Probe International Special Report

State-backed dam builders are erecting a string of skyscraper-high dams in earthquake-prone Yunnan province to meet Beijing's power production targets, without the benefit of market discipline or effective regulatory oversight.

In this special report, Probe International policy director Grainne Ryder argues that China's new electricity regulator should step in to examine the dam builders' projected costs and profits, and review the economic implications of Beijing's west-east hydro policy for China's power consumers and the country's power industry modernization goals.

By undertaking an open and impartial economic review of the west-east hydro policy, the State Electricity Regulatory Commission would bring much-needed financial transparency to the dam builders' plans for Yunnan before any more investment decisions are made. A SERC review would also help refocus the government's attention on market reform versus more centrally planned expansion.

SEG Plaza: The Xiaowan dam will be as high as this 71-storey Shenzhen skyscraper

Just outside Kunming, the capital of southwest China's Yunnan province, a giant billboard advertises Hydrolancang on a blue-sky background. You wouldn't know it from the billboard, but Hydrolancang is the company building two of the world's tallest and most controversial hydro dams on the Lancang River just a few hundred kilometres to the south.[1]

When completed in 2012, Xiaowan will be the world's tallest arch dam, with a height (292 metres) equivalent to the 71-storey SEG Plaza in the coastal city of Shenzhen.[2] Next under way is the 254-metre (or 52-storey-high) Nuozhadu dam, which is expected to start generating power in 2017. Hydrolancang, officially the **Yunnan Huaneng Lancang River Hydropower Company**, a subsidiary of one of China's "big five" power generating companies, already has two large hydro dams operating on the Lancang, and three under construction.[3]

Hydrolancang is not the only company building skyscraper-high dams in Yunnan province.

- The **Yunnan Huadian Nu River Hydropower Development Company** has plans for 13 high dams along the Nu River, one of only two major rivers in China that remain free-flowing. The tallest of the planned dams, located in Tibet, would stand 307 metres high and have an installed capacity of 4200 MW.[4]

- Further east along the border with Sichuan province, the **Three Gorges Corporation** is pushing ahead with the 278-metre-high Xiluodu dam. With an installed capacity of 12,600 MW, Xiluodu is part of a nine-dam cascade on the upper Yangtze (Jinsha), which, if completed, would produce three times as much power as the Three Gorges dam, the world's largest hydro generation project.[5]

The pace and scale of this dam-building spree has alarmed China's scientific and environmental communities.

One immediate concern is the frequency with which Yunnan is hit by earthquakes, rock falls and landslides. Experts have warned that the extra weight of the high dams and reservoirs could add stress to existing faults, triggering more earthquakes in a province devastated by a string of major quakes over the past decade.

Another concern is the ecological damage. The Nu River, which flows parallel to the Lancang and Jinsha, forms part of Yunnan's Three Parallel Rivers National Park, an area so biologically and culturally diverse UNESCO designated it a World Heritage Site in 2003. The projects would also require the forced resettlement of ethnic minorities living along the rivers. At least 50,000 people will be displaced by Hydrolancang's Xiaowan and Nuozhadu dams alone.

Earlier this year, environmentalists, joined by scientists and engineers, urged the country's top environmental regulator, the State Environmental Protection Administration, to disclose the dam builders' plans and hold public hearings, starting with the Nu River scheme.[6] Certainly, SEPA has the legal authority to intervene, in accordance with the country's new laws on environmental impact assessment and public participation in decision making.

The agency also appears to have high-level support for a careful review of the plans. In 2004, Premier Wen Jiabao announced that the Nu River project should be "seriously reviewed and decided scientifically." And He Shaoling, a senior engineer at the China Institute of Water Resources and Hydropower Research, was quoted as saying: "The Nu River dam project must go through an independent and authoritative investigation before any decision on its future should be made."[7] Whether or not SEPA will be able to hold the dam builders to public account, however, is open to speculation.

Dam building is centrally mandated

Dam building in the southwest is central to Beijing's western development campaign and its plan for tripling the country's hydropower production by 2020.[8] To meet that target, the State Council granted three state power companies exclusive development rights in 2002:[9]

- **Hydrolancang**, majority owned by China Huaneng, the largest of the big five state generating companies, holds development rights to the Lancang River;
- **Yunnan Huadian Nu River Hydropower Development Company**, majority owned by Huadian, another one of the big five state generating companies, holds rights to the Nu River; and
- The **Three Gorges Corporation**, which is responsible for the Three Gorges dam, holds rights to the upper Yangtze (Jinsha) River.

With monopoly privileges in hand, each company is now racing to meet Beijing's production targets, financed mostly with cheap capital from the central banks. Each parent company has at least one subsidiary listed on the Chinese stock market in order to raise additional capital for expansion. With an eye to the capital markets, the new dam-building subsidiaries now claim to be market-oriented, promising high returns for would-be investors and low-cost power for consumers.

But as state-owned power companies, the dam builders remain fundamentally policy-driven, not market-driven, unhinged from market signals and shielded by the central government from many of the financial risks and environmental liabilities associated with large dams. As such, the dam builders' multibillion-dollar hydro schemes are themselves a huge financial liability for the central government. As Chen Guojie of the Chinese Academy of Sciences puts it: "Driven by the profit motive, the dam builders are racing ahead with scant regard for environmental safety in the river valleys or possible changes in the power

market. Such shortsighted and unchecked development could lead to endless trouble in the future."

In a further carve-up, not only of the nation's hydropower resources but of its power markets, the central government has decreed that the bulk of the Yunnan dams' output will be sold to the rapidly industrializing eastern province of Guangdong, and the balance to neighbouring Vietnam and Thailand. All this was laid out in Beijing's 10th Five Year Plan (2001-05): Guangdong would import about one-quarter of its power supply from the southwest by 2005. Additional targets were set for hydro exports to Vietnam and Thailand.[10] Under Beijing's 11th Five Year Plan (2006-10), China Southern Power Grid, the state-owned transmission company responsible for transmission in the five southern provinces, plans to spend US$29 billion on infrastructure to increase west-east power transfers.[11]

Guangdong province

Meanwhile, one of the designated power purchasers, Guangdong province, has raised objections to increasing its reliance on hydro imports from the southwest. According to senior power sector planners and economists at the Guangdong Techno-Economic Research Development Centre, centrally mandated hydro imports are "worrisome" to the provincial government for a number of reasons.

In their 2004 report on Guangdong's power industry, the team, led by Zeng Leming and Zhang Chi, writes: "While the central government has been turning down [approval of] new power plants in Guangdong and mandates the Province to import southwestern hydropower instead, Guangdong fears that the imports are insufficient to either meet the level of market demand or match the load curve." Between 2001 and 2005, the Guangdong team reports, the central government banned construction of power plants in Guangdong in order to make room for western hydro imports - a directive that contributed to severe power shortages and discouraged private investment in new generating capacity just when the province needed it most.

Although the price of hydro imports is "competitive" at the government-fixed price of 3.8 US cents per kilowatt-hour, reliability is the biggest concern. The Guangdong team notes "uncertainty and reliability issues associated with southwestern electricity imports such as seasonality of southwestern hydropower, compatibility with planned dispatch and Guangdong load curve, and increase in power demand within western areas."[12] In particular, water shortages have "not been considered by central government planners when they decide how much Guangdong's demand will be set aside for southwestern hydro imports." Instead of increasing hydro imports under Beijing's directive, and thereby increasing the risk of future power disruptions and shortages, the Guangdong experts argue for abolishing what they call "political dispatch." They call for a new system of economic dispatch and market rules to promote investment in power plants within Guangdong, and without political interference.

SERC should step in

Guangdong's concerns warrant urgent attention from the new industry regulator, the State Electricity Regulatory Commission, as they affect power consumers and the future of the country's power industry. Set up by the State Council in 2002, SERC is responsible for regulating state power companies and introducing competition in power generation.[13] Together with the country's top planner, the National Development and Reform Commission, SERC is a driving force behind the State Council's 2002 plan to restructure the state power industry for competition and develop a new system of regulation.[14]

As the industry regulator, SERC is responsible for:[15]

1. Enforcing environmental laws, regulations and standards in co-ordination with relevant environmental protection agencies;

2. Issuing licences to power producers;
3. Ensuring orderly and fair competition in the market;
4. Regulating the non-competitive parts of the generation business;
5. Reviewing electricity tariffs;
6. Proposing changes to government pricing authorities;
7. Investigating possible violation of laws and regulations by market participants, and resolving disputes among them; and
8. Organizing implementation of reforms and proposing options for further reform.

Clearly, SERC has the mandate to assist the State Environmental Protection Administration with a review of the dam builders' costs of compliance with environmental regulations and standards. In addition to a full-cost review, however, SERC is the right agency to investigate Guangdong's concerns about the reliability of hydro imports from Yunnan and the broader economic implications of centrally mandated hydro development.

Finding the true cost of west-east hydro

Proponents claim that large hydro dams in Yunnan will generate high returns for investors and low-cost power for distant consumers.[16] SERC's first job as regulator should be to test the economic validity of the proponents' claims.

Essentially there are four questions SERC should ask on behalf of ratepayers and potential investors:

1. **What are the real costs of west-east hydro exports?**

   Dam builders in China typically underestimate and shift certain costs onto other government sectors, thereby inflating the profitability of their proposals at public expense. Guangdong, for example, buys hydropower from the southwest for 3.8 US cents per kilowatt-hour, which is set just less than the average price of power from coal-fired stations but does not reflect the total cost.[17]

   Prior to 2002, profitability was not an issue for hydro developers. The price of their output was set by the central government and bore no relation to actual costs. Today's dam-building companies, however, are promising high returns to attract commercial investors. The regulator's responsibility is to check that profits have not been inflated at public expense by underestimating costs or externalizing costs onto riparian communities and power consumers. Take the Three Gorges Corporation's listed subsidiary, Yangtze Power Company, for example, which reported a 2005 profit of US$417.51 million.[18] The company is selling hydropower from the Three Gorges and Gezhouba dams for 3 US cents per kilowatt-hour but this price does not include the full cost of dam construction, resettlement or environmental damages. As such, its profits warrant economic scrutiny from the regulator.

   West-east transmission costs also warrant scrutiny. Without long-distance transmission lines, the dam builders in Yunnan would not have access to a big enough market to absorb their dams' massive output. Yet the high cost of long-distance transmission, if included in the price of hydro imports, could render their hydro-dam investments uncompetitive compared with smaller-scale modern power plants built in Guangdong, close to where power is needed. The regulator should establish what China Southern Power Grid Company's actual costs and projected profits from west-east power transmission are; how

the company plans to recover its costs; and from ratepayers in which jurisdictions. Under the new market rules, all costs should be accurately assessed and disclosed to both regulators (SERC and SEPA) for public review prior to investment decisions.

2. **How will the dam builders' costs (and profits) affect future electricity rates?**

   Not much information is available to potential investors or ratepayers beyond the dam builders' preliminary cost estimates. The regulator should insist upon financial transparency from the dam builders and transmission-grid owners in order to determine how the proposed projects would affect future electricity rates.

3. **Who will assume financial responsibility for the hydro dams when things go wrong?**

   The regulator should call for disclosure on which parties will be held financially responsible if the proposed hydro dams cannot recover costs from ratepayers (for example, due to inadequate demand for their output, drought, or other natural disasters that either cripple production or render the dams inoperable). Under the old system of centrally mandated investments, state companies expected the central government to protect them from financial failure at any cost.

   But in China's increasingly competitive and decentralized (and soon-to-be-oversupplied) power market, this assumption may no longer be prudent. The near-bankruptcy of the centrally financed Ertan Hydropower Development Corporation is a strong indication that the central government, while still prone to interference, may be far less willing or able to shield its dam builders from future competition from provincial and municipal power producers.[19] To deter costly investment mistakes, the regulator should review these emerging financial risks and their potential impact on the cost of service.

4. **Are the dam builders' costs justified? Or would power consumers be better served by market reform that promotes investment in commercially viable generating technologies?**

   Here, the regulator should seek input from Guangdong's power industry experts, as well as would-be competitors, consumers in affected jurisdictions, and other parties concerned about the economic and environmental impacts of large hydro dams. A full-cost review is not enough. SERC should exercise its mandate and confront the prevailing monopoly structure that is driving investment in high-risk, high-cost dams at public expense.

   The fundamental policy question is this: should China's power consumers and citizens be forced to pay the true cost of hydro dams in Yunnan, plus the high cost of long-distance transmission? Or, would consumers be better served by market reform in terms of reliability and cost of service?[20] And finally, SERC should address the impact of centrally mandated hydro investments and power transfers on the development of competitive power markets.

Is SERC up to the job?

Some analysts doubt SERC has the independence to hold state power companies publicly accountable. They note that SERC chairman Chai Songyue is a long-time supporter of former premier Li Peng, whose son runs Huaneng, the majority owner of Hydrolancang and lead dam builder in Yunnan.[21]

Also, SERC staff are mostly former employees of the State Power Corporation, without the proper economic training to advance a rules-based approach to electricity regulation. The World Bank, a leading financier of China's large hydro dams, reports little progress in regulating state power companies since SERC's creation in 2002. "SERC is still struggling to establish its authority in the face of fuzzy 'ground rules' set by the State

Council and the counterveiling authority of long-established and more powerful bodies such as the NDRC [National Development and Reform Commission], which still has the final word on electricity tariffs. Lines of responsibility between SERC and NDRC are not yet clearly demarcated, with the latter seemingly reluctant to surrender any of its regulatory powers over the sector, even though it is overstretched. SERC has little autonomy and still depends upon a budgetary allocation from the Ministry of Finance to cover its operating costs," the Bank reports.[22]

Yet SERC has made progress.[23] It has established regional offices for supervising provincial markets. It has announced a new certificate system for power producers, which, if implemented, would oblige power companies to submit their business plans, financial reports and environmental performance records for assessment by SERC in order to be certified for operation.[24] And last year, it ran a trial market in southern China, in which power producers bid against one another to supply the grid.[25] According to SERC's director of power market regulation, Chang Jianping, investors should expect the new rules for competition in generation to be finalized within the next five years.[26]

In the meantime, however, SERC has warned the State Council that stalled market reform is impeding investment and economic growth. The separation of state-owned generation from state-owned transmission, which began in 2002 (as a prerequisite for competition), is far from complete. The State Power Grid Corporation, the country's largest transmission operator, still controls more than 36,000 MW of generating capacity and routinely dispatches its own generators before rival power producers, which has created conflict with private power producers. Counter to the industry reform plan, the two state grid companies, China Southern Power Grid and its larger rival, the State Power Grid Corporation, are busy entrenching their monopoly buyer and distributor positions by building super high-voltage power lines (1000-kV AC), which are designed to accommodate huge volumes of power over long distances.[27]

SERC should confront the power monopolists. Dissatisfied investors and the central governments' own advisers are openly calling for market reform as the best way to deliver reliable and affordable power to consumers while alleviating financial pressure on the central government. Last year, even the government's department of industrial economists warned that "the most severe problem" in China's power industry is "the government overstepping its role and disturbing the market mechanism by allocating resources. As a result, [state power] enterprises are still in a compulsory 'bind', with market supply and demand signals blocked or cut off."[28]

By undertaking an open and impartial economic review of Beijing's west-east hydro policy, SERC would bring much-needed financial transparency to the dam builders' plans for Yunnan before any more investment decisions are made. It would also help refocus the government's attention on market reform versus more centrally planned expansion. As the Guangdong experts write, "a new reform approach is badly needed to solve problems the industry faces."

Power consumers stand to benefit from SERC's initiative. If consumers in Guangdong province or elsewhere don't want or need to rely on remote and drought-prone hydro dams in Yunnan, proponents have no valid economic rationale for building them or expecting ratepayers across the country to pay their costs. If power consumers would prefer cheaper, more reliable, and less environmentally damaging generating options, the new market rules should be introduced to encourage such investments without further delay. (About one-third of Guangdong's existing generating capacity is oil-fired units under 50 MW, which are inefficient and polluting, and could be replaced with cleaner and commercially proven generating technologies, such as cogeneration and combined-cycle plants.

SERC should exercise its regulatory mandate and assist its environmental counterpart, SEPA, with a public

review of the hydro developers' costs for the environment's sake. China's power consumers and the economy would also be well served by SERC's review of west-east hydro development as it affects power consumers and the modernization of China's power industry.

Footnotes

[1] Hydrolancang is officially known as Yunnan Huaneng Lancang Jiang Shuidian Youxian Gongsi. Its website is www.hnlcj.cn. Xiaowan is more than 300 km southwest of Kunming, as the crow flies; Nuozhadu is about 400 km, and Jinghong about 500 km, south of Kunming.

[2] Xiaowan is the third of eight hydro projects to be built on the Lancang. "China to build huge power station on Lancang-Mekong River," Xinhua, 20 Jan 2002; "China eyes river for development," New York Times, 30 Sep 2001; "First generating unit of Xiaowan due in 2009," Xinhua (in Chinese), 17 Dec 2005. Xiaowan will have 38 times as much water-storage capacity as Manwan, the first Lancang dam, which was completed in 1996. See also "China's challenge," International Water Power & Dam Construction, November 1997.

[3] "China's challenge," ibid. For more details about the social and environmental effects of Lancang dams, see "Creating catastrophe: China and its dams on the Mekong," Watershed, November 2002-February 2003, pp. 43-48. The second Lancang dam, Dachaoshan, was completed in 2003. See Xinhua, 20 Oct 2003. The third dam under construction, Jinghong, will stand 118 metres when completed in 2010. "China's State Council approved Jinghong dam project," Dianchi Chenbao, 27 Apr 2004.

[4] For a complete list of the proposed dams on Nu (upper Salween) River, see Save the Nujiang and Nu River: Fact box.

[5] For more information about the Jinsha dams, see, for example, the website of the Chinese Institute of Engineers/USA.

[6] "Activists seek hearings on dam project," South China Morning Post, 21 March 2006; "China dam threatens World Heritage site," Voice of America, 13 Apr 2006.

[7] "Appetite for electricity eats into environment," Inter Press Service, 12 March 2004.

[8] Beijing expects to triple hydropower capacity from 83,000 MW in 2003 to 246,000 MW in 2020. International Water Power & Dam Construction, 13 Feb 2006.

[9] The monopoly carve-up of Yunnan's hydropower resources has been widely criticized inside and outside China. See, for example, Darrin Magee, "The science of China's hydropower," presentation to Role of Water Sciences in Transboundary River Basin Management International Symposium, Ubon Ratchatani, Thailand, 10-12 March 2005.

[10] Zeng Lemin, Zhang Chi, et al. "Guangdong Electric Power Market Reform: Options and Impact," Working Paper #33, Center for Environmental Science and Policy, Stanford University, November 2004.

[11] China Southern Power Grid; "Chinese grid firms plan expansion," China Power & Energy News, March 2006. In addition to its Yunnan-Guangdong transfers, the company began exporting power to Vietnam in 2004, and in that year earned more than half a billion dollars in total profit. By 2010, the company plans to boost its annual profit to US$1.2 billion.

[12] The term "dispatch" refers to the scheduling and operation of generation facilities to supply the grid based on forecasted load (demand) and the operating characteristics of each generating facility. With central planning, dispatch tends to be highly politicized to the detriment of consumers and the operating efficiency of the system. In a competitive market, scheduling of generators to supply the grid is typically done by an independent market operator and is executed to ensure the most reliable service at the lowest possible cost to consumers (also known as "economic dispatch").

[13] The National Development and Reform Commission, the country's top planning agency, still makes all final decisions on policy and pricing. But the trend is toward greater pass-through of costs to consumers. In May 2005, for example, NDRC announced a new "cost pass-through" mechanism allowing power producers to pass along a portion of their rising fuel costs to consumers.

[14] State Council Document No. 5, 2002, cited in World Bank Report No. 32664, "Project Performance Assessment Report People's Republic of China: Ertan Hydroelectric Project I & II, Sichuan Power Transmission Project and Zhejiang Power Development Project," 27 June 2005, p. 27.

[15] SERC's website.

[16] See, for example, comments made by Yunnan's vice-governor, Qin Guangrong. "China Huadian Corp to lead Nu River hydropower plan," Yunnan Daily, 15 June 2003.

[17] Zeng Lemin, Zhang Chi, et al., op. cit.

[18] "Yangtze Power output up 8.85 percent," China View, 10 Apr 2006; "YEP output surges 73.5 per cent," Shenzhen Daily, 11 Jan 2005. Analyst Li Yuan of Haitong Securities is quoted as saying 2005 is not expected to be as good as "high 2004 water levels are unlikely to be matched."

[19] See "Ertan's market failure," Three Gorges Probe, 16 Feb 2006.

[20] For information about competitive alternatives to China's supersized hydro dams, see, for example, Melanie Slade, "The dragon awakens," Cogeneration and Onsite Power Production, March-April 2006, pp. 89-95.

[21] Xu Yi-Chong. Powering China: Reforming the electric power industry in China, Ashgate Publishing, 2002; Liu Shijing and Feng Fei, et al., "China's Energy Market Reform," Sub-project 9, China National Energy Strategy and Policy Study, Energy Foundation China, 2005.

[22] World Bank Report No. 32664, op. cit.

[23] Chi Zhang, "China: stalled reform set to restart," The World Energy Book, World Energy Council, Autumn 2005; "China's electricity shortage to relieve this year," People's Daily Online, 25 Feb 2005.

[24] "New rules for electricity suppliers," China Daily, 21 Nov 2005.

[25] "South adopts electricity reform," China Daily, 22 Nov 2005.

[26] China Energy & Power Sector News, March 2006.

[27] "China's power industry reform unsuccessful Ð expert," Interfax, 22 Dec 2005.

[28] Liu Shijing and Feng Fei, et al., op. cit., Energy Foundation China, 2005.

The Jinghong dam, under construction on the Lancang River.
(See our Jinghong photo gallery.)

The Hydrolancang cascade

Hydrolancang's existing and proposed dams along an 800-km stretch of the Lancang (upper Mekong) River in Yunnan province (from upstream to downstream):

Projects	Installed capacity (MW)	Dam height (metres)	Estimated cost (US$millions)	Status
Gongguoqiao	750	130	625	Due to start: 2006 Completion: 2008
Xiaowan	4,200	292	4,000	Under construction. Completion: 2012
Manwan	1,550	136	473	Completed: 1996
Dachaoshan	1,350	111	600	Completed: 2003

Nuozhadu	5,850	216.5	5,000	Under construction. Completion: 2017
Jinghong	1,750	118	1,000	Under construction. Completion: 2010
Ganlanba	150	65	n/a	n/a
Mengsong	600	n/a	n/a	n/a

Notes:

Run-of-river versus storage reservoirs:
Six of the eight dams are "seasonal reservoirs," with output dependent on seasonal flows rather than storage capacity behind the dams. The two other dams - Xiaowan and Nuozhadu - will function as giant cisterns or storage reservoirs operated to maintain baseload power production throughout the year and downstream flow through the seasonal reservoirs. If completed, Xiaowan will be the world's tallest arch dam, with 38 times as much design storage capacity as the Manwan dam, and a reservoir that will stretch 169 km upstream. The Nuozhadu reservoir will stretch 226 km upstream.

Hydrolancang's power output crippled by water shortages:
Hydrolancang's Manwan and Dachaoshan dams were barely operational this March due to low flows in the Lancang River. Power production was 350 MW below average for March, when river flows are usually at their lowest. Water levels behind the two dams were almost at the "dead level," below which the turbines cannot operate, according to Yunnan Daily (20 March 2005). Kunming Daily reported that the Yunnan grid company (a subsidiary of China Southern Power Grid) had to cut back hydro exports to Guangdong province by 200 MW while importing 300 MW of coal-fired power from neighbouring Guizhou province to meet demand within the province (China Power News Network, 31 March 2006).

Sources:

- Department of Water Environment at the Institute for Water and Hydropower Research.
- "Main Features of Cascade Hydropower Projects on Middle and Lower Reaches of Lancang River," Hydrolancang website.
- "China's Challenge," International Water Power & Dam Construction, November 1997.