

# China's great leap backward

Posted on [September 21, 1998](#) by [Probe International](#)

Patricia Adams and Grainne Ryder  
International Journal  
September 21, 1998

## **Uneconomic and outdated, the Three Gorges dam will stunt China's economic growth**

The tragedy of the Three Gorges dam goes beyond the nearly two million people who will be resettled from their homes, villages, farms, temples, and work places to make way for it, beyond the 1,300 sites of cultural antiquities and the 100,000 hectares of precious farmland that will be submerged forever under the 600 kilometre long reservoir, and beyond the rare species that it will likely render extinct. Ironically, the tragedy created by the Three Gorges will also extend to the economy and its electricity sector – the chief justification for building the dam. The Chinese government must maintain the status quo in the electricity sector to protect the twentieth century's largest state vanity project from market discipline and public oversight. While rapid technological advances in electricity markets around the world will deliver cheaper, cleaner, and more readily available power, Chinese citizens will be forced to buy dirty, expensive, and unreliable power. As a source of electricity, the Three Gorges dam cannot compete with the alternatives. As a symbol, the dam sends out the discouraging signal that in China the central planners are alive and well and at the helm. The Chinese economy and all its citizens will lose if the dam is completed.

## **THE MAELSTROM OF THREE GORGES**

We know a great deal about the Three Gorges dam, now under construction on China's Yangtze River which flows past the major cities of Chongqing and Wuhan to the East China Sea at Shanghai. It would be the largest dam in the world, with an installed capacity of 17,680 megawatts, and the most expensive, costing \$28 billion according to official sources, \$34-36 billion according to industry sources, and \$77 billion according to an independent Chinese banker knowledgeable about the project.[fn] 'Some issues regarding the preliminary design of the Three Gorges project,' in Dai Qing, *Yangtze! Yangtze!* (London and Toronto: Earthscan 1994), 282; Jacob P. Alpren, 'China cool to U.S. turbine bids,' *Globe and Mail* (Toronto), 21 May 1996; Joseph Kahn, 'Dammed Yangtze,' *Wall Street Journal*, 18 April 1994; and Chad Rademan, 'Three Gorges befuddles financiers,' *Institutional Investor*, June 1995. All figures are in US\$ unless otherwise noted.[/fn] It would displace more people – 1.98 million according to the latest figures[fn]Qi Ren, 'Discussing population resettlement with Li Boning,' in Dai Qing, *The River Dragon Has Come!* (New York, London: M.E. Sharpe 1998), 50-5.[/fn]- than any dam in history and flood 13 cities, 140 towns, over a thousand villages, factories, farms, temples, and archeological treasures dating back to 50,000 BC. [fn] Elizabeth Childs-

Johnson and Lawrence R. Sullivan, 'The Three Gorges dam and the fate of China's southern heritage,' in Dai Qing, *The River Dragon*, 200-10.[/fn] With 27 submerged spillway bays (each with the average flow of the Missouri River) that are, according to Canadian engineers, 'well beyond proven world experience,'[fn]Canadian International Project Managers Yangtze Joint Venture, *Three Gorges Water Control Project Feasibility Study*, Volume 4, March 1988, 12-7.[/fn] it would be daringly experimental. Without a doubt, it would be the most challenging: the Yangtze River has the fifth highest silt load of any river in the world, and the dam's engineers will be pushed to find a way to flush silt through the reservoir, something that has never been done successfully before.[fn]Philip B. Williams, 'Sedimentation Analysis,' in Margaret Barber and Gráinne Ryder, eds, *Damming the Three Gorges: What Dam Builders Don't Want You To Know* (London and Toronto: Earthscan 1993), 133-44.[/fn]

Outside China, the problems besetting the project are well known. No other dam in history has received more ink. Every major daily newspaper from the *Wall Street Journal* to the *Guardian*, every major magazine from *National Geographic* to *Time*, and every major TV network has dedicated prime space and time to the debate and to the costs that the dam will inflict on the Chinese people, its environment, and its economy.

Inside China, the Three Gorges dam also receives wide and regular coverage but only in the form of government public relations packages which claim that the dam will generate electricity, stop life-threatening floods, and increase navigation of ocean-going ships to Chongqing. Criticism of the dam, or even debate in which different sides challenge each other, is strictly forbidden. Books which contain such debates are banned. Experts and journalists who attempt such discussions are harassed, even jailed.

While much is known and said about this project – the single largest capital project under construction today – one thing is rarely discussed and little known: there are cheaper, cleaner, and more reliable ways to provide the desperately needed power that the Three Gorges dam is meant to supply.

## **THE THREE GORGES DAM IS UNCOMPETITIVE**

Technological advances, brought about by regulatory changes in the world's energy markets, have turned mega-power projects like the Three Gorges into modern-day dinosaurs. Hydropower, energy analysts conclude, is 'costly' and 'uneconomical' because of high capital investment costs. Nor will nuclear power meet China's energy needs, even if capital costs were to decline by a third. A recent study by United States and Chinese energy research institutes, which compared conventional sources with advanced generating technologies, concluded that 'when you consider the full environmental costs of producing electricity, it's actually more economical to use [these] cleaner alternatives.[fn]'Battelle report: China needs more energy technology,' news release, Battelle Memorial Institute, Washington DC, 4 June 1998, <http://www.pnl.gov/china>.[/fn]

Large, conventional steam turbines (whether their fuel is coal, oil, gas, or nuclear) convert only 30 to 33 per cent of their fuel's heat into electricity. The rest is released as waste heat into the atmosphere or into an adjacent body of water. The new breed of smaller gas turbines reliably convert over 40 per cent of their fuel into electricity. Thus, large cost-conscious power consumers around the world are encouraged to install their own gas turbines and reduce environmental damage while boosting economic output. Cogeneration plants generally turn 60 to 80 per cent – sometimes 90 per cent – of their energy into electricity and commercially useful heat.

Gas-fired combined cycle units – in which a gas turbine generates electricity and drives a second electricity-producing steam turbine – achieve energy efficiencies of 50 per cent or higher. Such systems have already replaced aging coal and nuclear plants in Britain and North America and are expected to dominate the market for new power plants in Asia and Latin America into the next century. Combined cycle gas turbines could provide power with lower capital costs and greater reliability than Three Gorges and with far fewer emissions than conventional coal plants.

Combined cycle plants are commonly fuelled with natural gas which burns more thoroughly than solid or liquid fuels, and, unlike coal, contains no heavy metals or sulfur emissions that cause acid rain. Gas-fired combined cycle plants, therefore, produce no particulates or sulfur dioxide, 90 per-cent less nitrous oxide, and 60 per-cent less carbon dioxide emissions than coal-fired plants.

A combined cycle gas turbine costs about \$650 per kilowatt, roughly 15 to 40 per cent of the cost per kilowatt for Three Gorges, depending on the dam's final budget (see table 1). If the project was cancelled and the budget invested in combined cycle plants, China could have 43,078 megawatts (MW) to 118,461 MW of new generating capacity, which would provide two to six times the generating capacity and displace two to six times as much coal, about 300 million tons a year, as Three Gorges.[fn]*Ibid*, 17. Battelle estimates that the dam would displace 50 million tons of coal per year or 3.6 per cent of the country's total coal use.[/fn]

With gas supplies coming on-line, researchers at the Battelle Memorial Institute – a Washington-based energy policy think-tank – the Beijing Energy Efficiency Center, and China's Energy Research Institute predict the cost of electricity from combined cycle plants in southeastern China would be less than 4 cents per kilowatt-hour, compared to 4 to 5 cents for new coal plants, 6 to 7 cents for large hydro, over 7 cents for nuclear power, and at least 8.4 cents for Three Gorges.[fn]*Ibid*, 12. The cost of Three Gorges electricity per kilowatt-hour (kWh) was calculated by Jeff Logan of Batelle based on the following assumptions: transmission and distribution costs excluded, a capital cost of \$1650 per kilowatt, a 9-year construction period, a 12-per-cent interest rate, a 53-per-cent capacity factor, and operation and maintenance costs of 0.5 cents per kWh. In the United States, where gas prices have been falling since the mid-1980s, combined cycle plants are profitably supplying electricity for 3 to 4 cents per kWh compared to 10 to 20 cents for nuclear and 4 to 5 cents for coal. See Patrick McCully, *Silenced Rivers: The Ecology and Politics of Large Dams* (London: Earthscan 1996),221[/fn]

**TABLE 1**

Capital Cost of Generating Technologies in China per Installed Kilowatt of Capacity

Generating technology	Capital cost per kilowatt	Fuel conversion efficiency (%)
Three Gorges (17,680 MW)	1,584-4,355	-
large hydro	950-1,200	-
nuclear	2,000	30-33
combined cycle gas turbine	450-900	50-60
coal gasification combined cycle	1,325	50-60
micro gas turbines	300-500	30
coal – no pollution control	600	30-37
coal – with pollution control	730-860	30-37
coal-fired cogeneration	480-1200	70-80
wind	1,000	-
small/micro hydro	850	-
fuel cells	3,000	-
photovoltaic cells	4,500	-

&lt;!--

---

—>Combined cycle plants can be installed and generating power reliably within nine months to two or three years for the larger units.[fn]A Connecticut-based company installed a 50-MW plant for the Hainan Electric Company in just 38 days; in Argentina, Black & Veatch installed a General Electric 128-MW combined cycle unit to provide electricity and steam to a large oil refinery. Westinghouse installed a 150-MW gas turbine plant in Columbia in six months. The list goes on.[/fn] Three Gorges is scheduled to take 17 years. Fast installation reduces the interest costs and allows plants to repay lenders sooner. While combined cycle plants produce power 85 to 95 per cent of the year, the Three Gorges dam is expected to operate at full capacity for only about half the year.

Another major advantage of combined cycle plants – particularly combined heat and power systems – over Three Gorges is flexibility. Combined cycle plants can be switched on and off as needed and are therefore well suited to satisfying peak or intermittent power demands. Large hydro dams, on the other hand, generate the most power in spring when demand is low. Three Gorges has the added difficulty of operating its 600-kilometre reservoir for flood control and navigation which means that the dam won't always be able to meet power demands. Combined cycle plants have no such competing demands. The gas turbine can be run independently of the steam turbine, and both can be run either for electricity or for electricity and steam. Turbines can be plugged into new or existing transmission systems to suit varied industries, factories, university campuses, commercial buildings, municipal heating systems, apartments, shopping malls, and rural co-operatives.

Although China has abundant gas reserves, it has lagged behind other countries in exploration and development. Natural gas accounts for less than 2 per cent of the country's energy supply. The government has begun to increase natural gas availability, through the construction of major new gas pipelines in Guangdong and Sichuan provinces, a natural gas pipeline that supplies over 300,000 users in Beijing, and a recently signed deal with Russia to transport gas from Siberia to China's eastern coast. The country's huge reserves of coal bed methane, which can be used to fire combined cycle gas turbines, are also being developed. And, the government plans to import liquefied natural gas, which has become more readily available since the Asian financial crisis lowered demand in Japan and South Korea.

Natural gas is critical for China's energy future, according to energy experts such as William Chandler, the director of the Battelle Memorial Institute. He and Chinese researchers estimate that by 2020 China could meet up to one-third of its power generation needs with natural gas by manufacturing gas turbines domestically and developing low-cost natural gas sources. The cost would be less than if coal were used. 'If China combines new exploration technology with market and regulatory reform, then it could rapidly increase the amount of gas available for residential, industrial, and power applications.'<sup>[fn]</sup>'Battelle report: China needs more energy technology.'<sup>[/fn]</sup> Suppliers of combined cycle plants are also expecting a boom within the next five years, once gas supplies are adequate.

China desperately needs more clean, dependable power. In some areas, power cuts and black-outs affect about 40 per cent of industry, and some inland provinces experience chronic electricity shortages. In Fujian, Henan, and Sichuan, for example, combined cycle plants would reduce reliance on drought-prone hydro dams. Where electricity demand is growing rapidly, investors have already built several combined cycle plants and are running them on alternate fuels (diesel, blast furnace gas) until gas is available. In the booming province of Guangdong, bordering Hong Kong, ABB (a Swiss manufacturer of combined cycle plants) has installed three combined cycle plants, all of which run on alternate fuels. ABB's 280-MW Foshan plant, owned by the Shakou Power Plant Company and financed by a group of Hong Kong banks, supplies electricity to Foshan city. Near Shanghai, ABB's 150-MW combined cycle cogeneration plant provides electricity and steam to the Bao Shen Steel Corporation.

The obstacles to cleaner, affordable energy alternatives are not technical, economical, or environmental; they are bureaucratic and political. With every five-year plan, well-entrenched hydro, coal, and nuclear power bureaucracies do battle with one another for expansion funds – despite the growing evidence of poor performance and public opposition. Jeff Logan of Battelle's Advanced International Studies Unit reports that significant barriers exist, including artificially low prices for natural gas, which inhibit further exploration and development of gas supply infrastructure, biased leasing of potential fields, and perverse allocation of gas to favoured industries. 'Foreign technology for both exploration and power generation would help change China's energy future but not without dramatic policy reform,' he predicts.

‘Market reform is China’s most powerful policy tool,’ the Batelle study concludes and recommends that the government ‘take advantage of the current period of restructuring bureaucracies to establish an even more rational and market-based power system. Competition in the power supply sector is becoming more common in many countries because it lowers prices and allocates resources efficiently. China could also begin to consider a pathway to further competition in the generation of electric power.’[fn]Jeff Logan, et al, *China’s Electric Power Options: An Analysis of Economic and Environmental Costs* (Washington DC: Battelle Memorial Institute, June 1998), executive summary.[/fn]

Researchers at the Lawrence Berkeley Laboratory at the University of California and the Chinese State Planning Commission came to the same conclusion. In a 1996 study of China’s cogeneration development and market potential, they found that the primary market barriers for cogeneration were institutional and a direct result of a monopolistic utility sector and regulated heat prices too low to cover production costs. They concluded that China needs an energy policy that allows independent power producers to receive a fair price for their heat and power.[fn]Fuqiang Yang, D. Xin, M.D. Levine, and J. Naeb, *Cogeneration Development and Market Potential in China* (Lawrence Berkeley Laboratory, University of California, and Energy Research Institute, State Planning Commission of China, May 1996), 5.[/fn]

### **THREE GORGES IS NOT THE BEST WAY TO REDUCE RELIANCE ON COAL**

China leads the world in both coal production and consumption. About 40 per cent of its annual consumption is burned in conventional coal plants to generate electricity and 60 per cent in inefficient boilers and furnaces to meet industrial and municipal demands for heat and steam. According to the Battelle study, ‘no other major economy relies so heavily on coal to meet its primary energy needs.’ The environmental damage across the country is extensive. Energy experts calculate that sulfur dioxide emissions, the main cause of acid rain, cost over \$13 billion each year in damage to forests, farms, and public health, and erase two per cent of the country’s gross national product. Poor air quality also leads to millions of premature deaths and illnesses.[fn]Logan et al, *China’s Electric Power Options*, xi.[/fn]

Proponents claim the Three Gorges dam is the best way to reduce China’s reliance on coal. In fact, the dam would reduce coal burning at most by about three per cent and total carbon dioxide emissions from heat and electricity generating facilities by about five per cent (see table 2). Switching from coal to gas, and using either combined cycle gas turbines or cogeneration, would reduce carbon dioxide emissions by more than 60 per cent.

The cheapest way to reduce coal consumption, according to the Lawrence Berkeley researchers, is through cogeneration.[fn]Fuqiang Yang et al, *Cogeneration Development*, 51-5.[/fn] The researchers found that about 400 million tons of coal per year is burned in 450,000 industrial, commercial, and residential-use boilers, or about eight times the

amount of coal potentially displaced by Three Gorges. If just one-quarter of the boilers were retrofitted for cogeneration, with the same amount of fuel they could expand electricity supply by 80-90 billion kilowatt-hours annually, equivalent to Three Gorges' expected output, but at a fraction of Three Gorges' cost. They also found vast untapped potential for cogeneration in the iron and steel, chemical, paper, rubber, textile, and printing and dyeing industries, with capital costs well under \$1200 per kilowatt. In the chemical fertilizer industry, for example, approximately 55 billion kilowatt-hours of electricity could be generated by retrofitting half the existing plants for cogeneration. And if just 500 towns and cities installed small-scale cogeneration systems, they could generate about 50 to 60 billion kilowatt-hours of electricity – about two-thirds the Three Gorges output – which is sufficient to meet their year-round heating and cooling requirements.

**TABLE 2**

Effects of fuel type and generating technology on carbon dioxide emissions

<b>Energy source a) for electricity b) for heat</b>	<b>carbon dioxide emissions gener- ating electricity</b>	<b>carbon dioxide emissions generating heat</b>	<b>total carbon dioxide emissions</b>	<b>Percent reduction</b>
1 a) coal-fired steam tur- bines (33% efficiency) b) coal burned in boilers (75% efficiency)	1,000*-	- 880	- 1,880	- -
2 a) 90% supplied from coal-fired steam tur- bines; 10% supplied from Three Gorges** b) coal burned in boilers (75% efficiency)	900 -	- 880	- 1,780	- 5.3
3 a) coal-fired cogenera- tion*** (80%) efficiency (1:2 electricity to heat output) b) heat from a)	1,238 -	- -	- 1,238	- 34
4 a) combined cycle gas turbines (50%) efficiency b) gas burned in boilers (85% efficiency)	330 -	- 388	- 718	- 62
5 a) gas-fired cogenera- tion (85% efficiency, 1:2 electricity to heat output) b) heat from a)	582 -	- -	- 582	- 69

<!--

---

-->

*\* simplified base scenario: assume 100% of electricity demand is supplied by coal, generating 1000 arbitrary units of carbon dioxide emissions; heat load twice electricity load and currently met by coal in boilers with 75% fuel conversion efficiency; coal combustion releases two times as much carbon dioxide as natural gas combustion per unit of energy.*

*\*\* assume Three Gorges can displace 10% of coal used to generate electricity per year and its reservoir produces zero greenhouse gas emissions.*

*\*\*\* assume new coal and gas cogeneration plants can be built to provide twice as much heat as electricity with a total efficiency of 80% and 85% respectively.*

*SOURCE: Data compiled using procedure outlined in Norman Rubin, Submissions to Ontario Select Committee on Ontario Hydro Nuclear Affairs Regarding Carbon Dioxide Emissions, Energy Probe, 21 November 1997.*

*SOURCES capital costs: Logan et al, China's Electric Power Options, ix, 33-5, 39; three gorges: project cost estimates compiled by the authors (\$28 billion to \$77 billion); gas turbines: Gas Turbine World (January-February 1998), 28; and coal fired cogeneration: Fuqiang Yang et al, Cogeneration Development, 57.*

The benefits of replacing inefficient power plants, boilers, and furnaces with coal-fired cogeneration systems are well known in China, even though their commercial use is underdeveloped compared to other countries. The Lawrence Berkeley researchers found that one coal-fired cogeneration plant in Jingzhou province not only alleviated power shortages but also eliminated the need for 115 small coal-fired boilers and reduced sulphur dioxide and particulate concentrations in the area by 32 per cent and 48 per cent respectively. Less coal consumption means that less coal has to be mined and washed, which has the added benefit of reduced soil erosion and water pollution.

In China's northern region, the central government has built about 3700 MW of cogeneration plants to provide electricity and steam to industrial consumers and space heating for local residents. In the last five years, the giant Huaneng Power Generation Corporation has built three large-scale cogeneration plants in the north and is building a 300-MW cogeneration plant near Beijing. In the country's industrial sector, cogeneration plants over 100 MW are typically found in petroleum refineries, large chemical plants, food processing plants, and district heating systems. Medium-scale plants – between 25 and 100 MW – power sugar mills and industrial parks. Plants producing 25 MW or less are found in the chemical, textile, and paper industries.

Approximately 11 per cent of China's thermal power plants (that is, coal, oil, gas, and nuclear) are equipped for cogeneration. The government estimates that some 40,000 MW



of existing coal plants could be retrofitted for cogeneration. In terms of capital cost, old coal plants and boilers can be retrofitted for cogeneration for about two-thirds of the cost of building new power plants because their construction time is shorter and they require less initial capital. The government has already ordered retrofits or shut downs for the worst polluters and the most inefficient coal plants. But many upgrade projects have had to be stopped for lack of funding. Private investors have been reluctant to invest in cogeneration because electricity and heat prices are low, conflicts with monopolistic utilities abound, and the levies are high (for grid connections, back-up power, Three Gorges construction).

### THREE GORGES IS THE PROBLEM, NOT THE ANSWER

As long as the Three Gorges dam proceeds, desperately needed market and policy reforms will be stymied. Although 11 per cent of China's thermal plants are currently equipped for cogeneration, state investments for cogeneration projects in China have dropped in the past ten years by a factor of four. Meanwhile, the vast majority of the growth in electricity is to come from large-scale coal, hydro, and nuclear suppliers – investments that the command and control apparatus knows best. Three Gorges is the flagship of that large-scale, centralized electricity expansion programme.

Because of their large scale, megaprojects are technically and organizationally complex, experimental, and take a long time to build. Therefore, politicians must insulate them from changing economic conditions (by taxing competitors and subsidizing them) and from technical innovation (by granting various forms of monopoly control). Unforeseen construction and operation complications make them unreliable and costly providers of power. Three Gorges is no exception.

According to Institutional Investor, 'fundamental issues of technical feasibility, runaway cost and completion estimates, political risk and social and environmental impact make the Three Gorges Hydroelectric Project about the chanciest China play there is.'<sup>[fn]</sup>Rademan, 'Three Gorges befuddles financiers.'<sup>[fn]</sup> Because the private sector is shy about investing in Three Gorges, the state's full economic arsenal has been assembled to do the job. The dam is being financed by direct allocations of state funds, by transfers of revenues from the Gezhouba dam downstream of Three Gorges, and by increases in national electricity rates.<sup>[fn]</sup>Dai Qing, 'The Three Gorges project: a symbol of uncontrolled development in the late twentieth century,' in Dai Qing, *The River Dragon Has Come!*, 13.<sup>[fn]</sup> The Chinese government currently imposes a 0.12 cent per-kilowatt-hour tax on power consumers in the country to help defray the costs of building the Three Gorges dam. Nor is it uncommon for China's utilities to apply a number of additional charges, including Three Gorges construction fees, in determining the price of cogenerated power.<sup>[fn]</sup>Fuqiang Yang, 'Opportunities and risks in the Chinese cogeneration market,' *Power Economics* (February 1997), 33.<sup>[fn]</sup> When the government hasn't made support for Three Gorges obligatory, it has 'recommended' that some profitable large enterprises 'assist their counterparts' by making donations to the Three Gorges project.<sup>[fn]</sup>Dai Qing, 'The Three Gorges project,' 13.<sup>[fn]</sup>

Another crucial source of funds for Three Gorges is the government-owned State Development Bank (SDB), which fosters 'the economic development of China through the provision of long-term financing for policy-oriented and related projects in accordance with the State's development plan and its industrial policies.'<sup>[fn]</sup>The State Development Bank of China, Prospectus for US\$330,000,000 7 3/8 Notes due 1 February 2007, 30 January 1997, 4.<sup>[fn]</sup> The SDB made its first commitment to Three Gorges in 1996 when a ten-year \$3.6 billion loan made the dam the SDB's number one debtor. According to the China Daily of 7 April 1998, 'Huge amounts of loan money from the [SDB] have propped up the development of the country's key electric power projects.' Since its establishment in 1994, the bank has injected about \$14.92 billion into the construction of hydroelectric, thermonuclear, and thermoelectric stations, including the Three Gorges project. It will continue to favour large electric power plants, making it one of the most important sources of funds for construction of China's power industry. The SDB receives its capital and funding from the government. It also issues debentures to domestic financial institutions, construction bonds in China, and bonds in international capital markets; and it borrows money from foreign governments, international financial institutions, and foreign commercial banks. Sovereign guarantees make these debt instruments relatively risk free.

The promise of sovereign guarantees was the inducement the private sector in the industrialized countries needed to invest in Three Gorges. In 1996, the SDB launched its first international bond offering, ¥30 billion underwritten by Nomura Securities and IBJ Securities of Japan. When a Japanese critic of Three Gorges discovered that the bond issue violated Japanese security laws because it failed to provide clear information on the use and risks of the bonds, Nomura cancelled a second ¥30 billion bond issue. The SDB launched its second bond issue in January 1997; this time \$330 million in bonds was underwritten by Lehman Brothers, Credit Suisse First Boston, Smith Barney Inc, J.P. Morgan & Co, Morgan Stanley & Co Incorporated, and BancAmerica Securities, Inc.

Taxpayer-backed agencies have also been enlisted to fill the breach left by the private sector: although in the United States the Export-Import Bank and the Bureau of Reclamation have refused to support Three Gorges for environmental and economic reasons, the Canadian, Swiss, British, German, French, Brazilian, and Japanese state-financed export credit agencies have had no such misgivings; together they have contributed \$1.2 billion. Canada's Export Development Corporation, for example, has subsidized loans of approximately \$120 million to finance the sale of Canadian computers and turbines for the Three Gorges project.

State protection can keep market pressures at bay for a limited time. Even under the best circumstances, Three Gorges power will cost more than power from cogeneration, gas generators, and some renewables. Under more likely circumstances, it will become increasingly expensive as technical problems cause shortages and greater costs, which will encourage power consumers to leave the deteriorating state-run system for independent or self-generated power.

The signs are menacing. In October 1997, a visiting American engineering team discovered that the temporary cofferdam holding back the Yangtze while dam construction is under way is at risk of collapsing. Boulders are falling off the diversion channel walls, and it now seems that project authorities overestimated the rock strength under the dam. The rock could fracture, causing water to seep beneath and around the dam wall, threatening its foundation and triggering landslides. Chinese authorities have called in a team of Norwegian geotechnical engineers to stabilize the situation, but remediation may take decades and will be costly. Meanwhile, rock failures may damage ship traffic and the ship locks themselves. Sediment build-up, about which Chinese experts have been warning for decades, is forcing project authorities to dredge the diversion channel around the clock, leading the American engineers to predict that sedimentation will likely compromise the dam's operation sooner and more severely than was originally thought.[fn]Leonard S. Sklar and Amy L. Luers, Report on a Site Visit to the Three Gorges Dam (California: Sklar-Luers & Associates, 17-18 October 1997).[/fn]

The project's other Achilles heel, the forced resettlement of nearly two million people, also threatens the project. A recent study by a Chinese sociologist shows that rampant corruption and government trickery associated with resettlement is undermining the project. Interviews with farmers, workers, small-business owners, and local officials revealed that resettlement officials are pocketing resettlement funds, resigning, and then disappearing. In other cases, resettlement funds are used to build comfortable government offices and housing or to build model resettlement sites which are then 'showcased by local officials as success stories both to persuade other farmers to relocate and to impress senior inspectors.' Most of the 50,000 people already resettled are languishing. Farmers say their new land looks 'like ditches from a distance and like pigsties close up.' Many have returned penniless to their original homes. Those who try to defend themselves are silenced. In the autumn of 1997, when Li Peng visited a township slated for resettlement, officials refused to let angry petitioners near the premier; instead they brought in others to pose as resettlers.[fn]Wu Ming, Major Problems Found in the Three Groges Dam Resettlement Program (Berkeley CA: International Rivers Network 1998), 3[/fn]

Local officials are dreading the prospect of forcing nearly two million people to move from their homes. By 2003, the government plans to flood the valley to the dam's 135-metre mark. One local official predicted that: 'By then, some 500,000 people will need to be relocated immediately. But there won't be enough money to relocate [them]. There won't be enough jobs for the relocated factory workers. And there won't be enough land for the relocated farmers.' He then struck an ominous note: 'If the central government insists on filling up the reservoir, it will have to rely on the military or a man-made flood to force people out of their homes.'[fn]Cited in *ibid*, 3[/fn]

Technical complications and social upheaval may turn Three Gorges into a bottomless pit that will invite the wrath of a burgeoning economy anxious for reliable, cheap power. According to an American executive whose company operates competing power plants in China, Three Gorges 'is like the U.S. nuclear program; it will take forever, it will cost all the money in China, and it won't make any power for 30 years.' The final cost could well be at least \$2,000 per kilowatt and hence total more than \$36 billion, making it 'very

uncompetitive if you charge any capital costs for the power.’[fn]Rademan, ‘Three Gorges befuddles engineers.’[/fn]

## SYMBOL OF THE PAST, BELLWETHER FOR THE FUTURE

The Three Gorges dam is proceeding after 70 years of debate, despite the evidence that there are cheaper, cleaner, and readily available alternative energy sources. The reason, according to sinologist Lawrence Sullivan, is a ‘closed decision-making process that grossly distorts technical data and analyses to meet the political needs of a self-sustaining elite’ and a ‘Party-state apparatus that remains profoundly authoritarian.’[fn]Lawrence Sullivan, ‘The Three Gorges dam and the Chinese polity,’ in Dai Qing, *Yangtze! Yangtze!*,xiv.[/fn]

‘Outspoken opponents of the project have been silenced ... as key decision-making arenas deliberating on the Three Gorges dam have been packed with obedient and technically illiterate supporters. Opposition views are not treated as mere differences of opinion, but evidence of disloyalty and “counter-revolutionary” intent.’ To prevent a critical mass of opponents from coalescing among the scientific and intellectual élite, Sullivan says, committees to investigate various aspects of the dam proliferated until they tended ‘to confound and confuse rather than to enlighten.’[fn]Ibid, xiv-xv.[/fn] Sceptics at the National People’s Congress in 1992 that approved the project were prohibited from distributing opposition material. Without information there was no debate and no viable opposition.

The unchecked dam bureaucracies – the Ministry of Water Resources and the powerful Yangtze Valley Planning Office – used every tool available to them for the ‘mobilization of bias’: promises of administrative position and influence, buying off potential grassroots opponents, unrealistic budgetary figures that seriously underestimate true costs, ‘smoke and mirrors’ financing, glossing over and even ignoring potential dangers while exaggerating benefits, falsifying data, and fixing crucial technical experiments.[fn]Ibid, xvi-xvii.[/fn]

The scale of the Three Gorges project, Sullivan argues, makes it one of the last refuges of the old-style planned economy ‘with secure and everlasting financing, personnel, and political power.’ Insulated from economic reforms, the massive project is a political, ideological, and economic sinecure. ‘The Three Gorges project is proof of the Chinese government’s determination to inspire people to collective action for national goals. In the face of advancing individual consumerism, “poisonous bourgeois liberalism,” and growing economic power in the country’s regions, it demonstrates that the center can still be the boss. If, as a common Chinese saying goes, “only China can save socialism,” then the Three Gorges dam may be intended, in part, as political CPR.’ And then there is Chinese nationalism and ethnocentrism. ‘This is to be the world’s largest dam and, like many aspiring great powers, China wants to be “number one”: in walls, cities, grain production, and now dams.’[fn]Ibid, xvii-xviii.[/fn]

Dai Qing, the celebrated Chinese journalist who was jailed without trial in 1989 for publishing *Yangtze! Yangtze!*, a book critical of the dam, explains that the megadam represents more than a political and environmental debate; it is a metaphor for China's changing society, a microcosm of what is happening in the whole of China, symbolic of the power struggle between reformists and hard liners. 'China is undergoing rapid change. The politicians who support the project are seeking power and have all the characteristics of the old society, that is, authoritarianism, the one-party system, central economic control, and personal despotism.' She adds that she thinks 'that 90 percent of the Chinese people are really opposed to the project. The only ones in favour are those politicians and people in the hydroelectric departments who profit in some way – either financially, or through prestige, glory, and promotions.' [fn]Cited in Audrey Ronning Topping, 'The river dragon has come!' in Dai Qing, *The River Dragon Has Come!*, xx-xxi, xxix. *Yangtze! Yantze!* was denounced and banned in October 1989 on the grounds that it 'abetted the [Tiananmen Square] turmoil.' Dai Qing spent ten months in the notorious Qincheng maximum security prison and has been prohibited from publishing in China ever since. Despite these restrictions, she continued to gather information from critics of the dam and to write exposés about Three Gorges and other dams. She publishes her work outside China. *The River Dragon Has Come!* is her most recent book. [/fn]

'The Three Gorges project has both benefited from China's autocratic history and helped strengthen it. Those promoting the dam, from the 1950s to today, have all been masters of political gamesmanship, constantly referring to "Chairman Mao's desire" (Mao zhuxide xinyuan) and "Deng Xiaoping's support and concern" (Deng Xiaopingde zhichi he guanxin) for the project. By invoking the support of the country's autocratic leaders, the dam was made virtually unassailable.' [fn]Dai Qing, 'The Three Gorges project,' 12-13. [/fn]

Some now believe that Three Gorges could lead to political insurrection, even the downfall of the Communist party. Huang Wanli, one of China's most eminent hydrologists, has consistently warned the leadership against creating a situation similar to the Railroad Protection Movement in Sichuan which precipitated the 1911 revolution that overthrew the Qing (Manchu) dynasty (1644-1911) and led to the 1912 Republican revolution. (Local merchants in Sichuan resisted the central government's railroad nationalization plan because it entailed foreign loans, fostered official corruption, and imposed commercial taxes to finance the entire scheme. [fn]Cited in *ibid*, 16. [/fn]) Dai Qing warns that 'many people are concerned that, if it is not handled properly, the project may spell the end for the Communist Party and the People's Republic in a similar way as construction of the Great Wall more than 2,000 years ago brought down the First Empire of Qin (BC 221-207),' and that the Chinese pattern of reservoir construction over the past 50 years is one in which 'those who have suffered are not the beneficiaries while those who have benefited are not the sufferers.' [fn]Dai Qing, 'The struggle to publish *Yangtze! Yangtze!* in China,' in *Yangtze! Yangtze!*, 5. [/fn]

Dai Qing argues that there are two fault lines running under the Chinese Communist party, either of which could cause a serious rupture. The first is the question of how to interpret the events of June 1989 in Tiananmen Square for the history books. The second

is whether to support the continued construction of the Three Gorges dam.[fn]Quoted in John G. Thibodeau and Philip B. Williams, 'Preface,' in Dai Qing, *The River Dragon Has Come!*, xii.[/fn]

The political ground around the Three Gorges project appears to be shifting. Now that Deng is dead, Li Peng is the dam's most dedicated and powerful supporter. But he has been replaced as the director of the Three Gorges Project Construction Commission by Zhu Rongji, who is not known to favour the project. Wu Bangguo, China's vice premier, is not a supporter of the project either, and he was recently appointed first deputy director of the commission. Meanwhile, a number of journalists and environmentalists in China have begun organizing to conduct more critical reviews and studies of the project. Dissident scientists and engineers at China's Academy of Sciences have been invited once again to submit their opposing views to the new government.

As problems unfold at the dam site, as costs escalate, as economic pressures bear down on the Chinese government, and as energy alternatives become more attractive, obtainable, and necessary, we predict that the Three Gorges dam will be scaled back, slowed, postponed, even cancelled. For technical and economic reasons, we predict the dam will never operate as planned or designed. And on the political front, the struggle over the path and pace of reforms in China will be played out first with the Three Gorges dam. For as Three Gorges goes, so goes China.