CHOKE POINT CHINA: CONFRONTING WATER SCARCITY AND ENERGY DEMAND IN THE WORLD'S LARGEST COUNTRY

Keith Schneider, [*] ***Jennifer L. Turner,*** [**] ***Aaron Jaffe,*** [†] ***and Nadya Ivanova*** [††]

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* Keith Schneider is the senior editor at Circle of Blue. He is a nationally known journalist, online communications specialist, and environmental policy expert. Keith was a *New York Times* national correspondent for over a decade, where he continues to report as a special writer on energy, real estate, business, and technology.

** Jennifer L. Turner has been the director of the China Environment Forum at the Woodrow Wilson International Center for Scholars for eleven years.

† Aaron Jaffe is video producer and reporter at Circle of Blue. He is a graduate of Interlochen Center for the Arts and student at Medill School of Journalism, Northwestern University.

†† Nadya Ivanova is a reporter and producer with Circle of Blue. She is a graduate of the Medill School of Journalism, Northwestern University, with majors in Journalism and International Studies.

INTRODUCTION[1]

By any measure, conventional and otherwise, China's tireless advance to international economic prominence has been nothing less than astonishing. Over the last decade alone, 70 million new jobs emerged from an economy that now boasts the world's largest markets for cars, steel, cement, glass, housing, energy, power plants, wind turbines, solar panels, highways, high-speed rail systems, and airports. The fast and sustained pace of growth—averaging ten percent GDP (gross domestic product) growth over the past forty years—has, however, come at a great cost to the country's environment.

Globally, considerable attention has focused on China's huge air pollution problems that stem predominantly from coal burning and cars. Yet, China's water problems pose an even larger threat to the health of China's economy, environment, and people. The double threat to water is severe—scarcity in the North and pollution nationwide has left approximately thirty-five percent of the rivers with water quality so low that it should not be used for industry, agriculture, or human consumption. However, the need for water is so great that polluted water is used—the

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1. The interviews for this article were conducted as part of a joint Circle of Blue-China Environment Forum project called Choke Point: China. This project—funded by the Energy Foundation, Vermont Law School, and the United States Agency for International Development—is producing twelve online multi-media stories on the impact energy development is having on water resources in China. Some of the material for this article is reproduced from prior works by the authors, including: Nadya Ivanova, *Water Rights Transfers and High-Tech Power Plants Hold off Energy-Water Clash in Northern China*, CIRCLE OF BLUE (Mar. 8, 2011 6:30 AM), http://www.circleofblue.org/waternews/2011/world/from-agriculture-to-industry-efficiency-upgrades-transfer-water-use-rights-on-china%E2%80%99s-yellow-river/; Aaron Jaffe & Keith Schneider, *A Dry and Anxious North Awaits China's Giant, Unproven Water Transport Scheme*, CIRCLE OF BLUE (Mar. 1, 2011 08:26 AM), http://www.circleofblue.org/waternews/2011/world/a-dry-and-anxious-north-awaits-china%E2%80%99s-giant-unproven-water-transport-scheme/ [hereinafter Jaffe & Schneider, *Dry and Anxious*]; Keith Schneider, *Bohai Sea Pipeline Could Open China's Northern Coal Fields*, CIRCLE OF BLUE (Apr. 5, 2011, 8:09 AM), http://www.circleofblue.org/waternews/2011/world/desalinating-the-bohai-sea-transcontinental-pipeline-could-open-chinas-northern-coal-fields/ [hereinafter Schneider, *Bohai Sea Pipeline*]; Keith Schneider, *Choke Point: China – Confronting Water Scarcity and Energy Demand in the World's Largest Country*, CIRCLE OF BLUE (Feb. 15, 2011, 6:00 AM), http://www.circleofblue.org/waternews/2011/world/choke-point-china%E2%80%94confronting-water-scarcity-and-energy-demand-in-the-world%E2%80%99s-largest-country/ [hereinafter Schneider, *Choke Point*]; Keith Schneider & Nadya Ivanova, *China Responds to Explosive Growth, Pollution and Water Scarcity in Latest Five-Year Plan*, CSRWIRE TALKBACK (Mar. 15, 2011, 10:58PM), http://www.csrwire.com/csrlive/commentary_detail/4081-China-Responds-to-Explosive-Growth-Pollution-and-Water-Scarcity-in-Latest-Five-Year-Plan [hereinafter Schneider & Ivanova, *China Responds*]. Direct quotation from and citation to these works have been included at the authors' discretion.

Chinese news media recently reported that ten percent of China's rice is likely contaminated with cadmium.

Addressing China's water problems is further complicated by the increasingly fierce competition between energy and water that threatens to upend China's progress. China's huge energy and water hunger is driven in great part by an urbanization boom and a need to keep the economy growing. Simply put, according to Chinese authorities and government reports, China's demand for energy—particularly for coal—is outpacing its freshwater supply.

Students of Chinese history and geography, of course, understand that tight supplies of fresh water are nothing new in a nation where eighty percent of the rainfall and snowmelt occurs in the South, while just twenty percent of the moisture occurs in the mostly desert regions of the North and West. The new challenge is that China's surging economic growth is prompting the expanding industrial sector, which consumes seventy percent of the nation's energy, to tap new energy supplies, particularly the enormous reserves of coal in the dry North.

The problem, say government officials, is that there is not enough water to mine, process, and consume those reserves, and still develop the modern cities and manufacturing centers that the Chinese government envisions for the country.

I. GROWTH VERSUS WATER RESOURCES

A. Ruinous Confrontation?

On the surface, there is considerable evidence of a potentially ruinous confrontation between growth, water, and fuel already visible across China and virtually certain to grow more dire over the next decade. Over the past five to ten years, the Chinese government has passed aggressive laws and regulations that have catalyzed massive investments into clean energy technologies and aggressively set targets for installed renewable energy and huge increases in energy efficiency. Pushing "green" energy has the double bonus of lessening pollution from coal and decreasing pressure on China's limited water resources. However, the Chinese government wants to double the size of the economy again in ten years and urbanize another 350 million people over the next twenty. The energy needed to attain these goals cannot likely be met by clean energy alone and more coal will need to be mined—and mining coal needs water, water the country does not have.

1. Three Trends Converging

The tightening choke point between rising energy demand and declining freshwater reserves forms the central story line of the next era of China's unfolding development. Stripped to its essence, China's significant energy and water choke point is caused by three converging trends:

> Production and consumption of coal has tripled since 2000 to 3.15 billion metric tons a year. Government analysts project that China's energy companies will need to produce an additional billion metric tons of coal annually by 2020, representing a 30 percent increase. Fresh water needed for mining, processing, and consuming coal accounts for the largest share of industrial water use in China, or roughly 120 billion cubic meters a year, a fifth of all the water consumed nationally.[2]

> Though national conservation policies have helped to limit increases, water consumption nevertheless has climbed to a record 591 billion cubic meters annually, which is 42 billion cubic meters (11 trillion gallons) more than in 2000. Over the next decade, according to government projections, China's water consumption, driven in large part by increasing coal-fired power production, will reach 620 billion to 630 billion cubic meters annually—40 billion cubic meters a year more than today.[3]

And an announcement earlier this year by the government indicates water use could reach as high as 670 billion cubic meters (177 trillion gallons) annually over the next ten years.

> China's total water resource, according to the National Bureau of Statistics, has dropped 13 percent since the start of the century. In other words China's water supply is 350 billion cubic meters (93 trillion gallons) less than it was at the start of the century. That's as much water lost to China each year as flows through the mouth of the Mississippi River in nine months. Chinese climatologists and

2. Schneider, *Choke Point*, *supra* note 1.

3. *Id.*; Interview by Circle Blue with Wang Hao, Dir., Water Res. Dep't, China Inst. of Water Res. & Hydropower Research, in Beijing, China (Dec. 5, 2010) [hereinafter Wang Hao Interview].

> hydrologists attribute much of the drop to climate change, which is disrupting patterns of rain and snowfall.[4]

Last year, however, total water reserves surged to 2.85 trillion cubic meters (740 trillion gallons), the highest since 2002, largely as a result, said authorities, of persistent flooding in parts of southern China.

2. Coal Is King and the King Needs More Water

Most of China's coal is in the dry North and the water needed to mine it is getting steadily harder to access. The coal sector's share of national water use will rise to twenty-seven percent from twenty-two percent this year and likely reach thirty-two percent by 2035.

Much of the increase is due to the growing need for more coal and more power plants to burn it. China's big 1000 megawatt coal-fired power plants use upwards of one million gallons of water per hour for operations and cooling, 20 million gallons a day, 7 billion a year. China's electrical generating capacity from coal was 750,000 megawatts (750 gigawatts) in 2010, and heading to 1250 gigawatts in 2020, according to government projections. In other words, even with the new fleet of efficient plants, China's coal-fired power plants alone will use roughly thirty billion cubic meters (eight trillion gallons) of water annually by 2020.

The increase in water use also comes from the growing coal conversion sector. Last year, China consumed 470 million metric tons of coal to produce diesel fuel, chemicals, and natural gas. Depending on the product, every ton of coal converted to fuel, chemicals, or gas takes three to fifteen tons of water. China's coal conversion program is consuming more than 5 billion cubic meters of water annually, according to engineers, and will continue to expand.

Lastly, the increasing levels of technology and sophistication of China's power plants require a higher quality fuel. More coal than ever before, as a result, is washed with water to remove impurities. Wu Ying, the senior engineer at Beijing Huayu Engineering Company, which supplies the industry with technical devices, said in an interview with Circle of Blue that fifty-five percent of all coal is now washed, up from thirty percent a decade ago. It takes thirty to forty gallons of water per metric ton of coal, or 47 billion to 63 billion gallons of water (178 million cubic meters) annually.[5]

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4. Schneider, *Choke Point*, *supra* note 1.
5. Interview by Circle Blue with Wu Ying, in Beijing, China (Dec. 9, 2010).

B. Choke Points Do Not Slow Rapid GDP Growth Goals

Interviews with national and provincial government leaders, as well as energy industry executives, indicate that the Chinese government has every intention of continuing its ten percent annual economic growth. "We believe that this is possible and we can do this with new technology, new ways to use water and energy," said Xiangkun Ren, who oversees the coal-to-liquids program for Shenhua Group, the largest coal company in the world.[6]

Xiangkun acknowledged that avoiding the looming choke point will not be easy. The tightening loop is already visible in the jammed rail lines, huge coal truck traffic jams, and buckling roads in Inner Mongolia—the country's largest coal producer—which are responsible for transporting billions of tons of coal from existing mines to market.

Energy prices are steadily rising, putting new inflationary pressures on the economy. Even as China has launched enormous new programs of solar, wind, hydro, and seawater-cooled nuclear power, all of which use much less fresh water, energy market conditions will get worse without new supplies of coal, the source of seventy percent of the nation's energy. China's economy and the new social contract with its citizens, who have come to expect rising incomes and improving opportunities, is at risk, say some authorities.

That is why, as China's economic and environmental experts sort through various scenarios to evade the approaching collision, big proposals once thought preposterous are taking hold. The idea of transporting water long distances to the arid North and West is gaining fresh credence.

II. EVADING WATER AND ENERGY CHOKE POINTS FOR NOW

A. Ambitious Water Conservation Measures

To date, China has managed largely to evade the water-energy collision. Once regarded as one of the world's worst water wasters, China has enacted and enforced water efficiency and conservation measures for industries, agriculture, and cities since the mid-1990s. Industrial plants are required to prove there is enough water to operate prior to construction and then must recycle water used for manufacturing and processing. For example, in Baotou, a desert city of 1.5 million people in Inner Mongolia, the giant

6. Interview by Circle Blue with Xiangkun Ren, in Beijing, China (Dec. 1, 2010).

Baotou Iron and Steel Company plant—one of the world's largest—produces 10 million metric tons of steel annually in a region that receives mere inches of rainfall a year.[7] The plant—which is forty-nine square kilometers and employs 50,000 workers—recycles ninety-eight percent of its water, a requirement of a 1997 law that prompted owners of industrial plants to conserve water.[8]

Cities, led by Beijing, are recycling wastewater to use as "gray water"[9] for flushing toilets, greening urban parks, and car washes. New buildings are designed to include separate gray water plumbing systems. Municipal wastewater has long been the major pollutant of China's waterways, not due to a lack of treatment plants, but rather an unwillingness of local governments to pay the cost or use the energy needed to run them. One highly encouraging target that was reached during the recently concluded Eleventh Five-Year Plan was a leap from treatment of fifty-five percent of wastewater to seventy-five percent nationwide.

Another significant water conservation trend is that since 1998 China has taken 8.45 million hectares of farmland (21 million acres) out of production while also improving irrigation practices on millions more hectares of cropland. According to the Ministry of Water Resources, agriculture used 359 billion cubic meters of water, or approximately sixty percent of all water used in China in 2010.[10] This is a two percent drop over five years.

This conservation has been borne out of necessity; per capita, China has only one-quarter the freshwater resources of the rest of the world. In China's dry North, the per capita ratio falls to one-tenth. Ironically, Northern China is a major breadbasket for grain, but forty percent of the crops are dependent on groundwater. The overuse of water in the North has dried riverbeds, emptied aquifers, and exacerbated desertification. Thousands of villages in Northern China have been buried under an ocean of sand over the past decade.[11]

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7. Interview by Circle Blue with Baotou Iron and Steel Co., in Inner Mong. (Dec. 15, 2010).

8. *Id.*

9. Yan Xuejing, *The Utilization Rate of Recycling Wastewater in Beijing Achieves 65%, Ranks the Top of China*, BEIJING DAILY, Mar. 27, 2010, http://news.qq.com/a/20100327/000553.htm.

10. Schneider, *Bohai Sea Pipeline*, *supra* note 1.

11. LINDEN ELLIS, DESERTIFICATION AND ENVIRONMENTAL HEALTH TRENDS IN CHINA (2007), *available at* http://www.wilsoncenter.org/topics/docs/desertificationapril2.pdf; Chad Futrell, *A Vast Chinese Grassland, a Way of Life Turns to Dust*, CIRCLE OF BLUE (Jan. 21, 2008, 2:41 AM), http://www.circleofblue.org/waternews/2008/world/a-vast-chinese-grassland-a-way-of-life-turns-to-dust/.

B. Energy Conservation Equals Water Conservation

Strikingly, the investments and policies promoting water conservation are dwarfed by the government's efforts to expand the use of cleaner energy technologies. The goals of huge energy investments and policies to promote clean energy are to keep up with the steep climb in energy demand, but an important side benefit in some of the energy sources is lower water use. For example, the Chinese government has attempted to quench the thirst for energy by creating the world's most aggressive programs for building water-sipping wind and solar power plants in Northern deserts,[12] setting ambitious goals (which are currently on hold due to the Japan nuclear crisis) for seawater-cooled nuclear plants along the coast, and approving hundreds of hydropower dams in Southwest China to provide more power while reducing coal consumption and water use.[13]

Across the northern provinces, Chinese energy companies and utilities are constructing state-of-the-art coal-fired power plants. More than twenty "supercritical" and "ultra-supercritical" coal-fired power plants have been built that burn hotter and at higher pressure in order to produce ten to twenty percent more electricity per ton of coal consumed, and use fifteen to twenty percent less water.[14] Several more coal-fired power plants have been built in Ningxia Province that are cooled with air, saving seventy to eighty percent of the water needed to cool a conventional coal-fired plant.[15]

In Tianjin, south of Beijing, a consortium of coal companies and utilities is building the 1 billion dollar, 650 megawatt GreenGen coal-fired gasification power plant, a demonstration project to produce energy more efficiently and to prove out technology to capture and permanently dispose of climate changing carbon emissions. The plant has the capacity to be

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12. *Here Comes the Sun (and the Wind, Water, and Biogas): Opportunities and Challenges for U.S.-China Renewable Energy Collaboration*, WOODROW WILSON INT'L CENTER FOR SCHOLARS (Dec. 2, 2010, 9:00 AM), http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=643606.

13. *See* Peter Bosshard, *Dam Nation*, FOREIGN POL'Y (Mar. 8, 2011), http://www.foreignpolicy.com/articles/2011/03/08/dam_nation (examining China's new five-year plan, which includes new hydropower projects allowing China to shift away from fossil fuels); *Experts Suggest China Improve Safety Standard for Nuclear Power*, CHINA NEWSWEEK, Mar. 25, 2011, http://news.sina.com.cn/c/sd/2011-03-25/133622180778.shtml (describing Chinese environmentalists' reaction to Japan's Nuclear Accident); *National Energy Board Is Considering Increasing the Proportion of Nuclear Power up to 15% Non-Fossil Energy Source*, CHINA.COM.CN (Feb. 1, 2011), http://www1.china.com.cn/policy/txt/2010-02/01/content_19340695.htm (reporting the State Council's approval of a long-term nuclear power development plan).

14. Interview by Circle of Blue, in Ningdong Coal Mine, Ningxia Province, China (Dec. 14, 2010).

15. *Id.*

cooled by either freshwater or seawater. "The freshwater and seawater systems are in parallel," said S. Ming Sung, an engineer and the chief representative in Asia for the Clean Air Task Force.[16] "Obviously that costs more. But China is smart enough to test both systems. As they build more[,] the costs will come down."[17]

III. UNRIVALED PLANS TO MOVE WATER TO TAP COAL FIELDS

A. South-North Water Transfer Project

The water conservation trends are encouraging, but they are not enough to handle the steep growth in energy demand and production. It is that vector—the fast-rising energy demand side of the water-energy confrontation—that is proving so difficult for China to resolve.

For decades, water shortages in China have been dealt with through supply-side management strategies—namely, water transfer projects.[18] Emergency transfers to Beijing have become increasingly frequent over the past ten years, but a longer-term solution is being pursued: specifically, the construction of three giant canals for the South-North Water Transfer Project, a feat of national hubris and hydrologic engineering spanning twelve provinces and 3000 kilometers (1900 miles) of canals and tunnels. This project is meant to accomplish something only China would attempt: re-plumbing an entire nation.[19]

If scheduling and operations projections are accurate, some thirteen billion cubic meters (3.4 trillion gallons) of water per year will pour through the tunnels of the Central line (currently under construction in Henan Province) in 2014 and will be sent north to help curb water shortages in more than a dozen cities, including Beijing.

The Eastern line, a second transfer project, should already be operating by then, transporting 14.8 billion cubic meters of water annually from the

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16. Interview by Circle Blue with S. Ming Sung, in Beijing, China (Dec. 3, 2010).

17. *Id.*

18. Christoph Peisert & Eva Sternfeld, *Quenching Beijing's Thirst: The Need for Integrated Management for the Endangered Miyun Reservoir*, *in* 7 CHINA ENV'T SERIES 33, 35 (2005) (providing the South-North Water Transfer Project as an example of a long-term supply-side management strategy).

19. *See generally* CARLA FREEMAN, QUENCHING THE DRAGON'S THIRST: THE SOUTH-NORTH WATER TRANSFER PROJECT—OLD PLUMBING FOR NEW CHINA?, *available at* http://www.wilsoncenter.org/topics/docs/Quenching%20the%20Dragon%E2%80%99s%20Thirst.pdf (describing the immensity of the South-North Water Transfer Project).

lower Yangtze River to Tianjin.[20] After much debate, the Twelfth Five-Year Plan—the official guide to national development—approved construction planning for a third line. The Western line will transport an additional 8 billion cubic meters of water annually from the western Himalayan region to supply the upper and middle reaches of the Yellow River in the North.

Taken together, the three lines of the South-North Water Transfer Project are an audacious strategy to solve a commanding threat to China's modernization: the increasingly dire confrontation between rising energy demand in a nation that is steadily getting drier.

China's plan is to remove nearly 36 billion cubic meters (9.5 trillion gallons) of water every year from the Yangtze River Basin, which drains much of the nation's central and western regions, and to ship it North.[21] That is tantamount to reversing the flow of the Missouri River, which drains the Great Plains and part of the Northwest in the United States, and sending it back to Montana.

It is no surprise that, ever since construction began in 2002, the South-North Water Transfer Project has generated a strong current of public comment. China's government authorities insist the project, now estimated to cost 62 billion U.S. dollars (USD), is essential to developing the cities and energy-rich provinces of Northern and Western China, the fastest growing regions in the country, which are running out of water.

"Transferring water from the South to North makes perfect sense," said Wang Hao, director of the Water Resources Department at the state-run China Institute of Water Resources and Hydropower Research in Beijing and one of China's most influential government water scientists.[22] Wei Zhimin, a water expert within a unit of the Ministry of Water Resources in Hebei Province, said last year in an interview with *Xiaoxiang Evening News* that the South-North Water Transfer Project would not solve North China's water crisis, but was nevertheless essential.[23] "Lifeline is one word to describe it," Wei said, "and by lifeline, I mean a lifeline for North China, Beijing, Tianjin and Hebei included."[24]

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20 *North Water Transfer Project General Map*, NSBD, http://www.nsbd.gov.cn/zx/zj/2009wlzl/2009wlzl_gcgk/gcgk/20090915/200908300006.htm (last visited Apr. 2, 2011).

21. Jim Yardley, *Beneath Booming Cities, China's Future Is Drying Up*, N.Y. TIMES, Sept. 28, 2007, http://www.nytimes.com/2007/09/28/world/asia/28water.html?pagewanted=1&_r=1.

22. Wang Hao Interview, *supra* note 3.

23. Zhou Xifeng & Long Tao, *Can the South-North Water Diversion Project Save North China?*, PROBE INT'L (May 18, 2010, 9:26 AM), http://www.probeinternational.org/beijing-water/can-south-north-water-diversion-project-save-north-china.

24. *Id.*

But the project's critics—among them academics, economists, and environmental leaders—assert that the magnitude and cost of building and operating the continental water transport system would produce a cascade of unintended consequences that could overwhelm the benefits to China.[25] These consequences include much higher municipal, agricultural, and industrial water prices; damage to aquatic environments; additional treatment facilities for Yangtze water that is currently too polluted to use; and continuing water shortages in Northern China—and possibly in Southern China as well.

"We should take no pride in doing such a project," said Ma Jun, an author and the director of the Institute of Public and Environmental Affairs, a nongovernmental organization in Beijing.[26] "This is a moment for us, a sobering moment for us, to reflect upon how we drove ourselves to such a situation."[27]

1. Big Projects in China's DNA

Infrastructure projects designed to solve big national problems and produce projects of otherworldly scale are a cultural priority as old as China itself. The 2500 year old, 5500 mile long Great Wall of China was designed to safeguard the nation from northern invasion. More recently, China finished the Three Gorges Dam in 2008, which generates as much electricity as twenty-five big coal-fired plants, holds back 600 kilometers (375 miles) of the Yangtze River, and is so big that it makes the Hoover Dam—the iconic U.S. water engineering project of the twentieth century—look like a bathtub toy.

But history has shown that the Great Wall has more cultural usefulness as a modern income-generating tourist attraction than it ever did as an ancient deterrent to invasion. And some scientists have blamed the Three Gorges Dam for putting pressure on an unstable earthquake fault line and causing deadly landslides.[28]

In effect, there are sound reasons for a good number of Chinese to wonder whether the South-North Water Transfer Project will transport enough water to ease Northern China's water emergency. If it does not,

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25. Yardley, *supra* note 21.

26. Interview by Circle of Blue with Ma Jun, in Beijing, China (Dec. 17, 2010) [hereinafter Ma Jun Interview].

27. *Id.*

28. *See* Bosshard, *supra* note 13 (stating that the dam projects will be built on the earthquake-prone fault lines).

what is China's Plan B for supplying enough water so that the dry Northern and Western provinces—where most of the nation's big and water-thirsty fossil fuel reserves are located—can continue to develop?

"What if we don't transfer water?" asked Ma.[29] "We probably could have a collapse of the economy in some of the cities, which are going to run out of water. It will not really resolve the whole problem, though. It will mean that, even with this, it cannot fill even the current existing water shortage gap, let alone that much bigger water gap in the future."[30]

2. A Product of Policy

After years of debating the project, the Chinese government made the South-North Water Transfer Project one of the infrastructure centerpieces of China's Tenth Five-Year Plan (2001 to 2005). The project promises to help answer water scarcity questions in the North and to help the country access coal reserves. The Eastern and Central lines could provide close to the amount that the government estimates will be needed by the middle of the decade, when the lines are expected to begin operation: 27.8 billion cubic meters (7.34 trillion gallons) of water annually.[31] And much of the balance could be supplied when the Western line is finished, decades from now. The Western line is viewed as crucial in accessing coalfields in China's dry Northwest.

But what looks to some government agencies like a neat path for avoiding a ruinous collision between China's accelerating growth and scarce freshwater reserves, appears to other authorities to be a complex and expensive plumbing system that will be exceedingly difficult to operate. Three of the most significant problems have already emerged:

> High Water Prices. Because water from the transfer project will be very expensive, Tianjin and other cities that will serve as destination ports are currently looking into other options. Desalination plants could turn seawater into fresh water at considerably lower cost than what it would take to ship water in from afar, said city managers. New desalination programs are currently being launched. "The

29. Ma Jun Interview, *supra* note 26.
30. *Id.*
31. FREEMAN, *supra* note 19.

> unit water cost of desalination is actually cheaper than that of the South-North Water Diversion Project," Zou Ji said in an interview with the Asia Water Project, a research group, last month. Zou is a professor of environmental economics and management at Renmin University in Beijing, "Many coastal cities, including Tianjin, Qingdao, and Dalian have integrated desalination into their middle-to-long-term blueprints as an alternative water resource."[32]
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> Timing and Destination. The western line is the only one of the three transport lines that will deliver water directly to the Yellow River Basin, the primary water supply for the energy-rich northern and western provinces. Moreover, if the western line is constructed as several authorities predict, it won't be finished for at least a few decades. By 2020, China's demand for coal is projected to grow by 1 billion metric tons, a 30 percent increase. But most of the new reserves of coal that would be tapped lie in Xinjiang, Inner Mongolia, Shanxi, and Ningxia—provinces, supplied by the Yellow River, that are too dry to develop, since coal production and combustion uses vast amounts of water.[33]
>
> Pollution. Chinese and international organizations report that the water due to be transported in the eastern line, sourced from the lower Yangtze, is too fouled with industrial and municipal pollutants to use, even though it would have already passed through the more than 400 water treatment plants and pollution control projects China has built to remediate the river's pollution.[34]

3. The Last Big Barrier: Water Supply

A fourth barrier to the project's success, one that would have been considered ludicrous a decade ago, has also become more apparent in recent

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32. Jaffe & Schneider, *Dry and Anxious*, *supra* note 1.

33. *Id.*; *see also* INT'L ENERGY AGENCY, WORLD ENERGY OUTLOOK 2010, 203 (2010) (showing the coal market outlook for China and others); MAO YUSHI, SHENG HONG & YANG FUQIANG, THE TRUE COST OF COAL 5–14 (Kim H. Gordon et al. eds., 2008), *available at* http://www.greenpeace.org/raw/content/eastasia/press/reports/the-true-cost-of-coal.pdf (illustrating environmental coal impacts).

34. Jaffe & Schneider, *Dry and Anxious*, *supra* note 1; FREEMAN, *supra* note 19; Ma Jun Interview, *supra* note 26.

years: eventually, the southern China watersheds tapped by the transfer project may not have enough water to supply the dry North.

The mighty Yangtze, the third longest river on Earth and principal supplier of water to the South, drains watersheds in the south, central, and western regions of China.[35] According to the Ministry of Water Resources, the Yangtze River Basin contained over 1 trillion cubic feet of water, or thirty-six percent of the nation's total water supply, as recently as 1999.[36]

But like almost every other region of China, the water-rich South is steadily losing moisture. In 2009, the latest year for accurate figures, total freshwater reserves in the Yangtze River Basin had dropped 172 billion cubic meters, or seventeen percent, from 2005 levels, according to the *China Statistical Yearbook*.[37]

The new data has prompted southern provinces, like Sichuan, to express sharp concerns over the diminishing water supplies and to file formal oppositions to building the third and final transfer line in the West.[38]

"The problem is to coordinate the interest relations between the supply region and the transfer region," said Tan Yingwu, the Western line's chief, who thinks the political and cultural resistance can be resolved.[39] "Transferring water from one region to another is some people's gain and other people's loss. How to coordinate their relations, and how to compensate one's loss, is an important problem."[40]

Still, authorities close to the central government say the Western line will be built.[41] China's important Northern provinces need the water. "The Yellow River Basin has very little water, but this area has to supply seventy to eighty percent of the energy in the country," said Shaofeng Jia, vice director of the Center for Water Resources Research at the Chinese

35. Ge Jianxiong, *The Rise of Yangtze River*, SINA (June 11, 2004, 4:27 PM), http://finance.sina.com.cn/roll/20040611/1627809808.shtml.

36. Chen Qinghua, *The Urgency of Protecting Yangtze River*, CHINESE PEOPLE'S POL. CONSULTATIVE CONF. (Apr. 22, 2008, 3:35 PM), http://cppcc.people.com.cn/GB/34961/120830/120953/7151856.html.

37. NAT'L BUREAU OF STATISTICS OF THE PEOPLE'S REPUBLIC OF CHINA, CHINA STATISTICAL YEARBOOK 2010 (2010).

38. *See Sichuan Demands More Say in Major Water Diversion Project*, CHINA.ORG.CN, Sept. 27, 2006, http://www.china.org.cn/archive/2006-09/27/content_1182413.htm (trans. Zhang Yunxing) (illustrating local concerns for increased legislative involvement).

39. Interview with Circle of Blue, in Beijing, China (Jan. 15, 2011).

40. *Id.*

41. *Id.*

Academy of Sciences.[42] "Developing this requires the west line of the transfer."[43]

4. Guaranteeing Growth Comes at High Water Price

By undertaking the huge costs of starting such an ambitious infrastructure project in 2002, the Chinese government clearly viewed the South-North Water Transfer Project as the only credible way to supply northern China with water. However, in the subsequent decade, technologies like desalination have decreased in cost, while inputs to building canals, like labor, have increased.

The cost of water in China is rising, but is nowhere near the cost of the water that will be delivered by the transfer. Today, water costs 0.26 USD per cubic meter.[44] Water from the Central line is estimated to cost 0.80 USD per cubic meter, while water from the Western line, if built, will cost 0.66 USD per cubit meter.[45] Cities like Tianjin have balked at these prices and have started investing in technologies like desalination.

The higher price is prohibitively expensive for agricultural users, but is palatable to industry and utilities. "Industries can afford a slightly higher water price," said engineer, Tan Yingwu.[46] "Not only can they afford it, they need it."[47]

B. A Seawater Pipeline to Western Coal

In November 2010, as government leaders considered energy goals in China's new Twelfth Five-Year Plan, sixty-year-old geographer Huo Youguang took the podium at an academic meeting about water scarcity and coal production in Xinjiang Uyghur Autonomous Region, one of the driest inhabited areas on Earth. Over the next half-hour, Huo described a first-of-its-kind transcontinental pipeline that he believed would be a breakthrough in developing more fossil energy from Xinjiang and China's other northern coal-rich provinces, while conserving the region's scarce reserves of fresh water.[48]

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42. Interview with Shaofeng Jia, in Beijing, China (Dec. 20, 2010).
43. *Id.*
44. *Id.*
45. *Id.*
46. Interview with Tan Yingwu, in Beijing, China (Jan. 20, 2011).
47. *Id.*
48. Interview by Circle Blue with Huo Youguang, in Xi'an, China (Dec. 13, 2010) [hereinafter Huo Youguang Interview].

Youguang's proposal: drop a pipe into the Bohai Sea in China's east; draw nearly 90 million gallons of seawater a day into a complex of coastal desalination plants; pump the water 1400 meters uphill for more than 600 kilometers (nearly 400 miles); and pour 2.4 million cubic meters of water a week into Xilinhot.[49] The Inner Mongolia city of 177,000 people lies atop a mammoth and so far untouchable coal reserve estimated by Chinese authorities to contain 1.4 trillion metric tons.[50] That is enough at current rates of consumption—three or more billion metric tons annually—to power the country for 400 years.

The issue, Youguang said, was a tightening and economically dangerous choke point between the availability of water in the very provinces that were the primary new sources of fossil fuel. The fast growing provinces contained the nation's largest proven and unproven reserves of coal. But developing coal reserves, and the power and processing infrastructure to consume it, Huo said, takes tens of billions of gallons of water each year. Water is not readily available in this region, which receives just a few inches of rain annually and is experiencing reducing snow melt from climate change.[51]

If the first 6 billion dollar stretch of the Bohai pipeline performs as anticipated, it could be expanded more than 2500 kilometers west. This expansion could cross the rest of Inner Mongolia, northern Gansu, and all the way to the Xinjiang Uyghur Autonomous Region—China's huge western province—to open even larger coal reserves that Chinese geologists claim exist there.[52]

By the time Huo finished, he had ignited a national engineering debate about the cost and practicality of using millions of tons of purified seawater to produce more coal for China's modernization, while simultaneously easing northern China's water shortage. He also unwittingly revealed just how vulnerable China's powerful engine of growth is to deepening water scarcity, particularly in the energy-rich northern and western provinces, now the primary focus of China's development and modernization.

Whether such a project, if built, is really capable of slaking the big thirst of northern China's coal sector is not clear. But it could certainly help mitigate the water-energy choke points.

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49. *Id.*; *see Is Water Pipeline Project Merely a Pipe Dream?*, CHINA DAILY, Nov. 30, 2010, http://en.chinaxinjiang.cn/01/01/201011/t20101130_117276.htm (reporting pipeline specifics).

50. Schneider, *Bohai Sea Pipeline*, *supra* note 1.

51. Huo Youguang Interview, *supra* note 48.

52. *Id.*

IV. CHINA'S TWELFTH FIVE-YEAR PLAN CALLS FOR GROWTH LIMITS

In an era of economic turmoil that has produced massive unemployment, accelerated industrial decline, and sowed fear and doubt across much of North America and Europe, China offered a much different lesson on growth and development.

In the latest draft of its new Twelfth Five-Year Plan to manage the world's fastest growing industrial economy, China's leadership called for restraining the runaway growth that is raising the incomes of more than 400 million people.[53] The previous growth model has exacerbated a potentially calamitous confrontation over energy, water, and the quality of the nation's environment.

The Twelfth Five-Year Plan, submitted for review on March 5 at the start of China's annual plenary session in Beijing and adopted on March 14, sets a new limit on energy intensity in order to spur efficiency and conservation measures. But the plan also envisions record high levels of water use, which are expected to rise to 620 billion cubic meters (163 trillion gallons) by 2015—up from 599 billion cubic meters (158 trillion gallons) in 2010—and as much as 670 billion cubic meters (177 trillion gallons) by the end of the decade.[54] The restraints on coal production, which supplies seventy percent of the nation's energy and is the largest industrial consumer of fresh water, will serve to keep water use from climbing even higher.

In public statements and in interviews with Chinese media, the nation's top leaders said that the central focus of the new Five-Year Plan is to curb inflation and provide for investments and guidance that improve quality of life. The plan does so by ensuring the continuing development of manufacturing, transportation infrastructure, domestic production, the energy sector, research, science, health care, and education. In addition, the leaders asserted that the Twelfth Five-Year Plan is also meant to reckon with the damage that the nation's modernization is causing to air, land, and water—a steadily diminishing resource.

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53. *See China's Twelfth Five-Year Plan Emphasizes Balanced Growth and the Environment*, ASIA WATER PROJECT: CHINA, http://www.asiawaterproject.org/more-editorial/6031/ (last visited Apr. 28, 2011) (setting new growth limits to address environmental degradation concerns); Shin Wei Ng, *China's Twelfth Five-Year-Plan: Engaging the World on the Low Carbon Race*, E3G (Mar. 14, 2011), http://www.e3g.org/programmes/europe-articles/chinas-twelfth-five-year-plan-engaging-the-world-on-the-low-carbon-race/ (reporting official adoption of Five-Year Plan targets).

54. *National Economic and Social Development Twelfth Five-Year-Plan*, CHINA NEWS, Mar. 16, 2011, http://www.chinanews.com/gn/2011/03-16/2909913.shtml [hereinafter *National Economic and Social Development*].

From 2000 to 2009, total water reserves in China dropped thirteen percent, and water scarcity is especially evident in the northern and western provinces, where China's major coal reserves lie.[55] By calling for limits on energy intensity, China's leaders are apparently mindful of the dangerous choke point developing between the nation's surging economy and its demand for opening new coal reserves in the dry provinces that cannot currently be tapped because of water shortages.

A. Largest and Fastest—Is Restraint Possible?

It is not at all clear that China's provincial and industrial leaders—never mind the hundreds of millions of workers benefiting from modernization—will be eager to comply with the goals of the new development strategy.

"The restraints on economic growth described in the [Twelfth] Five-Year Plan come in the midst of a massive and politically popular economic transition that is rapidly converting China's economy from its previous focus on export-related revenue to one devoted to building domestic markets."[56]

> Over the next five years, China will continue to build one of the world's largest water transport projects, the world's largest highway and high-speed rail networks, and the world's largest network of hydropower dams. China also will continue to construct the world's largest industrial manufacturing installations, or "bases," to produce the components and plants that generate energy from coal, wind, solar, and nuclear power.[57]

B. Conservation and Efficiency Stressed

The Twelfth Five-Year Plan calls for reducing annual economic growth to seven percent a year (down from about ten percent in each of the last four years), restraining the growth in coal production to three percent a year

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55. Schneider & Ivanova, *China Responds*, *supra* note 1.

56. *Id.*; Michael Schuman, *Is China Serious About Economic Reform?*, TIME, Mar. 7, 2011, http://curiouscapitalist.blogs.time.com/2011/03/07/is-china-serious-about-economic-reform/.

57. Schneider & Ivanova, *China Responds*, *supra* note 1; *see also* Meng Si, *Hydropower's Green Excuse*, THIRD POLE (Feb. 14, 2011, 8:51 PM), http://www.chinadialogue.net/article/show/single/en/4105 ("[T]he 12th Five Year Plan called for hydropower development to be prioritized.").

(down from more than fifteen percent annually since 2000), and limiting water consumption.[58]

Economists note, however, that China routinely ratifies five-year plans that call for growth rates well below those that the nation actually attains. The Tenth Five-Year Plan (2001-2005), for instance, set a growth target of seven percent, but China's economy grew an average of 9.5% during the next five years. Similarly, the Eleventh Five-Year Plan (2006-2010) set a 7.5% average annual growth rate, but the actual rate was 11.2%.

Still, the new Twelfth Five-Year Plan (spanning 2011 to 2015)—which incorporates the most ambitious energy-saving, water-conserving, and emissions-reducing targets China has ever set—describes a nation at the peak of its growth and economic power. China is shifting, it appears, from the singular pursuit of economic growth to focusing new attention on the quality of its development.

C. Energy: By a Nose

According to the plan, China intends to cut its carbon footprint and be more energy efficient. It wants to cut its carbon dioxide emissions by seventeen percent and its energy consumption per unit of GDP by sixteen percent—meaning that, for each new dollar of economic growth, water use must decline by nearly a fifth.[59]

The energy efficiency target comes even as China's total power generation capacity is expected to increase from 960 gigawatts in 2010 to around 1440 gigawatts in 2015, which is an annual increase of 8.5%.[60] But, a number of authorities in and outside the government indicated in March 2011 that restraining energy production and consumption may be impractical, if not impossible, for China's fast-growing economy. A recent report released by the Chinese Academy of Engineering noted that the total

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58. *See* Deborah Seligsohn & Angel Hsu, *How Does China's Twelfth Five-Year-Plan Address Energy and the Environment?*, CHINAFAQS.ORG (March 7, 2011), http://www.chinafaqs.org/blog-posts/how-does-chinas-twelfth-five-year-plan-address-energy-and-environment (analyzing the policies of China's Twelfth Five-Year Plan); *see also* Xinhua, *Key Targets of China's Twelfth Five-Year-Plan*, CHINA DAILY, Mar. 5, 2011, http://www.chinadaily.com.cn/xinhua/2011-03-05/content_1938144.html (listing the key targets of the Twelfth Five Year Plan).

59. *China Announces 16 Pct Cut in Energy Consumption per Unit of GDP by 2015*, CHINESE GOV'T (Mar. 5, 2011), http://www.gov.cn/english/2011-03/05/content_1816947.htm (last visited Apr. 15, 2011).

60. INT'L ENERGY AGENCY, *supra* note 33.

energy consumption of standard coal in China could reach 5.1 billion tons, if the current situation remains unchanged.[61]

China struggled to meet its energy intensity reduction target of twenty percent during the Eleventh Five-Year Plan period, barely eking out 19.06%.[62] This reduction was limited despite closing many of China's cement factories, paper mills, small power plants, and steelmakers, and after building more advanced power plants and big industrial bases closer to the coal reserves in the north and northwest. Moreover, last year, several provinces across China cut power to industries, residential buildings, traffic lights, and even hospitals to meet their energy-saving targets.

Yet, total investment in the power sector under the Twelfth Five-Year Plan is expected to reach 803 billion USD, an increase of sixty-eight percent compared to the Eleventh Five-Year Plan.[63] Of that total investment, 416 billion USD, or fifty-two percent, will go to power generation, while 386 billion USD will be used to construct new transmission lines and other improvements to China's electrical grid.[64]

Renewable, clean, and nuclear energy will supply about fifty-two percent of the increase, while coal-fired power will provide the balance. By 2015, total power generation capacity from non-fossil fuel is expected to be 474 gigawatts, meaning that non-fossil fuel energy will replace 500 million metric tons (1.1 trillion pounds) of coal.

In a more radical measure, the Twelfth Five-Year Plan introduces a cap on energy consumption to about 4 billion metric tons (8.8 trillion pounds) of coal equivalent per year by 2015. For reference, China used 3.25 billion metric tons (7.2 trillion pounds) of standard coal equivalent in 2010 (up 5.9% from 2009), according to the National Bureau of Statistics.[65]

China will also continue to cut emissions of sulfur dioxide and nitrogen oxide, major air pollutants from coal burning and the cement industry, by about eight percent during the next five years, despite the projected rise in

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61. *Report Warns of High Energy Consumption in China*, XINHUANET (Feb. 28, 2011, 8:08 PM), http://news.xinhuanet.com/english2010/china/2011-02/28/c_13754385.htm.

62. Emily Werner, *China Proposes New Climate and Energy Targets in Twelfth Five-Year Plan*, REPOWER AM. (Mar. 14, 2011), http://www.repoweramerica.org/blog/china-five-year-plan/ (claiming nineteen percent was an exaggeration).

63. SHI WEI NG & NICK MABEY, E3G, CHINESE CHALLENGE OR LOW CARBON OPPORTUNITY?: THE IMPLICATIONS OF CHINA'S 12TH FIVE-YEAR-PLAN FOR EUROPE (2011), *available at* http://greengrowthleaders.org/wp-content/uploads/2011/02/E3G_Chinese_Challenge_or_Low_Carbon_Opportunity1.pdf.

64. *Id.*

65. *China: 2010 National Economic and Social Development*, XORTE, Mar. 1, 2011, http://www.asia.xorte.com/0,5,China-2010-National-Economic-and-Social-Development,13276.html (last visited Apr. 15, 2011).

coal consumption. The targets are expected to put more pressure on coal-fired power plants to install pollution reducing technologies, according to a recent Greenpeace report.[66]

D. Farm Sector: Production Growth on Less Land

Aside from the coal sector, the other big water consumer is agriculture. China strongly emphasizes the ability to feed itself and keep its food prices stable, even as it reduces the amount of arable land and water consumption on farms. Since 1997, according to government figures, China has cut its total farmland by 8 million hectares (20 million acres), and agriculture's share of water consumption is steadily decreasing.[67]

China, though, is the world's largest producer of grain. Last year, China's farmers harvested 546 million metric tons (1.2 trillion pounds) of wheat, rice, corn, soybeans, and other food crops.[68] The new plan calls for farmers to produce no less than 540 million metric tons annually over the next five years and for farmland reserves to total 121 million hectares (299 million acres).[69]

"Perhaps most important to China and its leaders is that, by 2015, the Chinese economy—almost 6 trillion USD in 2010—is expected to grow by fifty percent to 9 trillion USD."[70] Many economists project that, at current rates of growth, China's economy will exceed the economy of the United States as the world's largest sometime in the mid-2020s.

E. Water: A Clear Winner

China wants to reduce water use and pollution. The new Five-Year Plan calls for reducing water use by thirty percent for every new dollar of industrial output, which is the same water target as was in the Eleventh Five-Year Plan.[71]

China easily met the previous goal, decreasing water consumption by almost thirty-seven percent from 2005 to 2010.[72] The water-conserving

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66. Schneider & Ivanova, *China Responds*, *supra* note 1.

67. Schneider, *Choke Point*, *supra* note 1

68. *Bureau of Statistics: 2.9% Increase of Grain Production*, CNGRAIN (May 12, 2010, 11:40 AM), http://www.cngrain.com/Publish/news/201012/473220.shtml.

69. *National Economic and Social Development*, *supra* note 54.

70. Schneider & Ivanova, *China Responds*, *supra* note 1.

71. *China Unveils New Energy, Water Efficiency Goals*, CHINA POST, Mar. 29, 2011, http://www.chinapost.com.tw/business/asia-china/2011/03/29/296442/China-unveils.htm.

72. Wang Hao Interview, *supra* note 3.

measures have helped hold the growth in water use to around one percent annually, which is good considering Beijing and other northern and western cities are currently enduring the driest winter in sixty years.

"With the Twelfth Five-Year Plan, China is adopting its most stringent water resource policies to date," Wang Hao, director of the Water Resources Department at the state-run China Institute of Water Resources and Hydropower Research in Beijing, told Circle of Blue in December.[73] "For example, China is introducing total volume control for the Yellow River Basin provinces. Back in the day, it was established that the total water use could not exceed water supply. Now there's also a specific limitation on the total water use."[74]

By 2015, the Twelfth Five-Year Plan calls for an eight percent reduction in chemical oxygen demand—a measure of water pollution. The Plan also dictates an eight to ten percent decrease in ammonium nitrate—a common fertilizer for agriculture—from 2010 levels.[75]

73. *Id.*
74. *Id.*
75. Seligsohn & Hsu, *supra* note 58.