public water supplies."

Paradoxically, even "when the facilities are available, poor incentive structures leave them inoperative or sometimes simply turned off to save on *energy* costs."[9] Indeed, in 2006, "nearly half of China's major cities did not meet state drinking water quality standards."[10]

In a third example, Beijing has embarked on a vigorous effort to secure long-term strategic access to key raw materials and natural resources, including energy. China became a net oil importer in 1993 in the face of dwindling domestic oil reserves, highly inefficient energy use within China, and the leadership's determina-

6. Debbie Yan Lee, "Child Mortality and Water Pollution in China: Achieving Millennium Development Goal 4," A China Environmental Health Project Research Brief (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2007), p. 2; quoted by Yinglin Liu, "China's Drinking Water Situation Grim; Heavy Pollution to Blame," Worldwatch Institute, Washington, D.C., August 3, 2006, http://www.worldwatch.org/node/4423.

7. Ibid.

8. Christine E. Boyle, "Water-borne Illness in China," A China Environmental Health Project Research Brief (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2007): p. 1. Quoted by Z. Shalizi, "Addressing China's Growing Water Shortages and Associated Social and Environmental Consequences," World Bank Policy Research Working Paper 3895 (Washington, D.C.: World Bank, 2006).

9. Ibid., emphasis added.

10. Ibid.

tion to keep the domestic price of oil artificially low lest rising energy prices slow the country's rapid economic growth.[11]

By some estimates, increases in China's oil demand have accounted for approximately 40 percent of the increase in worldwide oil demand during the past five years.[12]

Thus, the United States and China are now the world's largest consumers of oil, with China as the world's third-largest oil importer, behind the United States and Japan.

No wonder energy is a focal target for Chinese innovative strategies in the coming years—to reduce inefficiencies in energy use, to stretch known and likely current energy sources, and to push the innovative frontier for future alternative energy sources (for example, fuel cells).

Conclusion

This brief paper has argued that China sees itself at the convergence of a twenty-first-century regional (Pacific) and modes of production (knowledge economy) sweet spot. In a significant declaration of national strategic intent, Beijing will seek to become an "innovative society" by providing not only a globally competitive mass-manufacturing base (by continuing to use imported technology and capital) but also by increasingly seeking to become both a leader in the creation of intellectual property and an owner of innovative processes that generate core value in the global knowledge economy.

Yet the paradox and unanswered question remains: To what extent can Beijing's twenty-first-century innovative focus also resolve its nineteenth- and twentieth-century agricultural and industrial challenges—especially those centered on the interplay of water, agriculture, and energy within the complex context of continuing urbanization, rising standards of living, and natural resources constraints in search of a sustainable environment strategy?

11. Jonathan D. Pollack, "Energy Insecurity with Chinese and American Characteristics: Observations and Possibilities," in *Maritime Implications of China's Energy Strategy: Interim Report* (Newport, R.I.: China Maritime Studies Institute, 2006), p. 197.

12. Ibid., p. 9.

CHAPTER 3

China: Urbanization and the Surge for Water and Energy

Jan Lundqvist

Delving into each critical trend, Jan Lundqvist illustrates how urbanization, water, and energy are dramatically affecting China. He explains how urban dynamics are uprooting the society as he draws attention to the unsettled migrants moving between cities and rural areas. Lundqvist also provides a detailed account of China's water management, citing the development and consequences of the Three Gorges Dam as a case study. The rise of economic activity and urban-industrial growth has led to increased energy and water consumption in China, and Lundqvist offers insights into various geopolitical implications.

Mighty as the Yangtze and its waters, a wave of millions of people moving into, and also out of, urban centers is a striking feature of economic growth and social change in China. Statistics about many of the features of the Chinese development are dodgy. Many people who are registered as rural residents are neither residing nor working there most of the time. A large number of people in urban areas are classified as migrants although some obtain a temporary registration. An annual two-digit growth rate of gross domestic product (GDP) for some three decades, even during turbulent periods, is found nowhere else. China alone accounts for a major share of the 300 million people in Asia who have been lifted above the $1 per day poverty line since 1990.

Other facets of Chinese development are problematic, to put it mildly. In terms of improvements in resource use efficiency, the Chinese economy is far below accomplishments in many other countries.[1] Also a comparison with India reveals a poor performance in productivity improvement. Drawing on several studies, Elizabeth C. Economy claims that environmental degradation and pollution cost the Chinese economy between 8 and 12 percent of its GDP annually.[2] Other estimates are less dramatic. Figures on the cost of resource depletion and environmental degradation are hard to interpret. Cost for cleanup is one thing. Cost associated with desiccated rivers and wetlands and losses of environmental services is another. An

1. *OECD Review of Agricultural Policies—China* (Paris: Organization for Economic Cooperation and Development, 2005), http://www.oecd.org/document/57/0,2340,en_2649_33727_35557433_1_1_1_1,00.html#HTO.

even more basic challenge refers to prospects for parts of the country to run out of water.

Resource Rich but Not on a Per Capita Basis

China has some of the mightiest rivers in the world, an arable land area of some 130 million hectares, huge mineral deposits, and extensive forested areas. With a population of 1.3 billion, many of whom are still quite poor and below the Chinese poverty lines (which are different for urban and rural areas) and several hundred million who have attained socioeconomic positions in the middle class or higher, a momentum for a continuous growth in aggregate demand for goods and services is a reality. It is also a fact that the per capita availability of water and land is low, particularly in the northern and northeastern parts of China.

Urban Dynamics Is Uprooting the Society

According to official figures, about 40 percent of the population is urban. The rate of current and future annual increase is estimated to be somewhere between 0.8 and 1.2 percent, which means an annual increase of some 10 to 15 million urban people. To this figure should be added the people who migrate to cities for shorter or longer periods either because of pull factors, like searching for jobs and income opportunities and better social services and opportunities, or because they are driven away from an increasingly tough context in rural areas. The floating population is currently estimated to be between 100 and 150 million.[3]

Over time, the rules dictating where people are registered have become less strict. A couple of decades ago, even travel within China was restricted. People who are not registered as permanently settled in urban centers lack social security, such as unemployment benefits.[4] Migrants have therefore been pushed back to rural areas in periods of unemployment. Investments in the provision of social services for migrants can thus be at a minimum.

Half the World's New Buildings in China?

An often quoted scenario is that about half of all the buildings that will be erected in the world during the next couple of decades will be in China, primarily in urban

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2. Elizabeth C. Economy, "The Great Leap Backward?" *Foreign Affairs* 86, no. 5 (September/October 2007); see also Annette Huber-Lee, Karl Hallding, Eric Kemp-Benedict, Guoi Han, Sivan Kartha, Ke Chen, and Ying Li, *Policy Options Scenarios for Sustainable Urbanization in China—Policy Outlook Summary,* for the China Council for International Cooperation on Environment and Development (Stockholm: Stockholm Environment Institute, 2005), pp. 7–37.

3. Karl Hallding, manager, SEI China Cluster, personal communication with author, 2007.

4. Athar Hussain, "Urban Poverty in China: Measurement, Patterns and Policies" (Geneva: ILO, 2003), http://www.ilo.org/public/english/protection/ses/download/docs/china.pdf.

centers. The construction boom fuels backward linkages. About half of the world's production of cement and flat glass is in China. Similarly, the share of global steel production in China increased from about 13 percent to about 35 percent between 1995 and 2005. But, as mentioned above, resource use efficiency is low. On average, Chinese steel makers use about 20 percent more energy per ton compared with the international average; the energy input ratio is even worse in the manufacturing of many other industrial products, including cement, aluminum, and ethylene.[5]

Amid this construction bonanza are examples of resource conservation projects as well as projects displaying illusions of plenty in a context of dwindling resources. A high-profile project in Beijing, covering about 30,000 square meters of housing, includes a rainwater harvesting scheme. A diametrically opposite showpiece is the advertising of waterfront property close to lakes, filled with pumped groundwater, on the outskirts of the city of Shijiazhuang.[6]

Household Sector and Urban Lifestyle

With increasing disposable income, the household sector is increasingly significant in the economy and in resource pressure. For example, the soaring energy consumption is partly due to an increasing number of air conditioners. In cities like Beijing and Shanghai, air conditioners have increased dramatically since the 1990s compared with other countries in developing Asia.[7] The demand for heating and cooling is also related to poor house construction. The vast majority of the new buildings in China do not even meet China's own codes for energy efficiency.[8]

Private consumption is an important driver in aggregate resource demand in several respects. Already in the 1970s the urban population in China consumed twice as much pork as people residing in rural areas.[9] Between 1961 and 2002 meat consumption in China grew by a factor of seven, from 6 kilograms to 40 kilograms per capita per year, although it is not clear how much of the consumption is related to the urban population.[10] A larger share of animal-based food items in the diet

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5. Joseph Kahn and Jim Yardley, "As China Rises, Pollution Soars," *International Herald Tribune,* August 25, 2007, www.iht.com/bin/print.php?id=7254418.

6. Jim Yardley, "Though Water Is Drying Up, a Chinese Metropolis Booms," *International Herald Tribune,* September 27, 2007, www.iht.com/bin/print.php?id=7660278.

7. Brian Roberts and Trevor Kanaley, eds., *Urbanization and Sustainability in Asia: Case Studies on Good Practice* (Manila: Asian Development Bank, 2006), http://www.adb.org/Documents/Books/Urbanization-Sustainability/urbanization-sustainability.pdf; "Asia's Clean Energy Challenge," Section 2, USAID/ASIA, 2006, http://www.usaid.eco-asia.org/programs/cdcp/reports/Section%202.pdf.

8. Ibid.

9. "World Population Highlights: Key Findings From PRB's World Population Data Sheets," United Nations, Population Reference Bureau, September 2007.

10. Charlotte de Fraiture, "Changing Diets, Changing Water Demand" (paper prepared for conference and published in *World Water Week Synthesis Document 2007,* Stockholm, August 12–17, 2007); data sources: Food and Agriculture Organization of the United Nations, FAOSTAT, http://faostat.fao.org/default.aspx, and International Water Management Institute, http://www.iwmi.cgiar.org/.

means escalating pressure on water resources. Depending on the source of feed for animals, the breed of animal, and water and land management, the production of animal calories requires generally at least a couple of times more water compared with the same amount of vegetarian calories.[11] Trends in diet composition and the related pressure on natural resources, including environmental impacts, must of course be compared with nutritional requirements.

Urban centers in China are, no doubt, the scene for rapid economic growth and social change. So far, there are few signs that they also promote innovations that promote efficiency and technological progress in the management of natural resources and the environment. In terms of per capita demand for water, energy, and other scarce resources, people in urban centers put more demands on the environment than people in rural areas. The common statement that some 70 percent of water use in China—as well as in many other countries—takes place in the agricultural sector is gravely misleading. Most of the food, fiber, energy, and other goods and services produced in the rural sector are in demand and consumed in urban areas.

Water from the Yangtze River to North China

Water shortages have become a tangible threat to continued growth and decent livelihoods for people in northern China, which has approximately 45 percent of China's population and is home to prominent megacities like Beijing, Tianjin, and Shijiazhung. In the past, water was available in natural springs and streams, and wetlands were common. As elsewhere in China, the biggest threat was the occurrence of floods. One flood in the early 1960s had devastating consequences for the region. During the Mao period, sufficient numbers of laborers could be mobilized to build flood control systems. Gradually, these structures became a basis for the water supply to urban centers. Parallel with the growing thirst of the expanding cities, farmers were stimulated to increase agricultural production. Erratic and low rainfall caused farmers' reliance on groundwater to increase. The remains of what used to be rivers and streams are today only trickles compared with previous flows and are far below demands in the region. The sucking up of groundwater for both urban sectors and rural areas has therefore continued.

There is unanimity among scientists that there will be a precarious water scarcity in North China within a decade or so. Cities and farmers alike will run out of water in the amounts necessary to sustain current levels of production and consumption. But is this a unanimous interpretation among all who are affected? A pertinent question is whether people in general, local party bosses, and other officials heed the scientists' interpretation. Even as far back as 1972, the Yellow River

11. Jan Lundqvist, Jennie Barron, Göran Berndes, Anders Berntell, Malin Falkenmark, Louise Karlberg, and Johan Rockström, "Water Pressure and Increases in Food and Bio-Energy Demand—Implications of Economic Growth and Options for Decoupling," in *Scenarios on Economic Growth and Resource Demand—Background Report to the Swedish Environmental Advisory Council,* Memorandum 2007:1 (Stockholm: Environmental Advisory Council, 2007), pp. 55–150, http://www.regeringen.se/content/1/c6/08/04/36/13c3422b.pdf.

was desiccated for a number of days. As a result, the flow did not reach the sea and water provision to Shandong Province was reduced.[12]

The vision of bringing water from the South of China, which is blessed with relatively more water than the North, has been nurtured at least since the 1920s. The construction of a huge dam and storage reservoir on the Yangtze, generally known as the Three Gorges Dam project, was officially approved in 2002. It is the world's largest control facility, with a capacity to store 39 cubic kilometers of water. The control of the fabled and at times deadly Yangtze is an important objective of the dam. It also includes a hydropower generation capacity equal to about 15 nuclear power plants, and huge volumes of water will be transferred to northern China, including big cities like Beijing.

At a two-day forum held in Wuhan at the end of September 2007, Chinese officials told about the dam's adverse impacts on the environment. The huge weight of the water in the 600-kilometer-long reservoir and behind the 185-meter-high dam had started to erode the banks, resulting in a series of landslides. According to the vice mayor of Chongqing, Tan Qiwei, the shore of the reservoir had collapsed in 91 places. The waves generated by the landslides could perpetuate damage.[13]

Now that the dam is there and reports show tremendous risks, Chinese officials openly admit environmental woes. The path chosen does, however, reflect a belief in an engineering approach aimed at controlling nature. In his seminal work *Science and Civilisation in China,* Joseph Needham included an interesting discussion about hydraulic principles in China: he referred to a Taoist in Hydraulics, Chiang Jang, who believed that dikes and control structures should be designed to allow the river to expand and contract within wide boundaries, "Rivers are like the mouths of infants-if you tried to stop them they only yelled the louder."[14]

Contemporary flood control and water development projects in China expose the difficulties of foreseeing the magnitude of the forces that are at play in large-scale and multipurpose development projects. For people in northern China, the remarks made at the meeting are a reminder of the difficulties and risks associated with a reliance on the supply of water from the South.

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12. Mark Giordano, Zhongping Zhu, Ximing Cai, Shangqi Hong, Xuecheng Zhang, and Yunpeng Xue, "Water Management in the Yellow River Basin: Background, Current Critical Issues and Future Research Needs," Research report 3 (Colombo: Comprehensive Assessment Secretariat, 2004), http://www.iwmi.cgiar.org/assessment/FILES/pdf/publications/ResearchReports/CARR3.pdf.

13. "China Warns of 'Catastrophe' from Gigantic Dam," Probe International, 2007, http://www.probeinternational.org/catalog/content_fullstory.php?contentId=6529&cat_id=24; "China Warns of Three Gorges Dam Catastrophe," Environment News Service, September 26, 2007, www.ens-newswire.com/ens/sep2007/2007-09-26-04.asp.

14. Joseph Needham, with the collaboration of Wang Ling and Lu Gwei-Djen, *Science and Civilisation in China,* vol. 4, part 3, "Civil Engineering and Nautics" (Cambridge: Cambridge University Press, 1971), pp. 234–235.

Energy Demand and Options

Energy fueling the rapid economic growth in China has to a very large extent been based on coal. An estimated 60 to 70 percent of China's energy emanates from coal. Projections about future energy demand have repeatedly been thwarted by real growth rates. In 2000 China anticipated that its coal consumption would double by 2020 but currently it is thought to be close to such an expansion already.[15] Given the serious pollution problems in China and China's contribution to global greenhouse gases, alternative energy options are important.

Hydropower from the Three Gorges Dam has led to a decrease of carbon emissions on the order of 100 million tons per year but with heavy costs in social and other environmental terms. A rapid increase in energy from nuclear power plants is being seriously considered in China. According to the International Atomic Energy Agency, China has 11 plants in operation and 4 under construction. Even with a substantial increase in construction of nuclear power plants in China, the number of plants in relation to the size of its population will be quite low. In the United States, 104 plants are in operation, and in Sweden, with a population of about nine million, 12 plants are in operation. The lead time for the development of nuclear power plants, investment requirements, and the abundance and relatively low price of coal imply that coal will continue to be much more important than nuclear power for many years to come.

But other options exist. Renewable energy, particularly wind power, is potentially an important option. Globally, wind power has become a major component in efforts to increase the energy supply. Worldwide, wind power is about 12 times more important than nuclear power in efforts to add capacity to generate energy. In China, a number of companies are developing a capacity to build modern and efficient wind power stations.

Obviously, a most important option for balancing demand and supply in the energy sector is to enhance efficiency in resource use in industry, in transport systems, and in households. Similar to the water sector, the challenge is to develop an effective system of incentives and sanctions to promote efficiency, notably with a social dimension.

International Dimension

The resource requirements associated with galloping economic growth in China have already resulted in a substantial impact on water resources, in terms of both depletion of quantity and quality degradation. Other natural resources are similarly under substantial pressure. Imports from other countries are logically on the increase.

Approximately 3,000 bankers and finance officials participated in the African Development Bank's annual meeting that was held in Shanghai in May 2007. The choice of location for the meeting was telling. At the meeting, African governments

15. Economy, "The Great Leap Backward?"

secured some $20 billion in credits from China to finance roads, railways, power stations, and other urgently needed projects. At the same time, China negotiated oil and mineral supply contracts to fuel its economy.[16] Discussions about Chinese expansion in Africa have tended to highlight the self-interest of China in gaining access to natural resources and flooding local markets with cheap Chinese products, and they have downplayed the role of China as a supporter and builder of infrastructure in Africa.[17]

Also in low-income countries in East and Southeast Asia, China is deepening its assistance. In connection with a visit to Cambodia in April 2006, China's premier, Wen Jiabao, pledged $600 million in assistance, which is almost equivalent to the level of assistance planned by Western donors but without any conditions pertaining to election reform, government transparency, and other conditions that Western countries want to include.[18] The very low profile of China in relation to current deplorable developments in Burma is another telling token about Chinese interests in the region and the perspective on social and political stability.

What Next?

Concerns about dwindling water resources and environmental degradation are increasingly included in official rhetoric in China. So far, there are few signs that these concerns have been translated into practice. Mounting international pressure on China to combat global warming, for instance, is important, but Chinese leaders do not accept mandatory caps for emissions.

From economic history we know that expectations are a very potent driver of investments and economic growth. Politically it may be hazardous to try to challenge these expectations. The prospects for large-scale social unrest seem to be feared more by the leadership in China than the heavy problems of environmental degradation, resource depletion, and significant public health impacts. Investments in China from foreign interests do not seem to slow down. Similarly, imports of relatively cheap products from China are favored by consumers and other buyers all over the world.

There are no systematic signs of dramatic improvements in resource use efficiency and reduction of pollution in the short run. In such a dynamic economy, however, it is hard to foretell the most probable situation for the future.

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16. Patrick Smith, "New Trade Winds," *Africa Report,* no. 7, Johannesburg, July 2007 (editorial).

17. Barry Sautman and Yan Hairong, "A New Perspective on Afro-Chinese Relations," *Africa Report,* no. 7, Johannesburg, July 2007, p. 88.

18. Oxford Analytica, "US/ASIA: Democracy Partnership Scheme," *International Herald Tribune,* May 31, 2007, http://www.iht.com/articles/2007/05/31/news/oxan.0531.php.

CHAPTER 4

Economic Growth and Climate Change

David Pumphrey, Sarah Ladislaw, and Matthew Frank

As the economies in Pacific Asia continue to grow, energy consumption and carbon emissions will follow suit. The CSIS Energy Program offers an analysis of energy use and possible climate change mitigation efforts in the different types of economies in the region. China is expected to continue to increase carbon emissions significantly in the coming decades. The success of its mitigation efforts depends largely on enforcement at local levels, structural adjustments in the economy, and implementation of new incentive mechanisms toward energy efficiency. Similar trends play out in other rapidly industrializing countries in Pacific Asia. However, the highly developed economies (like Japan and to a lesser extent South Korea) will face different challenges in reducing emissions as they have already achieved high rates of efficiency and have transitioned to service-oriented economies.

The challenges and opportunities for sustaining economic growth while mitigating its effects on climate change vary throughout the economies of Asia. Patterns of energy production and use are closely associated with both economic growth and the greenhouse gas emissions that are responsible for climate change, particularly carbon dioxide.[1] The collective Asian economy is the fastest growing and already among the largest of any in the world. But because Asian economies vary widely in expected growth, scale, and level of development, the same trends in energy consumption and CO_2 emissions are not valid for all countries in the region. Japan, South Korea, Singapore, and Taiwan have undergone higher degrees of industrialization and urbanization than others, establishing relatively high gross domestic product (GDP) per capita and steady prospects for economic expansion. Smaller but more rapidly emerging economies like those of Malaysia, Thailand, the Philippines, and Vietnam are poised for development through many of the same mechanisms and will become ever more important energy consumers in the region

1. The Intergovernmental Panel on Climate Change recently identified concentrations of one of the greenhouse gases, carbon dioxide, as the most important source of anthropogenic emissions driving climatic changes. Carbon dioxide emissions from fossil fuel combustion for energy purposes (oil, coal, and natural gas) make up the largest share of global carbon dioxide emissions.

as their needs rise. However, projected high growth coupled with sheer magnitude give China a dominant role in the determination of energy consumption and the CO_2 emissions outlook for the entire region.

China

With estimates of average annual GDP growth placed near 6.5 percent until 2030, the Chinese economy will experience significant expansion across all sectors.[2] The emissions picture for China is heavily dependent on fuel choices made in larger high-growth areas like industry and power generation. Industry should continue to boom, demanding an increasingly massive supply of coal and electricity, although energy intensity in the sector will improve dramatically as China moves further along the technology curve. Construction of emissions-free nuclear and hydroelectric projects will do little to balance expected growth in coal-fired plants, which should hold pace with the 6.0 percent average annual growth rate of total electricity generation.

To gauge acceleration of demand for power generation in China, consider that just the increase in total electricity generated in 2004 was 75 percent of total electricity generated in the United Kingdom that same year.[3] Higher GDP per capita will translate into greater demand for oil-dependent automobiles in the transport sector while rising urbanization signals commercial and residential growth in energy demand likely fueled by natural gas and electricity. It is clear that China will be even more dependent on cheap fossil fuels in the future, particularly its coal resources, to feed rapid growth in a hungry economy. Some estimates project a limited domestic supply of coal, but this would not necessarily constrain coal-fired power generation as China would likely seek imports from elsewhere in the region.

Although China's government is making efforts to curb emissions, as evidenced by aggressive renewables and energy intensity targets in its most recent Five Year Plan, it has not yet demonstrated that it can meet those targets. It is estimated that Chinese emissions will increase by an annual average of 4.1 percent, to reach 9,600 million tons of CO_2 annually by 2030. The greatest share is likely to come from industry and power generation, anticipated to constitute 22 percent and 59 percent, respectively, of total CO_2 emissions. China will soon, if it has not already, surpass the United States as the largest global emitter of CO_2. Therefore, development and energy consumption choices in China could potentially place a serious strain on global carbon dioxide levels and are the keys to Asia's efforts to sustain economic growth while curbing climate change.

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2. The energy and carbon dioxide emissions data in this paper come from *APEC Energy Demand and Supply Outlook 2006* (Tokyo: Asia Pacific Energy Research Center, 2006), http://www.ieej.or.jp/aperc/2006pdf/Outlook2006/Whole_Report.pdf.

3. "Key World Energy Statistics 2007" (Paris: International Energy Agency, 2007), http://www.iea.org/Textbase/stats/index.asp.

More Developed Economies

One group of more established Asian economies will experience trends in contrast with China in development, energy consumption, and emissions profiles. Pace of expansion in the industrial, transport, and power generation sectors looks to be moderate and steady in Japan, South Korea, Singapore, and Taiwan. These comparatively wealthier countries will have the means to afford cleaner, more efficient energy sources to support demand. Although oil will continue to fuel large portions of industry and will exclusively fuel transport, a definite shift away from emissions-intensive fossil fuels will be observed in favor of gas- and nuclear-powered electricity generation—Japan and South Korea are projected to significantly expand nuclear generation capacity in the coming decades. Reliance on cleaner energy sources combined with further reductions in energy and emissions intensity per unit generated GDP will limit CO_2 emissions and pressure placed on the environment by this group of Asian countries. The emissions from this group are not trivial, estimated to increase annually at a combined average rate of 1.3 percent, to 2,735 million tons of CO_2 annually by 2030.

Rapidly Industrializing Economies

Other Asian countries are facing growth challenges similar to China's, albeit on a greatly reduced scale. Industry and transport are exploding in places like Malaysia, Thailand, Vietnam, and the Philippines, meaning a heavy reliance on fossil fuels for support. Gas will be used to meet part of energy demand in these Southeast Asian countries, but much like China, coal will significantly fuel growth, particularly in power generation. Because of the slower rates at which these consuming nations will reduce their energy and emissions intensities and their strong dependence on oil and coal, their economic development will do more to create inertia opposing climate change mitigation. Total CO_2 emissions of these Asian countries are estimated to increase annually at a combined average rate of 3.8 percent, to 1,710 million tons of CO_2 annually by 2030.

Mitigation Efforts

The first and most commonly discussed element of dealing with climate change is mitigation: decreasing the amount of CO_2 and other harmful greenhouse gases emitted into the earth's atmosphere in the hope of stabilizing and ultimately reducing the overall concentration. Efforts to mitigate the CO_2 emissions caused by energy production and use are particularly challenging in regions undergoing economic development and periods of rapid industrialization. As countries develop and grow, they shift from agricultural-based to industrial-based economies, which causes energy intensity (the amount of energy it takes to produce a unit of GDP) to rise. At the same time, increased economic growth and urbanization raise the overall level of energy demand for residential, commercial, and transportation sectors

of the economy. Historically this development curve has also been characterized by the introduction of low-cost, low-efficiency, and often high-polluting technologies and industries.

Avoiding this development path is a matter of either changing the overall composition of the economy away from energy-intensive industries like steel, chemicals, cement, aluminum, and paper and toward service-oriented enterprises; or ensuring that the country adopts high levels of energy efficiency, incorporates low carbon energy options, and adheres to strict pollution control practices among the most polluting segments of the economy. Companies often can find win-win opportunities when it comes to the long-term savings associated with incorporating greater levels of energy efficiency through the latest technologies and practices. More often than not, however, the private sector must receive incentives to choose these energy-efficient and low-carbon alternative solutions.

Within the context of the global climate change debate, China is by far the most important economy in the region. Efforts at curbing China's CO_2 emissions while enabling continued economic growth have not been effective to date. Despite relatively aggressive targets at the national level for both energy efficiency and the role of low-carbon energy technologies (such as renewables, nuclear, and coal with carbon capture and storage), the central government has been unable to implement the changes that would realize its stated policy goals. Local government officials are often blamed for turning a blind eye to companies that disobey environmental regulation in favor of commercial opportunities. The entire Chinese economy lacks the correct enforcement and incentive mechanisms necessary for allowing the adoption of new technologies, greater levels of energy efficiency, and a greater diversity of fuel choices (away from coal) to take hold in any meaningful way.

In the September/October 2007 issue of *Foreign Affairs,* Elizabeth C. Economy of the Council on Foreign Relations argues that China must reform its basic underlying political culture to one that includes an appreciation for "transparent information, official accountability, and an independent legal system" in order to have more effective environmental protection.[4] Many China watchers speculate that growing popular unrest over local pollution issues, also caused by rapid industrialization and urbanization, has helped raise public awareness over the sustainability of China's current rate of economic growth. In addition to these internal forces, external pressure from the global community is often identified as another important driver for China to more effectively implement its mitigation policies. Without the United States (the largest historical emitter) taking a leadership role and concrete action to reduce its own emissions, however, China will continue to be insulated from real international pressure.

Although China accounts for an overwhelming global and regional share of emissions, it is important to focus on the mitigation challenges and opportunities elsewhere in the region. Mature economies of Asia may more easily be able to reduce energy and emissions intensity by expediting their transition from an industrial-based economy to a service-oriented economy. In contrast, highly developed

4. Elizabeth C. Economy, "The Great Leap Backward?" *Foreign Affairs* 86, no. 5 (September/October 2007): 56.

economies like Japan may find it more difficult to reduce emissions owing to their already high rates of efficiency and their service-oriented economies. For smaller, rapidly industrializing economies, it is important to manage climate change and local pollution issues and avoid the same dirty development path experienced by today's developed economies.

To help identify the various opportunities for these countries to influence their development paths, it is necessary to understand the drivers of their development. Most of the development occurring in these countries is happening as a result of private investment, the adoption of new technologies, demand drivers from import markets, increased market information to which they respond, and greater levels of public engagement and education as greater portions of society become involved in industrial economy activity and urban life.[5] To the extent that the public sector can harness these drivers of industrial activity, it can also improve the environmental impact of the region's development path. Through a mix of regulations, standards, incentives, and information sharing, these countries can arguably strike a better balance between economic growth and their emissions. The role of the international community is particularly important here. Although Southeast Asia is home to the rapidly industrializing economies of today, these trends will someday take hold in other parts of the world such as Latin America and Africa. Tackling the twin challenges of economic development and environmental degradation (including climate change–causing emissions) will be important in each of these regions in the years to come.[6]

Adaptation Efforts

There is broad-based scientific agreement that despite our best efforts to reduce current and future greenhouse emissions, certain impacts of climate change caused by historical emissions are now unavoidable. It is this realization, as well as evidence of today's impacts of climate change, that is driving much of the urgency around the global climate change debate. As the effects of global climate change become increasingly severe and manifest themselves in different parts of the world, adaptation efforts will be of great importance to maintaining security, economic development, and overall public confidence in governments' ability to deal with climate change.

The Intergovernmental Panel on Climate Change (IPCC) has identified some of the more typical impacts of climate change as altered growing seasons, changes in

5. David P. Angel, Michael T. Rock, and Tubagus Feridhanusetyawan, "Toward Clean Shared Growth in Asia," in *Asia's Clean Revolution: Industry, Growth, and the Environment*, ed. David P. Angel and Michael T. Rock (Sheffield, England: Greenleaf Publishing, 2000), pp. 11–39; and United Nations Economic and Social Council, Commission on Sustainable Development, Fourteenth Session, Report of the Secretary General, Document no. E/CN.17/2006/3, May 1–12, 2006, http://daccessdds.un.org/doc/UNDOC/GEN/N06/247/18/PDF/N0624718.pdf?OpenElement.

6. These countries are not destined to experience the identical historical emissions path of currently developed economies as countries are only able to purchase existing technologies that are much cleaner and more efficient than technologies used in the past.

overall patterns of precipitation (droughts and floods), and extreme weather conditions. In the short run these impacts can lead to economic dislocation, difficulty insuring shoreline property and assets, and changes in energy demand patterns and fuel choices. In the long run, rising sea levels and the inability to manage severe weather conditions can lead to greater loss of shoreline assets and infrastructure, mass migration, and security concerns. The IPCC has also identified developing countries as the most vulnerable to climatic changes and the least likely to cope effectively with the impacts.

China's first national assessment report on climate change projected a severe decline in precipitation and agricultural yields as well as overflow from rivers caused by increased glacial melting that could threaten neighboring cities with increased flooding. The IPCC report on the impacts of climate change and adaptation efforts states that delta areas in Asia, particularly the island and coast regions of Southeast Asia, are likely to be susceptible to floods caused by rising sea levels and the overflow of rivers. The international community, through the leadership of the United Nations, is encouraging countries to develop national adaptation strategies and improve their understanding of potential climate impacts on various regions of the world through increased focus on climate science collection, monitoring, and modeling. The United Nations has also called on developed countries to assist developing countries by providing resources and expertise to insulate the most vulnerable countries from the unavoidable impacts of global climate change.

Conclusion

Asia is at the forefront of determining how to achieve sustainable economic growth while mitigating greenhouse gas emissions and adapting to the inevitable impacts of global climate change. It is far from certain that governments in the region can effectively accomplish either of these goals. Significant opportunities exist, however, to develop and implement clean development strategies such as encouraging greater levels of efficiency, incorporating clean energy technologies, and increasing public awareness and engagement in local patterns of development and energy use.

CHAPTER 5

In Deep Water: Ecological Destruction of China's Water Resources

Jennifer L. Turner

Moving from energy to water issues in Pacific Asia, Jennifer Turner discusses the many implications—environmental, social, and political—of China's poor management of resources. Not only is China's water crisis inciting civil unrest, but regional impacts are causing concern among China's neighbors. Turner argues, however, that the many problems arising from pollution and water scarcity may ultimately serve as an impetus for China to improve its environmental governance institutions.

When the issue of water problems in China is raised, many people may first think about the infamous Three Gorges Dam—an infrastructure project hotly debated even within China because of the need to relocate 1.3 million citizens, concerns about the dam exacerbating water quality problems in the Yangtze River, and the loss of cultural relics and endangered species. Since the beginning of construction of the dam, local residents have lodged numerous complaints about local government officials pocketing funds meant to go to relocated communities.

Although it is true that many dams, dikes, and water transfer projects in China create ecological problems and place hardships on citizens who are in the path of the construction, equally severe are water pollution and scarcity that are threatening the health of China's watersheds, its people, and potentially its political stability. While many other Asian nations struggle with water quality and quantity problems, China's water woes are perhaps among the most severe in the region, not simply owing to the country's large population and rapid growth but also to its extremely poor implementation of environmental protection laws and a water management system that lacks many mechanisms to encourage water conservation.

Although serious problems of air pollution, solid waste, and rapid biodiversity loss are quite severe in China, the country's water problems are perhaps its greatest environmental threat. During the past few years the dire water quality and quantity problems are finally becoming higher priorities for the Chinese government and international community. China's water woes may ultimately become catalysts for the Chinese government to strengthen its environmental governance system, which

could become a useful model for other nations in the region. Below is a brief overview of the water pollution and scarcity challenges as well as highlights of how these problems are making an impact outside of China.

Black Water

Water pollution within China has become so bad that it even makes headlines internationally. In November 2005, for example, an explosion at a PetroChina chemical plant in Jilin Province released a 100-ton slick of the carcinogenic benzene into the Songhua River. Officials in Jilin initially covered up the spill, informing officials in Harbin—the capital of the downstream province Heilongjiang—only days before the slick reached the city of almost 10 million. Another 600 kilometers downstream the Songhua River turns into the Amur River and becomes the main water supply for the Russian city of Khabarovsk, whose officials were also in the dark about the pollution floating toward them.

Once informed of the spill, Harbin officials also tried to cover up the crisis, but their announcement about shutting down the city's water supply for routine maintenance led to a large public outcry. Municipal officials quickly revised their announcement, stating that the water system would be shut down to prevent citizen exposure to benzene. The sequence of events remains murky, but it appears the central authorities were not informed until the Harbin officials revised their story, at which time the Chinese news media were quick to investigate the explosion and the cover-ups. Reporting became so intense that the central authorities ordered the news media to shift focus to the efforts of the People's Liberation Army to help get water to the needy in Harbin during the shutoff. The spill was China's largest pollution accident ever reported, and it became an embarrassment because it was reported widely internationally. Pollution flowing into Russia aggravated tensions with cross-border areas that had long complained of China's pollution and excessive withdrawals of water from the Amur River.

The head of China's State Environmental Protection Administration (SEPA)—Minister Xie Zhenhua—stepped down. His agency had not been informed of the spill when it happened, but he took responsibility for its lack of a swift response. Soon after the slick moved past Harbin, the central government passed new rules that limit the ability of the Chinese news media to report on environmental emergencies.[1] In the months following the spill, SEPA did pass some regulations criminalizing businesses that neglected to report spills within 24 hours. SEPA also undertook a highly publicized survey of chemical plants in China, which revealed that nearly half of the 21,000 chemical plants are close to drinking water supplies along the Yangtze and Yellow rivers.

This anecdote captures many of the drivers of water and other environmental problems throughout China: powerful local officials who are often more concerned

1. Iain Marlow, "Black Rivers, Red Future: Political Overhaul Not Necessary to Save China's Environment," GlobalFLUX, Carleton University School of Journalism and Communication, 2007, http://www.carleton.ca/sjc/globalflux/marlow.html.

about protecting their own economic interests than the environment; the weakness of SEPA in terms of staff (just under 300), funding, and clout; and a news media that at times is an effective watchdog but is often limited by the state. The Songhua River case also illustrated some promising signs: a central government that is prioritizing water problems but often in an ad hoc fashion, an environmental watchdog agency ready to take advantage of crises to increase its authority, and a Chinese public that is increasingly willing to take to the streets or protest through the courts on environmental issues. Although China's nongovernmental organizations (NGOs) were not active in the Songhua spill, a growing number of grassroots groups are active in the field of water protection.

The litany of water pollution problems stems not simply from chemical accidents but also from extremely low rates of municipal wastewater treatment. At the end of 2002, the official municipal wastewater treatment rate was 39.9 percent, and in rural areas these rates are much lower. The highest rate of wastewater treatment is in Beijing, which in the run-up to the Olympics will increase wastewater treatment to 90 percent in the city center and surrounding suburbs—a striking increase from a treatment level of 40 percent in 2001 when the city was awarded the 2008 games.[2] Many of the municipal wastewater problems stem from local protectionism. A 2004 survey by SEPA of sewage treatment plants built since 2001 found that only half of them were actually working and the other half were closed down because local authorities considered them too expensive to operate.[3]

Another major, yet rarely acknowledged, source of water pollution stems from China's 14,000 factory farms (also known as concentrated animal feeding operations [CAFOs]). In 2003, it was estimated that 90 percent of animal farms in China lacked any kind of pollution controls and fewer than 10 percent had conducted any form of environmental impact assessment (EIA).[4] China's CAFOs produce 40 times more nitrogen pollution and 3.4 times the solid waste of industrial factories.[5] When effluents from industries are combined with the growing levels of organic pollution from CAFOs and agricultural runoff, the result is toxic algae blooms in lakes and a growing severity of red tides that have affected much of the east coast of China since the 1990s.

The lack of pollution control in industrial, municipal, and agricultural sectors has left China's waterways seriously degraded:

- More than three-quarters of the surface water flowing through China's urban areas is considered unsuitable for drinking or fishing, and 90 percent of urban groundwater is contaminated;[6]

2. Beijing Organizing Committee for the Games of the XXIX Olympiad (BOCOG), "New Beijing," 2001, http://61.135.180.163/eolympic/xbj/lsbj/lsbj.htm.

3. "China Politics: Green-Tinted Glasses," Economist Intelligence Unit, July 6, 2004.

4. Linden Ellis, "Environmental Health and China's Concentrated Animal Feeding Operations (CAFOs)," China Environmental Health Research Brief (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2007), http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.item&news_id=225795.

5. Ibid.

- Nearly 40 percent of river water is worse than grade 5 (not suitable for agriculture or industry);[7]
- More than 300 million rural Chinese, about a quarter of the country's total population, lack access to clean drinking water;[8]
- Water pollution is causing growing agricultural losses as well as increasing protests against industries by farmers who have lost use of land and water and cannot sell their "toxic" harvests;
- Dramatic increases in aquaculture production in the 1990s have created growing eutrophication and chemical deposits (especially antibiotics) in coastal waters, destruction of mangroves, and increasing incidents of red tides;[9] and
- Along major rivers and large lakes in China, communities suffer from higher than normal rates of cancer, tumors, spontaneous abortion, and diminished IQs caused by the high level of contaminants in the soil and water.[10]

Thirsty Country

Water scarcity is another major threat to China's economic growth and human health. China's annual per capita water supply is 25 percent below the global average. By 2030 the per capita supply is expected to fall from 2,200 cubic meters (m^3) to below 1,700 m^3, a level that meets the World Bank's definition of a water-scarce country.[11] Water scarcity is most acute in northern China where per capita water resources are only 750 m^3 per year.[12] Although agriculture still consumes nearly 80 percent of water resources in China, water consumption in industrial and domestic sectors has been rising quickly. A lack of conservation measures in all sectors is accelerating the depletion of water resources, particularly in the dry northern part of China where, despite having only 24 percent of China's water resources, grain production accounts for more than 45 percent of China's GDP.[13]

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6. Chao Shengyu, "Underground Water in 90 Percent of Chinese Cities Polluted," Jinhua News Network, December 28, 2005, http://www.jhnews.com.cn/gb/content/2005-12/28/content_552266.htm.
7. *OECD Environmental Performance Review of China* (Paris: OECD, 2007).
8. Yinglin Liu, "China's Drinking Water Situation Grim; Heavy Pollution to Blame," Worldwatch Institute, August 3, 2006, http://www.worldwatch.org/node/4423.
9. Aaron Cosbey, "Reconciling Trade and Sustainable Development," in *State of the World 2006: Special Focus: China and India* (Washington, D.C.: Worldwatch Institute, 2006), pp. 134–151.
10. Elizabeth C. Economy, *The River Runs Black: The Environmental Challenge to China's Future* (Ithaca: Cornell University Press, 2004).
11. Elizabeth C. Economy, "China's Environmental Challenge: Political, Social, and Economic Implications" (testimony before the Congressional Executive Commission on China, Washington, D.C., January 27 2003), http://www.cfr.org/publication/5573/chinas_environmental_challenge.html.
12. "China's Water Supply Problems," U.S. Embassy in Beijing, October 2003, http://www.usembassy-china.org.cn/sandt/water-supply.htm.

While China's naturally dry climate in the North and its large population are clearly key drivers of water shortages, it is ultimately shortcomings in governance institutions that exacerbate the problem. For example, in China there is a lack of clear water rights. Water is owned by the state, which has made water an ostensibly open-access resource. The water withdrawal permit system and higher water fees mandated under the 1988 National Water Law have not yet succeeded in limiting water use, in great part because there is no legal means for water users to sell water that they conserve.[14] In recent years a number of major cities have begun to increase water fees and install more water meters, which are key changes needed to slow the dangerous overdrawing of surface and groundwater resources. Nevertheless, when cities lack water they usually opt to tap new supplies rather than strictly enforce fee, permit, or other conservation policies.

The South-North Water Transfer Project is the most recent example of this continuing reliance on creating water supply. This ambitious water transfer project has been debated for decades but was passed within weeks of Beijing being awarded the Olympics in 2001, in part to guarantee the capital's thirst will be adequately quenched in time for the 2008 games.[15] In 2002, construction began on the first of three huge canals—each at least 1,200 kilometers long—to divert water from the Yangtze River and its tributaries to thirsty northern China. The middle route will demand relocation of at least 300,000 rural residents in Henan and Hubei provinces—two densely populated provinces with little extra land for the relocated farmers.[16] Because of the importance given to this project by central officials, there was little public discussion on its social and environmental impacts.

Low prices also drive waste in water in China. For example, only 43 percent of the water consumed in agriculture is used efficiently for irrigation, compared with 70 to 80 percent in developed countries.[17] China's industrial water consumption is even more wasteful, using 10 to 20 times the average of industries in developed countries.[18] Chinese urban dwellers increased their per capita daily water con-

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13. Bryan Lohmar et al., "China's Agricultural Water Policy Reforms: Increasing Investment, Resolving Conflicts, and Revising Incentives," Agricultural Information Bulletin no. 782 (Washington, D.C.: U.S. Department of Agriculture, 2003), http://www.ers.usda.gov/publications/aib782/.

14. Wang Yahua, "River Governance Structure in China: A Study of Water Quantity/Quality Management Regimes," in *Promoting Sustainable River Basin Governance: Crafting Japan-U.S. Water Partnerships in China,* ed. Jennifer L. Turner and Kenji Otsuka, IDE Spot Survey no. 28 (Chiba: Institute of Developing Economies, 2005), pp. 23–36.

15. Christoph Peisert and Eva Sternfeld, "Quenching Beijing's Thirst: The Need for Integrated Management for the Endangered Miyun Reservoir," in *China Environment Series* 7 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2005), pp. 33–45, http://www.wilsoncenter.org/topics/pubs/feature32.pdf.

16. Michael Eng and Ma Jun, "Building Sustainable Solutions to Water Conflicts in the United States and China," in *China Environment Series* 8 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2006), pp. 155–184, http://www.wilsoncenter.org/topics/pubs/CEF_SpecialReport.11.pdf.

17. Jennifer L. Turner and Kenji Otsuka, *Reaching across the Water: International Cooperation Promoting Sustainable River Basin Governance in China* (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2006).

18. Lohmar et al., "China's Agricultural Water Policy Reforms."

sumption from less than 100 liters in 1980 to 244 liters in 2000. At least 20 percent of water supplies to cities is lost through leaky pipes.[19]

Water as a Catalyst for Stronger Environmental Governance

Water problems have been a major catalyst for stricter top-down policies and bottom-up pressure and protests—both trends could potentially help push China to create significantly stronger environmental governance institutions and better implement existing pollution and conservation laws. Some promising top-down measures include greater prioritization and investment into water quality and quantity initiatives in the 10th and 11th Five Year Plans. For example, investment into desalinization of waste and seawater has increased significantly to provide coastal cities with greater access to clean water.

For rural water needs, during the past five years the Chinese government has spent $3 billion to help 71 million rural citizens obtain safe drinking water. The government will allocate another $1 billion in 2007, targeting safe water for another 20 million rural people, one-third of whom are in the particularly poor Southwest, where the majority of water is in underwater rivers that are susceptible to pollution and difficult to access.[20] In an attempt to stem the rampant violation of water pollution control laws, in July 2007 SEPA announced it would suspend the approval of all new industrial projects in 13 cities and industrial parks along the Hai, Huai, Yangtze, and Yellow rivers, all of which suffer from severe water pollution.[21]

Beyond project investments, the Chinese leadership's openness to using the free market in water allocation is growing. To promote water conservation in dry areas, for example, some water trades—officially these trades have been illegal—have taken place between counties and between industry and agricultural users.[22] Opening up such trading could spark considerable efforts for conservation in agriculture in order for farmers to be able to sell water to thirsty cities and industry.

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19. Dabo Guan and Klaus Hubacek, "Lifestyle Changes and Its Influences on Energy and Water Consumption in China" (paper prepared for the sixth conference for postgraduate students, young scientists, and researchers on environmental economics, policy, and international environmental relations, Prague, October 7–8, 2004), http://homepages.see.leeds.ac.uk/~leckh/leeds04/6.5final-gdb-march%20conference.pdf.

20. Jennifer L. Turner, "Environmental Health Crises in Southwest China" (summary of China Environment Forum meeting, Woodrow Wilson International Center for Scholars, Washington, D.C., November 8, 2006), http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=20691.

21. Ling Li, "China Takes Steps to Restore Polluted River Basins," China Watch, August 23, 2007, http://www.worldwatch.org/node/5325.

22. In 2000 in Inner Mongolia, for example, a new coal power plant lacked sufficient water because the province had no extra water allocation available from the Yellow River runoff. The plant invested 89.5 million yuan to develop water-saving projects in irrigation districts in the area. In return for the investment, the local government permitted the plant to obtain a water withdrawal right of 50 million m^3. For more details of this and other such trades, see Wang, "A River Governance Structure in China."

During the past few years perhaps the most significant top-down measures have been the surge of new rules and regulations empowering the public and NGOs to participate more in EIAs and other forms of environmental decisionmaking.[23] New regulations pushing industries to disclose pollution emission information could greatly empower the public and NGOs in pressuring polluters. This greater space for citizen participation in the environmental sphere has created more opportunities for China's NGO sector to strengthen existing water protection laws and act as watchdogs against local governments.

Advocating transparency in dam building. One striking example of NGOs beginning to push the boundaries and work to improve enforcement of laws took place in September 2004, when Chinese environmentalists and journalists launched a huge national campaign to protest the Yunnan provincial government's plans to build 13 dams on the Nujiang River (Salween River)—one of China's last remaining wild rivers in an area that is recognized as a World Heritage natural site. Highlighted in the campaign was the lack of an EIA on the dams, which is required by law. The extensive public debate caught the attention of China's leaders, and in February 2005 Premier Wen Jiabao suspended planning of the dams pending an EIA. In August 2005, a broad coalition of Chinese groups—which included 61 NGOs and 99 researchers and government officials—sent an open letter to the top leaders urging public disclosure of the EIA, which had been declared a state secret. The EIA was subsequently released and revealed plans for 4 instead of 13 dams. The debate over the Nujiang River gave SEPA the power to finally draft and issue regulations in March 2006, formalizing the procedures for how the public could participate in EIA hearings. These regulations have led to some highly publicized hearings in Beijing,[24] but currently the question of holding a public hearing around the Nujiang dam is at a standoff because of its high sensitivity.

Advocating for rights of pollution victims. One unique Chinese NGO empowering the public is the Center for Legal Assistance for Pollution Victims (CLAPV), which helps pollution victims successfully navigate the court system and increasingly win cases. CLAPV has been most successful in assisting cases linked to damages from water pollution, and even cases it loses have an impact in that this NGO is adept at using the news media to promote legal education surrounding the case. Most cases end up highlighting local government protection of industry and unresponsiveness to citizen needs.

Promoting water pollution information disclosure. Ma Jun, a major water activist who founded the NGO Institute for Public and Environmental Affairs, created China's first online public database on water pollution emissions in 2006. The water pollution map enables users to monitor water quality and pollution discharges using digital mapping. Data were drawn from official statistics, but this NGO is also providing grassroots groups throughout the country with equip-

23. Allison Moore and Adria Warren, "Legal Advocacy in Environmental Public Participation in China: Raising the Stakes and Strengthening Stakeholders," in *China Environment Series* 8 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2006), pp. 3–23, http://www.wilsoncenter.org/topics/pubs/CEF_Feature.1.pdf.

24. Moore and Warren, "Legal Advocacy in Environmental Public Participation in China."

ment to monitor water quality. Data on water quality will be entered into a geographic information system (GIS) linked to the map, making it more of a real-time data source.[25]

While NGO activism is growing in this area, citizen protests around water and other environmental issues are significantly larger. Disputes over water have raised tensions within communities and between provincial governments. Xinhua News reported that more than 50,000 environmentally related protests occurred in China in 2005, slightly more than half of which were about water pollution issues.[26] Many of these incidents do get reported in China, but some of the larger protests are censored, such as the April 2005 protest in which 60,000 farmers battled police as part of a blockade of an industrial park with 13 chemical plants that had been contaminating water and soil for years.[27] This explosion in protests about water supplies indicates a critical absence of effective water resources management and conflict resolution mechanisms. Water scarcity is also a source of conflicts[28] and potential destabilization, particularly in the dry North, where the United Nations predicts the number of eco-refugees fleeing the growing ocean of sand could reach 50 million by 2010, adding to the existing infrastructure and social pressures in coastal urban areas.[29]

Regional Impacts

Another important source of pressure on China to deal more comprehensively with its water problems stems from the growing regional impacts of poor protection and mismanagement of rivers.

Since the well-publicized benzene spill, governors and mayors downstream in Russia have become more outspoken about the long-standing Chinese pollution contaminating the Amur River. The tensions have helped to catalyze some bilateral monitoring initiatives, which represents an important first step in addressing the cross-boundary water problem. In addition to the Russians' displeasure about pol-

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25. Ke Zhang, "Group Monitors China's Water Polluters Using Online Mapping," China Watch, September 26, 2006, http://www.worldwatch.org/node/4622.

26. "China to Address Urgent Environmental Issues," Xinhua News Agency, May 4, 2006, http://english.peopledaily.com.cn/200605/04/eng20060504_263042.html.

27. "Sixty Thousand People Protest against Pollution," AsiaNews.it, April 14, 2005, http://www.asianews.it/index.php?art=3036&l=en.

28. Throughout the 1980s and 1990s, for example, villages along the Zhang River (a tributary of the Hai in northern China) have undertaken near-guerrilla warfare, destroying each other's water diversion canals after a growing number of government-sponsored water diversions further upstream created a severe water shortage in the basin. For nearly two decades local governments in the basin have struggled to resolve these conflicts, and it was only when the Ministry of Water Resources set up a special river basin management office to mediate the situation in 2004 that tensions began to cool. See Timothy Hildebrandt and Jennifer Turner, "Water Conflict Resolution in China," in *China Environment Series* 7 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2005), pp. 99–103, http://www.wilsoncenter.org/topics/pubs/chinaenv7.pdf.

29. "China Says Desertification Being Controlled Yet Still Grim," Agence France-Presse, June 15, 2005, http://news.inquirer.net/world/index.php?index=1&story_id=40369.

lution, leaders in the Russian Far East are critical of China's growing agricultural withdrawals and dam building on the tributaries that feed the Amur (Heilong) River. These projects alter the volume and timing of the flow of water, disrupting agriculture and fisheries throughout Russia and Mongolia.[30]

While China's coastal pollution is beginning to worry its closest neighbors, Korea and Japan, a more pressing marine environmental issue is China's growing consumption of fishery products, which is strongly linked to the country's growing freshwater pollution. Many species in China's seas and rivers have declined so precipitously from pollution and overfishing they now face total extinction.[31] Thus, to meet the growing domestic and international demand for fish, Chinese fishers and fishery companies have had to expand their fishing in the coastal zones of other countries or the high seas. Chinese fishers have sparked many high seas and diplomatic clashes as they have encroached on the coastal waters of other countries; relations with Vietnam have been particularly tense over this issue. China has negotiated a network of bilateral fishery management agreements with Japan, South Korea, and Vietnam, but clashes still occur.[32] Such incidents represent yet another irritant in China's relationship with other countries.

China is facing serious shortages of both water and energy as its rapid economic expansion further strains its limited natural resources. Under the current round of dam building, which includes plans for more than 200 dams in southwest China, the government plans to triple hydropower capacity by 2020. China's damming, pollution, and channelization of the upper reaches of the Mekong River have created perhaps the most sensitive transboundary water situation. Of particular concern to the downstream Southeast Asian nations is the current boom of dam building for hydropower.[33] Local governments in southwest China are currently planning or building more than 200 dams, and few of these projects have completed the required EIAs. On the Mekong River, the Chinese side has conducted transboundary impact assessments (TIAs) for channelization and some of the dams, but these TIAs generally are superficial and overlook the true environmental and social impacts of the planned project on downstream communities.[34]

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30. Juli S. Kim and Michael Murphy, "Transboundary River Tensions: Opportunities for Collaboration," in *China Environment Series* 8 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2006), pp. 209–211.

31. David Rosenberg, "Managing the Resources of the China Seas: China's Bilateral Fisheries Agreements with Japan, South Korea, and Vietnam," July 1, 2005, http://community.middlebury.edu/~scs/intro.html.

32. Li Yong Yan, "China Goes Fishing," *Asia Times,* March 17, 2005, http://www.atimes.com/atimes/China/GC17Ad01.html.

33. "China's Upper Mekong Dams Endanger Millions Downstream," Briefing paper no. 3 (San Francisco: International Rivers Network, October 2002).

34. Linden J. Ellis and Jennifer L. Turner, "Environmental Security and Regional Politics in the Mekong Basin" (summary of China Environment Forum meeting, Woodrow Wilson International Center for Scholars, Washington, D.C., February 26, 2007), http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=224757.

A Way Out

While China's water woes are severe, they have catalyzed progressive policies and created more political space for grassroots activism. International assistance in this sector is also growing, but much more could be done to help improve China's water management infrastructure.[35] For example, the European Union's various pilot projects and research initiatives in the Liao River basin since 2002 produced basin-wide recommendations on reforming water sector institutions and tariffs that Liaoning Province integrated into its 10th Five Year Plan. All of China's seven main river basins are under severe ecological stress—mainly from pollution—so there exist many opportunities for bilateral and multilateral aid agencies to pursue basin-wide initiatives such as the EU is doing.

The World Bank's environmental information disclosure initiative addressing industrial emissions in Jiangsu has led to a national program and new regulations that aim to push industries to become more transparent in pollution emission information. International organizations and businesses could play an important role in increasing the capacity for this program, which could pressure industries to lessen water pollution emissions.

Currently not many international organizations are working on sustainable urban planning, which is an issue that could promote more sustainable water use. For example, much of the construction of upscale apartment buildings in China's water-short regions does not take available water resources into account.[36]

International corporations also are beginning to play a potentially important role in pushing for better water management and protection in China. For example, Coca-Cola has begun implementing its new worldwide policy of net zero water loss in China, which will bring considerably more efficient wastewater recovery processes into its plants and partner companies in China. GE is greatly expanding its market presence in China in water-saving and water treatment equipment, most strikingly illustrated in its construction of China's first rainwater recycling project for the National Stadium being built for the 2008 Olympics in Beijing. The nanofiltration membranes in this system recycle rainwater using underground pools, which will then be reused for landscaping, firefighting, and cleaning the Olympic village.

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35. Turner and Otsuka, *Reaching across the Water.*

36. Jim Yardley, "Beneath Booming Cities, China's Future Is Drying Up," *New York Times,* September 28, 2007, http://www.nytimes.com/2007/09/28/world/asia/28water.html?_r=1&th=&oref=slogin&emc=th&pagewanted=print.

CHAPTER 6

Cost-Effective Electric, Gas, and Water Services: The Case for Efficiency

Michael Totten

In a survey of potential technological solutions for sustaining water and energy resources in an urbanized Pacific Asia, the improvement of utility services offers an opportunity for positive changes—for the economy, the environment, and public health. Michael Totten outlines the myriad ways that China can reform its delivery systems for electricity, natural gas, and water to prevent the continuation of expensive and damaging waste. Starting with the adoption of decoupling regulations (as exemplified in California's utility regulatory process) and moving into integrated resource planning, we see that increasing efficiency across the board could have profound positive impacts in the decades ahead.

Most utility regulation worldwide overseeing the electricity, natural gas, and water service sectors still precludes end-use efficiency opportunities from fully, fairly, and equitably competing in the utility resource planning process as a means of cost-effectively delivering customer utility services.

Historically and conventionally, utility earnings were based on revenue from sales. This undermines all incentive for a utility to help any customer save energy because the lost revenues reduce earnings. Since 1974, however, when the American Physical Society's assessment on the thermodynamic efficiency of energy use found all the ways society used energy were highly inefficient, there has been a continuous stream of economic engineering analyses providing fine-grained maps for capturing these no-cost, ultra-low-cost, or low-cost and highly competitive energy (and water) service opportunities that touch on virtually every daily action that human beings carry out.[1] Most recently, the McKinsey Global Institute's detailed energy efficiency assessment concluded: "By capturing the potential available from existing technologies with an internal rate of return (IRR) of 10 percent or more, we could cut global energy demand growth by half or more over the next 15 years."[2]

1. Kenneth Ford, ed., *Efficient Use of Energy: A Physics Perspective*, American Institute of Physics (AIP) conference proceedings (College Park, Md.: AIP Press, June 1975), p. 300.

Efficiency improvements create what are popularly called "smarter" energy services. Smart energy services result from the inventive and ingenious infusion of information-rich, design-innovative, knowledge-intensive ways of delivering utility services with less energy, less water, fewer resources, less pollution and waste, and lower life-cycle costs. Monetary and resource savings accrue all along the value chain, from manufacturing smarter appliances, lights, office equipment, electric motor systems, consumer electronic devices, and vehicles, to constructing smart buildings and factories. In the ubiquitous world of Internet connectivity, wireless sensors embedded in more and more energy- and water-consuming devices are giving rise to ever smarter utility services propagated through the increasingly smarter grid that enables real-time pricing facilitated by communicating algorithms.

These higher-productivity, highly efficient smart utility services are capable of delivering several-fold to an order of magnitude more energy services and carbon reductions compared with a similar investment in a giant power plant.

Since the 1980s California has established itself as the world leader in continually fine-tuning the utility regulatory process for aligning the financial interests of the utility with those of the customer in capturing end-use efficiency opportunities. California addressed the problem by decoupling utility earnings from revenues and rewarding utilities for promoting customer efficiency savings by allowing the utilities to recoup earnings on lost sales (that is, in kilowatt-hours, therms of gas, liters of water). This powerful paradigm shift refocuses the utility's attention on its earnings remaining robust even as revenues decline, and customers can watch utility bills decline even as rates increase to recoup utility lost earnings.[3]

California's world leadership in setting continuously stronger appliance and building efficiency standards has positioned the state to achieve saving in each household of $1,000 per year on electric utility bills and cost-free reductions in CO_2 emissions to 50 percent below the national average.[4]

If all states had followed California's example, today the U.S. utility bill would be several hundred billion dollars less than it is, and the nation would have surpassed the CO_2 reduction targets of the Kyoto Treaty.

This regulatory shortcoming was first recognized nationally in the United States in 1989, when the National Association of Regulatory Utility Commissioners (NARUC) adopted a resolution expressly recognizing this serious impediment to greater use of the energy efficiency resource and recommended a simple and unequivocal response: Reform regulation to align the utility's financial interest with the interests of its customers in having energy efficiency integrated into the utility's resource portfolio.[5]

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2. McKinsey Global Institute, *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity* (San Francisco: McKinsey & Company, May 2007), p. 9.

3. *Integrated Energy Policy Report,* report no. CEC-100-2005-007CMF (Sacramento: California Energy Commission, November 2005), chap. 8, www.energy.ca.gov/2005publications/CEC-100-2005-007/CEC-100-2005-007-CMF.PDF.

4. Arthur H. Rosenfeld, "Near-Term Solutions for Mitigation of Carbon Dioxide" (presentation to California Near-Term Solutions Symposium, California Air Resources Board, March 5, 2007), www.energy.ca.gov/commission/commissioners/rosenfeld.html.

Adoption of decoupling regulations by all electric, gas, and water utility regulators is vital for enabling efficiency to compete against unnecessarily more expensive, polluting, and some more risky, large-scale power plant construction. In the United States, a dozen states have adopted electric decoupling regulations, two dozen states have adopted gas utility decoupling regulations, and California is pioneering water utility decoupling.

Three provinces in China—Jiangsu, Shanghai and Beijing—are in the process of adopting decoupling regulations so that aggregated efficiency savings opportunities, referred to as efficiency power plants (EPPs), can compete in the integrated resource planning (IRP) process along with coal, nuclear, and large hydroelectric plants.

The fundamental strength of IRP, including EPPs, is the transparency it brings to decisions now typically made without full comparison of costs, risks, and benefits against the entire portfolio of options. For example, 60 percent of China's electricity is consumed by industrial drive systems—electric motors, pumps, compressors, and fans. Utility incentive programs empirically show that upgrading the efficiency of existing systems achieves 30 percent savings at five times less cost per kilowatt-hour than building new generation to power the inefficient ones. New motor systems can achieve 50 percent savings.

A worldwide initiative for transforming the motor market would save two trillion kilowatt-hours per year, equal to one-fourth of all coal plants to be built through 2030, and would reduce global energy bills by $240 billion per decade. Chinese motor experts are fully engaged in this process, promoting standards for energy efficiency of electric motor systems.[6] Potential savings in China are worth $100 billion per decade while eliminating the need for 63,000 megawatts of coal plants. For perspective, this one initiative would eliminate annually the shipment of 147 million tons of coal in nearly 1.5 million railroad cars, prevent the release of 420 million tons of CO_2 and 2.3 million tons of sulfur oxide and nitrogen oxide pollutants, and eliminate the need for 9.5 trillion gallons of water.

On the big-picture level, IRP-EPPs could help avoid an estimated half of the $10 trillion China will spend on power plants to be built between now and 2030 and expected to operate for more than 30 years. How? Given the anticipated fourfold growth in the Chinese economy during the next two decades, including the projection for China to build half of all new buildings in the world, there is every opportunity for regulators and policymakers to provide incentives for this growth to promote radical gains in energy (and water and resource) efficiency. Providing the incentives and technical assistance for manufacturers to install high-efficiency motors, pumps, and compressors and to produce higher-efficiency goods; for builders to design and construct zero-net-energy "green" buildings; and for builders, retailers, and customers to install the top 10 percent most efficient appliances, lights, consumer electronics and office electronic equipment could reduce by half

5. "Clean Energy Policies for Electric and Gas Utility Regulators," *Regulatory Assistance Project Issues Letter,* January 2005, http://www.raponline.org/Pubs/IssueLtr/RAPjan2005.pdf.

6. See Standards for Energy Efficiency of Electric Motor Systems (SEEEM), 2007, www.seeem.org.

the electricity services otherwise provided by power plants powering inefficient devices, equipment, and buildings.

Some $5 trillion in avoided power plant construction and operating costs could be saved: Perhaps $1 trillion would be required as incentives and technical assistance to achieve the savings investments and the other $4 trillion could be freed up from the utility sector for additional economic activity. Just as important, this energy savings could avoid several times this amount in health and environmental damages, including preventing 16 billion tons per decade of CO_2 emissions and some 90 million tons of acid rain and urban smog pollutants.[7]

Although the figures are impressive, actual results hinge not only on implementing a highly effective IRP-EPPs regulatory process but also on reinforcing other key policy tools and regulatory actions. With China annually producing several hundred million appliances and constructing more than 20 billion square feet (2 billion square meters) of new buildings, the Chinese market needs more stringent standards and effective enforcement mechanisms and the transfer of more efficient technologies for appliances. Introduction of international best practices in enforcement and monitoring of standard compliances is also critically needed.

Standards for buildings, motors, appliances, consumer equipment, and vehicles have a multidecade proven record as one of the most cost-effective ways of delivering electricity, gas, water, and mobility services while reducing energy consumption, preventing multiple pollutants (CO_2, acid rain, urban smog), and saving money. Just 15–20 years into the future, international needs for electricity and natural gas will be determined primarily by buildings and devices that do not yet exist. Those unbuilt structures and machines are likely to account for about half the world's global warming pollution. The fastest, cheapest, and cleanest way to minimize those emissions is to use flexible performance-based standards to ensure that the maximum possible cost-effective energy efficiency is built in up front.

China offers immense opportunities. China produces one-third of the world's computers and refrigerators; half of its textiles, digital cameras, and DVDs; and 60 percent of its air conditioners, microwave ovens, and copy machines. Yet China's energy consumption is astonishingly inefficient: The nation's coal combustion per dollar-equivalent of gross domestic product in 2004 was fully 10 times the global average and 20 times that of Japan. In 2006, in its 11th Five Year Plan, China adopted one of the world's most aggressive energy efficiency goals: 4 percent per year. Although it has fallen short of this goal for the past two years, it greatly increased funding for the initiative in July 2007. Vigorous implementation of both IRP-EEPs and efficiency standards enforcement will be essential to meet this aggressive goal.

Just as with energy services, scientific and technological advancements are giving rise to continuous innovations for delivering water services far more effectively

7. Michael Totten, "China's Bold Initiative," *Solar Today,* March/April 2007, http://www.solartoday.org/2007/mar_apr07/china.htm; Lu Zhi, Michael Totten, and Philip Chou, "Spurring Innovations for Clean Energy and Water Protection in China: An Opportunity to Advance Security and Harmonious Development," in *China Environment Series* 8 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 2006), pp. 61–84 http://www.wilsoncenter.org/topics/pubs/CEF_Feature.4.pdf.

and efficiently.[8] This could not be more timely given that China's water problems are so acute that high-ranking officials see water scarcity as the major impediment to sustaining economic growth.

For centuries China's water has been consumed largely as a free resource, with water prices barely covering distribution costs. Neither the real cost nor the productive value of water is considered in establishing water prices.[9]

For industrial production, China is using some 10 to 20 times more water than advanced nations to produce the same amount of value added. The situation in agriculture is similar: about 60 percent of irrigation water is lost by canal seepage at different levels. Inefficient irrigation "causes water loss, raises the water table and with it the ineffective evaporation of the ground water, as well as soil salinization and waterlogging, both of which can lead to decreases in agricultural productivity."[10]

In April 2005, China's National Development and Reform Commission (NDRC) and four ministries issued a joint announcement on China water conservation technology policy, a codification to promote a water conservation–conscious society.[11] While very ambitious, the announcement ultimately fails to mandate an IRP process with water efficiency options. Without a thorough and continuous comparison of the costs, benefits, and risks of water supply expansion projects with the full range of demand-side conservation methods and highly efficient techniques for delivering water services, an imbalance of resources, misallocation of investments, and failure to capture lost opportunities will inevitably occur.[12]

For example, water savings in the three drought-stricken northern Chinese provinces has been estimated at between 50 and 90 km^3. A mandated IRP would ensure against the misallocation of tens of billions of dollars on more expensive giant-scale shipments of water across the country.[13]

Worldwide, some 1,500 km^3 (1,500 trillion liters) of irrigation water is wasted annually.[14] In China, such waste is driven by misplaced subsidies, suboptimal as well as inadequate investment allocations, artificially low water prices 70 to 80 per-

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8. *Integrated Energy Policy Report;* Water Action Plan, California Public Utilities Commission, December 15, 2005, http://www.cpuc.ca.gov/PUC/hottopics/3Water/051109_wateractionplan.htm; Peter H. Gleick, "Water Use," *Annual Review of Environmental Resources* 28 (November 2003): 275–314; Peter H. Gleick, "Global Freshwater Resources: Soft-Path Solutions for the 21st Century," *Science* 302 (November 28, 2003), pp. 1524–1528, www.pacinst.org/.

9. *China: Air, Land, and Water: Environmental Priorities for a New Millennium* (Washington, D.C.: World Bank, 2001), www.worldbank.org.cn/English/content/china-environment.pdf.

10. Klaus Hubacek and Laixiang Sun, "Economic and Societal Changes in China and Their Effects on Water Use, A Scenario Analysis," *Journal of Industrial Ecology* 9, no. 1–2 (Winter/Spring 2005): 188, http://mitpress.mit.edu/journals/JIEC/v9n1_2/jiec_9_1-2_187_0.pdf.

11. "China Water Conservation Technology Policy Outline," Announcement 2005, no. 17 (Beijing: National Development and Reform Commission [NDRC], People's Republic of China, April 21, 2005), http://en.ndrc.gov.cn/policyrelease/t20050621_8427.htm.

12. Gleick, "Water Use."

13. "The Unacceptable Cost of the Proposed South-North Water Transfer Scheme in China," cited in Dam Right, *Rivers at Risk, Dams and the Future of Freshwater Ecosystems* (Godalming, England: World Wildlife Fund, 2003), http://assets.panda.org/downloads/riversatriskfullreport.pdf.

14. Gleick, "Global Freshwater Resources."

cent below prices in other countries, institutional and political impasses, balkanized decisionmaking, and broad-scale failure to inventory and capture lost opportunities.[15]

Upgrading the utility regulatory system is imperative for capturing the top three most cost-effective electric, gas, and water utility services: (1) efficiency; (2) efficiency; and (3) efficiency. It is the most fiscally responsible action, the most equitable action for addressing the energy needs of impoverished communities, and an essential cornerstone for securing climate solutions at the least cost and lowest risk.

15. Tina Butler, "China's Imminent Water Crisis," mongabay.com, May 30, 2005, http://news.mongabay.com/2005/0531-tina_butler.html.

CHAPTER 7

Lessons Learned from the Asia Foundation's Environment Program

Terry Foecke and Chris Plante

Governance is a crucial element in implementing solutions for water and energy problems across the region. As such, the goal of governance reform for sustainable resource management attracts countless delegations from the international community to engage with government, civil society, and private sector groups in Pacific Asia's developing countries. Terry Foecke and Chris Plante offer a window into the strategies employed by practitioners on the ground in this region. Based on their experiences in the field, Foecke and Plante recommend multistakeholder, market-oriented approaches for programs to stimulate environmentally sustainable practices over the long term.

The Asia Foundation's Environment Program is part of the foundation's largest thematic and program area, which is the Law and Governance Program. The Environment Program provides support for 17 field offices in Asia on the interconnections of governance and environment with economics and other Asia Foundation programs. This support includes country program analysis, project proposals and management support, metrics development and management, and guidance on emerging issues.

The mission of the Environment Program is to reverse the degradation of human health and the environment in Asia by reforming the political economy of environmental governance. The mission is advanced through integration with the foundation's core competencies and specific country objectives. The mission takes as organizing principles a focus on public participation, multistakeholder dialogue, pollution prevention, and market-driven adoption of resource use optimization practices.

The Asia Foundation's Environment Program addresses the negative effects of society's decisions about the natural environment and human health and safety, and the negative effects that result from improper alignment of political, economic, and social incentives. In particular, the program addresses the need for innovative approaches to achieving economic growth without sacrificing environmental

progress. Project partners for this focus have been and are most likely to be those government agencies and civil society organizations able to modify incentives and their application, or provide evidence and support for that modification.

Current approaches to environmental governance rely on education, enforcement of regulations, and stakeholder dialogue. These have proved to be necessary elements but are insufficient for achieving sustainable environmental progress because of the perception that economic growth and environmental protection cannot be achieved simultaneously. Current funding and project trends to improve environmental governance in Asia focus on activism, increased enforcement of environmental regulations, public participation, and intergovernmental efforts to address transboundary environmental issues. The Asia Foundation's Environment Program integrates and supports these approaches based on law and education, but it also adds a third way: market-driven approaches emphasizing a realignment of political economy incentives and collaborative public policy.

Analysis—Lessons Learned

Environmental activism and government regulation, long the favored approach for protecting human health and the environment, are not up to that task in developing Asian economies, at least not alone. An environmental protection model of activism and enforcement ignores too many realities of developing economies, especially their tendency to pursue and reward economic growth over almost all other objectives. Yet the need for superior environmental governance grows as industrial activity and resource consumption shift massively to these rapidly developing Asian economies, and evidence of pollution in the region grows weekly.

During more than 50 years of program work in developing Asian economies on governance and law, economic development, and the environment, the Asia Foundation has found that the policy context—economic, institutional, and social incentives—often supports polluting and environmentally destructive practices. The primary problem is that, by its very nature, the status quo approach to environmental protection slows growth. Pollution control and cleanup drains resources away from short-term productivity and places resources into long-term investments like protected lands and forests, clean water, and clean air.

These investments are crucial but difficult to monetize, and as a result they are often cut from budgets. In addition, local enforcement is deeply conflicted and generally ineffective. Local authorities are more easily rewarded for economic growth, or, in the case of regulatory authorities, for not creating barriers to growth. Regulatory agency staff may have ownership positions in entities they regulate, and independent oversight is rare and episodic. Resources for regulatory activity are difficult to secure and never sufficient for achieving complete coverage. Finally, environmental progress is hard to sustain. Pollution control and remediation, the default mechanisms, are bottom-line costs for the regulated entities and are usually either evaded entirely or delayed indefinitely by the payment of fines too small to change behavior.

On the basis of this analysis, the Asia Foundation concentrates its resources toward development and support for innovative approaches to achieving economic growth without sacrificing environmental progress. The goal is to stimulate the reform of environmental governance in developing Asian economies by emphasizing the following principles:

- Effective and efficient environmental governance flows from good data, transparency, and public participation.
- Prevention of degradation is preferred to policing regulations.
- Behavior is changed more quickly and flexibly by markets than by mandates.
- Innovation (in clean technology and improved policies) is a better long-term investment than inspection (for regulatory compliance).

The Asia Foundation has a historically strong record of success in working to improve business and government practices in Asia on sensitive topics such as migrant women workers' rights, strengthening farmers' cooperatives, and partnerships between nongovernmental organizations (NGOs) and businesses; and it has emphasized building cross-sector and multisector partnerships to promote innovative environmental management strategies and policies. Drawing on lessons learned, the Environment Program continues to convene (both on the record and off) industry associations, government, and civil society leaders into interest-based partnerships that promote mutually beneficial environmental outcomes. With this multistakeholder approach, the Asia Foundation has been working to reform the way that public and private sector institutions interact with each other and with citizens on the issues of industrial pollution and resource consumption.

By properly informing, motivating, and advising all stakeholders and by taking into consideration the local context, including the political, institutional, and social constraints as well as technical barriers to environmental progress, the Asia Foundation believes that its approach:

- Builds a common platform and framework for multistakeholder organizing and engagement;
- Tests innovations and measures results and impact against higher standards of environmental performance;
- Catalyzes citizens in understanding and taking control of pollution risks, and turning less to inflammatory protests but to well-informed collaborative action so that change can be sustained;
- Persuades enterprise owners and managers that they, too, are at risk from improper environmental practices, and that positive action should be taken;
- Assists government authorities in modifying their approach so that they can take real preventive action and economic development can still proceed;
- Solves one of the most difficult and persistent sustainable development challenges, which is that the incentives for governance, material production, and

services and the fundamental protection of ecological systems compete where they should complement.

Putting Lessons Learned to Use

On the basis of the Asia Foundation's research, analysis, and project record, and in combination with the public record of sustainable development progress, the foundation's Environment Program currently focuses on three main components:

Action through supply chains to target and reduce industrial pollution sources. To persuade others of the Asia Foundation's vision of economic growth in developing countries as supportive of environmental progress, there is a need for believable success stories with a clear path to "viral" replication. In the 1980s and 1990s, pollution prevention and cleaner production demonstration projects and technical assistance attracted early adopters around the world to improve their already quite good environmental performance. When the funding died, however, the efforts withered away. Not because the content or delivery was incorrect, but because the context and actors were not biased for replication.

The Asia Foundation is tackling this problem by engaging the self-interest of suppliers and other advisers in increasing their sales and market penetration. The foundation is targeting pollution hot spots where direct technical assistance can yield measurable results fairly quickly and is working through suppliers, customers, and other advisers to engage the polluting enterprises, analyze their needs, and deliver solutions. This activity provides the raw materials for further discussion and projects, including with government agencies. Perhaps more important, the first projects will begin to replicate because all the actors have a self-interest in supporting replication.

Working with supply chains, customers, and advisers is an especially auspicious choice at this time because of several concurrent pressures. The most current pressure is today's news about products like toys coated in lead-bearing paint or medicines laced with dangerous materials. But those incidents are just the most recent in a chain of demands by customers—and demands by customers' customers—to improve the environmental performance of their supply chains. Product safety concerns have been preceded by concerns over global corporate social responsibility, including environmental performance. But most efforts to date have led mainly to paperwork exercises, self-certification processes, and management system upgrades.

In the economies of developing Asia, management systems are mostly nonexistent, and paperwork does not reflect reality. The company that made the lead-bearing paint that went on those toys was at the far end of a chain with numerous links (an average of 17 links in China). They and the other links in that chain have had little incentive before now to produce, market, and support paint that does not contain lead, even though lead-free paint is technically and economically superior. In the future, the Asia Foundation, from its position of experience and strength, will use the success stories to open dialogues with other suppliers and expand the

dialogue to other stakeholders, advocating the reform of environmental governance that has been allowing such obvious dysfunction.

Improved targeting for measurable, replicable results. To demonstrate the success of the Asia Foundation's model for improved environmental governance, the foundation has had to work with not just the willing but also the doubting. The foundation also needs to work on not just the obvious issues, but also on those that lie hidden behind old attitudes or incomplete analysis. The foundation's core principles state a preference for interventions that are data driven and market driven and that have a clear path to replication and policy reform.

In China, the foundation has applied those principles to develop two projects that are now under way. When looking at water issues in China, the Asia Foundation saw problems that were diffuse, poorly addressed, and in need of the kind of multistakeholder, innovative approach used by the foundation. In addition, there was the opportunity for creating a path to long-term reform of environmental governance through capacity building and transparent data. In particular, the foundation saw rivers, and the industrial and agricultural enterprises polluting them, as good targets. The foundation now has in place two pilot projects in China looking at very different approaches to the question of reducing heavy metal pollution in China's rivers. One is taking a focused approach, looking at a single type of enterprise (electroplating) in a short reach of river in Nanhai, Guangdong Province, and incorporating suppliers and government agencies. The other is quite experimental: it looks at all enterprises and stakeholders in a specific reach of river in Beijing, seeking the critical project design elements that lead to measurable success.

Expanding the discussion by mapping a path to reform of environmental governance. Even with good targets and evidence that this model and approach are useful, the transition to superior environmental governance will require intervention. For that intervention to be successful, the Asia Foundation has sought to understand who influences and benefits from the current model, who has the willingness and ability to make changes, and what is needed for those changes to occur. Simply put, status quo environmental governance is a good deal for enterprises and government and a bad deal for the public and the natural environment. Because the public and the natural environment have little power, change will be motivated by an acceptance by the powerful that the foundation model provides benefit beyond awards and professional satisfaction. This is of course too broad a statement: every country has selfless individuals who act for the common good, and they will be key allies. But for systemic reform to occur, this model must out-compete the status quo. The following are some of the benefits that a data-driven, market-oriented model can provide:

- Measurable environmental progress,
- Replication that does not require a heavy burden of public support,
- Business improvement for enterprises,
- The possibility of reducing social unrest caused by pollution,
- Optimized public expenditures for regulatory enforcement, and

- Collaborative relationships with enterprises.

These benefits are closely aligned with sustainable development itself. The stakeholders whose relationships the Asia Foundation needs to map and understand include those at the intersection of economic growth and environmental progress. Business and government would welcome market-driven approaches to achieving the former without imperiling the latter. The political, economic, and social incentives controlled by these partners are misaligned, in that the incentives tend to support pollution control and regulatory enforcement, approaches with little remaining ability to address sustainable development—both economic growth and environmental progress.

The Asia Foundation has brought a combination of technical expertise; knowledge of the local economic, social, political, and ecological context; strong relationships with the relevant players; and a long history of success in facilitating multistakeholder partnerships to tackle complex environmental challenges. For more than 50 years, the Asia Foundation has worked on the fundamentals of building public participation, good governance, and economic development and of nurturing Asia's environmental civil society, business, and government leaders. We work locally, with Asian partners, to bring together diverse interest groups that are impacted by environmental degradation. The Asia Foundation Web site (http://asiafoundation.org/Environment/overview.html) provides details and examples of our work. In this regard, two of our most innovative programs include:

Mongolia: Securing Our Future

The Asia Foundation is supporting a long-term partnership among public, private, and NGO sector representatives in Mongolia to facilitate a constructive national dialogue on water and responsible mining policies and practices. Through public awareness campaigns, environmental education partnerships with universities and secondary schools, and a public forum to establish stronger mining and environmental standards, the Asia Foundation is demonstrating that economic development and environmental protection can be complementary development priorities. Core program activities include citizen-based monitoring of licensing agreements and water quality monitoring.

China: Clean Water

The Asia Foundation launched a major new environmental initiative in 2007 to inform, engage, and empower citizens and businesses to monitor water quality, identify pollution sources, and then take action to improve river health. The project will also serve as a model for multisector cooperation in pollution prevention that can be replicated in other waterways of China and Asia. Working with local partners in Beijing and Guangdong Province, we are striving to reduce pollutant loading in targeted waterways near Beijing and the city of Nanhai by using a process that emphasizes a multistakeholder approach, cleaner production alternatives, and actual measurement of river conditions and that will address policy reform.

CHAPTER 8

Framework for Resource Management in East and Southeast Asia

Gene M. Owens

Although resource management reform in Pacific Asia is often applied in an urban context, it is also important to assess environmental stewardship in rural areas. Gene M. Owens focuses on decentralization of governance, encouraging a bottom-up model for allocating natural resources and preventing social conflict. He discusses strategic environmental assessment and climate change adaptation strategies as useful tools for facilitating local-level decisionmaking. Both of these tools require an assessment of the scale and intensity of potential environmental impacts on communities, followed by the formulation of a farsighted capacity development plan closely involving stakeholders.

As noted in the introduction, we need to ask whether the developing countries in Pacific Asia are hurtling down an unsustainable course that could be derailed by any number of factors. The visual image of "hurtling"—being out of control—serves as the principal focus of this essay. How do we manage to slow things down, to get back under control, to introduce some means of resource management leading to a more sustainable path?

This task is complicated by contradictory pressures, pushing some regions toward accelerated growth under the rubric of "development." Other regions and areas—especially expanding urban areas—now recognize the environmental costs of spontaneous growth characterized by air pollution, problems of health and sanitation, and inadequate urban infrastructure. Population increase, climate change, and resulting weather volatility have worsened conditions with respect to critical resource constraints, particularly with respect to energy and water availability. These constraints impact on resource productivity of land, urban sanitation, and health, and an ever expanding array of critical resources needed to sustain future populations.

Looking at the interconnected trends in water, energy, and urbanization in East Asia, resource economists have painted a grim picture. The CSIS white paper on global water futures notes:

The consequences of over-consumption and mismanagement [of global water resources] on human health, economic development, and the functioning of regional and global aquatic systems are already dire and can be expected to worsen. Groundwater levels are dropping, and rivers, lakes, and wetlands are drying up around the world. Billions of people already lack access to safe drinking water or basic sanitation facilities.[1]

The environmental costs of rapid urban growth are clearly evident in the rapidly deteriorating air quality in Chinese cities. If growth in East and Southeast Asia is to be sustainable, these countries will have to change their energy mix away from coal and toward cleaner fuels, manage natural resources more efficiently, secure stable supplies of fuels and raw materials, and improve environmental regulations and enforcement.

Exacerbating these resource constraints are climate change uncertainties. The critical variables accounting for the vulnerability of nations and regions to impacts from global warming are largely unknown. Climate science informs us that as the air gets warmer there will be more water in the atmosphere. But where and when it comes down as rainfall is the big uncertainty. "Global warming will intensify drought, and it will intensify floods."[2] Analytic tools must be developed to account for different probabilities and varying vulnerabilities to climate impacts across a range of countries.

We can perhaps take comfort in the realization that Malthusian doomsayers in the late eighteenth century portrayed similar pictures. These were overcome by technological, economic, and institutional innovations leading to the industrial revolution. But do we have 200 years to get it right once again? Institutional capacities in governance systems around the world must be strengthened now to address adequately the magnitude of future challenges.

This paper briefly examines how innovation in governance may be able to provide a framework to address issues of growing resource constraints at local levels in order to provide greater potential for resource management. It looks at how enhancing local participation may contrast with regional and national limitations or policies. Finally the paper surveys strategic environmental assessment (SEA) tools and climate change adaptation strategies—or a mix of the two—to provide us with a potential longer-range focus for integrating institutional strategies to address future resource scarcity in East and Southeast Asia.

Decentralization as a Tool for Resource Management

Governance has many definitions. The perspective used here deals with the use of institutions, structures of authority, collaboration, and social sanctions to allocate resources and coordinate or control activity in society or the economy.[3] Poor gover-

1. Global Strategy Institute, *Addressing Our Global Water Future* (Washington, D.C.: Center for Strategic and International Studies; Albuquerque, N.M.: Sandia National Laboratories, September 30, 2005), pp. 5–6, http://water.csis.org/050928_ogwf.pdf.

2. Doug Struck, "Warming May Exacerbate Global Water Conflicts," *Washington Post,* August 20, 2007, Sec. A.

nance can impair the effective application of both innovative technology and innovative policy. Good governance covers a range of issues such as the institutional and regulatory environment; tensions between central and periphery management; and governance capacity, including transparency, accountability, predictability, and participation. This paper's scope is limited here to tensions between central and periphery management.

Much evidence suggests that the greater the direct involvement of local people in the resource conservation process, the more successful and sustained is the operation. Lila Buckley in a recent review of China's efforts to grapple with the problem of protecting endangered species through the establishment of nature reserves notes that typically weak management and top-down decisionmaking have caused China's nature reserves to be little more than demarcated lines on a map. Her study of the Mount Tomur Nature Reserve in northwestern China's Xinjiang Uighur Autonomous Region is illustrative.[4] New efforts to involve directly the local population through an indigenous nongovernmental organization (NGO) had a profound effect. Using participatory approaches, Chinese NGOs were much more effective than traditional top-down regulatory initiatives. By developing alternative economic activities, providing schools and health care, and finding ways that local people can engage in and benefit from the conservation process, communities can become part of the solution instead of the problem. This is especially important in resource conservation where local people's lack of appropriate livelihoods is often the greatest threat to a region's protection.

This recent success in using communities for conservation should not be surprising. In China, local community involvement in resource management goes back thousands of years. Jerome Delli Priscoli describes the synergy between communities and resource management:

> Water irrigation helped build early communities and bring those communities together in large functional arrangements. Such community networking was a primary impetus to the growth of civilization. Indeed, water may actually be one of humanity's great learning grounds for building community. . . . The thirst for water may be more pervasive than the impulse toward conflict.[5]

In early 2007 this author was involved in the review of a beneficiary assessment of a large-scale renewable energy project in China. The importance of local-level participation was expected, but not to the extent shown in the assessment. The beneficiary assessment suggested that a fundamental barrier to effective project management is that much of the training and capacity building for management is

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3. World Bank, *Governance and Development* (Washington, D.C.: World Bank, 1992).

4. Lila Buckley, "Participatory Development: Chinese Environmental Group Works to Protect Species by Empowering Local People," Worldwatch Institute, August 16, 2007, http://www.worldwatch.org/node/5304.

5. Jerome Delli Priscoli is the editor of the journal *Water Policy* and a social scientist at the U.S. Army Corps of Engineers; cited in Rob Verheem and Reinoud Post, "Strategic Environmental Assessments: Capacity Building in Conflict-Affected Countries," Social Development Papers, Conflict Prevention and Reconstruction, Working paper no. 30 (Washington, D.C.: World Bank, December 2005).

focused on goals that reflect national policy directives and concerns—for example, national and provincial plans, sectorwide reviews, economic growth and change—and not on the local issues that define development. As a consequence, local beneficiary perceptions and ideas and their suggestions for project adaptation are often marginalized and largely ignored.[6]

A more sustained, innovative effort at resource management would incorporate five components that reflect local beneficiary interests:

- Consensus among the project staff and the local community that reflects the mutually agreed components that define the project intervention;
- Transparency and openness in the selection of target groups;
- Project design consistent with the community's capacity for self-development and decisionmaking (self-development is considered a basic foundation for sustainability);
- Beneficiaries that are selected on the basis of their motivation to participate; and
- A project intervention that adds value to the existing community's economic system.

These components appear to recognize that rural resource management in China is local—not national—and will depend ultimately on the commitments and capacity of local groups to develop their own institutional capacity for self-development. In short, knowledgeable local participation is a critical component in adapting projects to manage impacts (negative and positive) in order to achieve sustainable, beneficial outcomes from development projects.

Coordination and Linkages among Governing Institutions

Addressing the underlying causes of resource competition requires a clear understanding of who is involved in making resource management decisions, what powers these different actors exercise, and how they are held accountable for their decisions. Research on governance of watershed management in Southeast Asia and promotion of renewable energy in provincial rural areas of China suggests that conventional (national) policy responses frequently fail to address the social and institutional decisions of resource use and sometimes aggravate conflict. Although it is generally recognized that effective resource management at local and regional levels requires collaboration, effective communication, innovative technologies, and a multistakeholder process, governmental efforts have suffered from an overly technical emphasis on engineering solutions. Moreover, agencies often work at

6. Libin Wang, Gene Owens, and Li Xiaoyun, "Beneficiary Assessment as a Tool for Project Adaptation: A Case for Promoting Renewable Energy in China" (draft submission prepared for peer review by *Journal of Rural Studies,* College of Humanities and Development, China Agricultural University, Beijing, May 2007).

cross-purposes. Efforts to integrate such sectors as water resources, agriculture, transportation, and industry among resource users ranging from rural to urban have not been notably successful.

New planning and management tools such as integrated water resource management plans and SEA have resulted in expanded institutional linkages and institutional innovation,[7] particularly in the Greater Mekong subregion and in western China. Nevertheless, global warming and the impacts of climate change portend the likelihood of regional instability and competition caused by resource scarcity and, in some instances, the possibility of conflict over a dwindling resource base. It is this potential for conflict, and the resulting social and economic instability, that can have the most detrimental impact on sustained development.

The first sentence of this essay described the region as "hurtling down an unsustainable course." It is suggested that an appropriate way forward is to assume that future "resource conflict" is inevitable. This increases the stakes of both national planners and local communities. The inevitability of resource conflict also implies a longer time frame for problem identification, conflict resolution, mediation, and the gradual development of local institutional capacity for resource management. In the concluding section, two planning tools are examined as possible means for resource management. One is SEA, specifically as applied in conflict-affected countries.[8] The other tool covers various methods of assessing vulnerability and adaptation to climate change.[9] An amalgam of the two methods might be most useful—integrating a better understanding of the impact of human-induced activities on the natural environment and, conversely, the impact of nature on man and the social environment.

SEA and Climate Change Adaptation Strategies as Tools for Resource Utilization

SEA can be defined as a participatory approach that identifies and highlights for decisionmakers the environmental and social issues that influence development planning, economic decisionmaking, and implementation processes at the strategic level. SEA takes into account not only the environmental effects of policies, programs, and plans but also their social and economic effects on current and future generations. In practice the SEA approaches are consultative and iterative, and they rely on partnerships, local participation, and open discussion.

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7. Board of Directors, Asian Development Bank (ADB), *Water For All: The Water Policy of the Asian Development Bank* (Manila: ADB, 2000), http://www.adb.org/Documents/Policies/Water/default.asp?p=policies; Kulsum Ahmed, Jean Roger Mercier, and Rob Verheem, "Strategic Environmental Assessment—Concept and Practice," *Environment Strategy* no. 14 (Washington, D.C.: World Bank, June 2005).

8. Verheem and Post, "Strategic Environmental Assessments: Capacity Building in Conflict-Affected Countries."

9. Santiago Olmos, "Vulnerability and Adaptation to Climate Change: Concepts, Issues, Assessment Methods" (Foundation Paper prepared for the Climate Change Knowledge Network, July 2001), http://www.cckn.net/pdf/va_foundation_final.pdf.

The World Bank has carried out a series of studies to examine the efficacy of SEA in conflict-affected counties, covering local situations where:

- Not enough of a given natural resource exists, causing grievances over land, water, or food; or
- Populations have been physically moved from the area that sustained their livelihoods.[10]

It is interesting that the resource management situations of countries in conflict are similar to regions that are vulnerable to climate change impacts. The Intergovernmental Panel on Climate Change describes climate change vulnerability as

> the extent to which a natural or social system is susceptible to sustaining damage from climate change, and is a function of the magnitude of climate change, the sensitivity of the system to changes in climate and the ability to adapt the system. . . . A highly vulnerable system is one that is highly sensitive to modest changes in climate and one for which the ability to adapt is severely constrained.[11]

For both SEA and climate change adaptation tools, following the initial assessment of the scale and intensity of natural impacts, future action to resolve the situation depends on two factors: first, the formulation of a long-term capacity development plan and, second, the establishment of stakeholder involvement. Both steps appear to be necessary, regardless of whether impacts are due to social conflict or derive from climate intensity. In both instances, local institutional innovations will be needed to address the issue of natural resource management or to adapt to resource changes.

Workshops on capacity building in conflict-affected countries suggest that there is a need to put more emphasis on the cultural context of the SEA. Special attention should be given to the mind-set of the population, flexibility and willingness to adopt new approaches, attitudes of the people toward the environment, and the role of parties outside of the country or region at stake. Similarly, the "USAID Climate Change Adaptation Guidance Manual" also recommends flexibility and innovation, noting that climate change is a stressor, not a competing sector.[12] What is critical is to work at the project level to improve resilience through design. In this regard, institutional capacity building is required to ensure that adaptation options are integrated into the original project design, that solutions accommodate all parties, and that the climate change adaptation strategy incorporates the interests of a wide range of stakeholders who may know best what might work.

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10. Verheem and Post, "Strategic Environmental Assessments: Capacity Building in Conflict-Affected Countries."

11. Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2001: Impacts, Adaptation, and Vulnerability,* Contribution of Working Group II to the third assessment report of the IPCC (Geneva: UNEP/WMO, 2001), http://www.grida.no/climate/ipcc_tar/wg2/index.htm; cited in Olmos, "Vulnerability and Adaptation to Climate Change."

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In conclusion, instead of hurtling toward an abyss of unsustainable futures, we can try using tools for innovation in governance to address these resource issues. The overall goal of improved governance can be summed up under a number of generic recommendations for capacity building:

- Leadership matters;
- Incentives also matter;
- Build on what exists and what works;
- Build capacity by focusing on local solutions; and
- Define training needs in a strategic context.

CHAPTER 9

Conclusion

Erik R. Peterson and Rachel Posner

In the context of an urbanizing Pacific Asia, increased consumption of water and energy will present major challenges to sustainable development in the years ahead. Economic and social consequences of air and water pollution, decreasing availability of freshwater resources, and impacts of climate change may dramatically slow economic growth for China and its neighbors in East and Southeast Asia.

As noted by the various contributors to this white paper, however, numerous opportunities exist for curbing carbon emissions and mitigating environmental degradation. Technological innovations carry enormous potential, but scaling up these energy and water efficient practices requires policy tools and regulatory actions. For example, the private sector needs economic incentives for choosing energy and water efficient alternatives. Markets—especially in the developing world—need standards and enforcement mechanisms as well.

A number of governance approaches can be used to this end, helping to activate environmentally sustainable practices in the developing countries of Pacific Asia. At the highest level, bilateral and multilateral aid agencies have the opportunity to pursue basinwide initiatives improving water management in China and in other developing countries in Pacific Asia. Other international organizations and businesses could also work with governments in the region to push transparency and information sharing regarding industrial pollution emissions. At the local level, the international community can help initiate environmental stewardship programs that bring various stakeholders together, encourage public participation in decisionmaking, focus on local solutions, and use market-driven approaches.

Progress in all of these areas is needed quickly. Industrializing and urbanizing countries in Pacific Asia are changing at rapid speed. In the next 15 to 20 years, the construction of countless new buildings and consumer devices—especially in China—presents a prime opportunity to profoundly reduce water and energy waste up front. It is the role of the international community to work with governments in the region to identify and implement appropriate, cost effective policies for sustainable energy and water use.

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