Hydropower in China: development or slow-down?

The approval process of China's hydro-power projects has slowed down considerably since 2005, in spite of expansionist plans. Chinese targets are usually met or surpassed, but for hydropower this has not been the case. Until 2015, installed hydropower generation capacity will continue to grow by about 20 GW annually, based on approvals given before 2005, but very few large projects will be completed thereafter. For many reasons this is surprising.

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DEMAND FOR ELECTRICITY has grown annually by over 10 percent since 2000, and hydropower is the cheapest and cleanest supplier. Demand will increase by a further 7.5 to 9.5 percent annually between 2011 and 2015, to 6,000-6,600 TWh.[1] Additionally, hydropower is the main contributor to China's non-carbon targets pledged in Copenhagen. Of the 15 percent non-carbon final energy target for 2020, at least 9 percent will have to come from hydropower, 4 percent from nuclear, and less than 2 percent from wind, solar and other energy sources.

Fossil and non-fossil alternatives

Let us consider the alternative sources of power generation, first and foremost coal. In 2011, thermopower (a very small part of which comes from gas) was responsible for as much as 82 percent of China's electricity generation. After years of rapid expansion, the construction of coal-fired power stations is grinding to a halt now. Between 2006 and 2010, the average investment cost per kilowatt capacity of completed thermopower stations fell by 2 percent to 3,745 yuan, primarily because of their increased size with 600 MW units. Those of hydropower projects rose by 19 percent to 6,870 yuan.[2] Of the latter cost, actual expenses for compensation of submerged land and buildings, and for resettlement, constituted 20 percent, much more than the originally budgeted 12 percent; construction costs grew too, but capital costs went down. However, the operating cost of hydropower stations varied between 0.04 and 0.09 yuan per kWh, compared to 0.20 yuan and more for thermopower.[3] The costs of thermopower production have risen steadily, along with the price of coal, and power companies, constrained by state-set low electricity prices, have been suffering losses for several years. Their reluctance to invest in more coal-fired stations led to an electricity shortage of 30 GW in 2011, and probably 40 GW in 2012. Coal and cokes have to be imported nowadays at a rate of 20 million tons per month. Coal is perceived as a great burden to the environment, and rightly so. Carbon dioxide emissions have doubled from 3.5 billion tons in 2000 to 7.2 billion tons in 2009, making China the biggest emitter of carbon dioxide worldwide.[4]

The Electric Power Industry Association has calculated that it needs a 30 percent electricity price rise (from 0.57 yuan/kWh in 2010 to 0.73 yuan/kWh in 2015) to accomplish the planned increase of thermopower generation capacity. Failing that, the present electricity shortage is likely to worsen. Rather than coal, natural and shale gas may become the preferred sources of energy, but their development will take considerable foreign technical support, and many more years.

As for non-carbon alternatives, the expansionist plans for nuclear power (80 GW by 2020) in the Chinese interior have been put temporarily on hold after the Fukushima disaster. Wind power, though rapidly expanding, can supply only a few percent of electricity needs in the mid-term future. Moreover, it still requires subsidization of producers and high feed-in tariffs (0.51 to 0.61 yuan/kWh), and provincial governments are unwilling to invest in the necessary additional power lines and pumped storage stations. In contrast, most hydropower stations supply electricity to the grid at prices 30 percent (since 2009, for new ones about 20 percent) below those of desulphurized thermopower stations – in 2009, on average, at 0.25 yuan rather than 0.38 yuan per kWh. In 2012, after the poor year of 2011, water supply was abundant again.

So far, only one-third of China's economic hydropower potential has been utilised, compared to over two-thirds in most developed countries. The rivers flowing from China's sparsely inhabited western regions have a huge, untapped potential. In the 1980s and 1990s, because of past under-investment in long-distance power lines, many large hydro-power stations such as Sanxia had to be situated along the middle reaches of rivers, and their reservoirs inundated much land and displaced many people. Since then, three ultra-high-voltage lines have been built running from West China to the coastal areas, where most consumption is found. They have created cheap long-distance transport and greater flexibility in the power grid. Local coal power pit stations benefited, but hydropower projects even more so, because dam sites can now be selected in the mountains of West China, where relatively few (less than ten thousand people in almost all cases) have to be displaced.

Other positive factors for hydropower development are China's engineering experience, sophisticated equipment industry, and a strong state command over land resources and investment capital. The low interest rates over the past few years favour projects with high capital and low running costs, such as hydro-power stations. Moreover, usually they enjoy local political support because, apart from electric power, downstream communities may enjoy additional benefits of flood control and water supply. Negative factors include the uncertainty about future obligations for power companies to pay more resettlement compensation, and about sharing reservoir benefits with other users (such as flood control or irrigation), and the worries about the vulnerability of high dams (after the 2008 Wenchuan earthquake). In particular, the historical and present social cost of resettlement and growing ecological concerns have begun to dominate Chinese political discussion after 2004.

The 11th Five-Year Plan (2006-2010) announced that construction of 70 GW of hydropower stations would be approved, but actual approvals totalled only 43 GW and construction started on little more than 20GW during that period. During 2012-2015, hydropower capacity will increase greatly, reflecting project approvals made before 2005 (typically, construction of a hydropower station takes ten years), but growth will be much less thereafter. Given the favourable economic conditions for hydropower, what has been delaying its rapid expansion and will delays continue?

Causes of the slow-down in approvals of hydropower projects

Several temporary causes may be found for China's difficulties in transitioning to new institutional arrangements, for present uncertainties in electricity price formation, and for the adoption of different, more inclusive planning procedures since 2005. More permanent causes are the higher valuation of the cost of displacement and resettlement and ecological damages, and even more important (because actual numbers of displaced people and the extent of environmental damage are lower than in previous decades) is a growing political reluctance to take decisions that may threaten social stability through popular protest. Moreover, the alternatives of nuclear and wind energy, the so-called 'new energy sources', have succeeded in attracting a great deal of technological and political support.

The moment that more-comprehensive planning and implementation procedures, such as public consultation and representation of all stakeholders in river water use, result in longer planning and construction periods, the costs of hydro-power will increase for investors, and projects may become less attractive. For instance, after 2004 provincial authorities were forbidden to issue permits to start with preparatory foundation work at dam sites in anticipation of an eventual central government permission to cut off the river flow. In defiance of that rule, construction of the Ludila power station on the Jinsha River started in 2006, was halted, and finally only obtained formal approval in 2012. The Ministry of the Environment has a greater role now, but apart from delaying and demanding revisions to constructions approved by the mighty NDRC it cannot impose sanctions that really hurt, and depends on political backing by the Politburo, rather than on legal means. Unsurprisingly, with responsibilities and rules being unclear, both local authorities and displaced persons try to, privately or publicly, get the most out of national companies that build and finance large projects. The days of top-down administrative imposition and implementation of projects are over.

Longer procedures did not deter planners from increasing their hydropower generation targets for 2020. To what extent planning has become detached from political realities will be tested again this year. For 2012 alone the State Energy Bureau has planned the approval of 20 GW of hydropower projects, but last October and this January the Ministry of the Environment promulgated stricter rules for environmental approvals. Delays in approval of large dams, and stalemates between national and provincial governments, have led to unlicensed and wanton construction of many medium- and small-size hydropower dams (for instance, almost one hundred dams totalling 1.7 GW in the Nujiang (Salween) basin over the past few years; a most worrying development. Environmental NGOs, who are mostly active in Beijing and at universities, find it impossible to keep up with the great number of hydropower construction projects in the western regions. Project authorities are required to post formal notices and organize hearings in the project area, giving the public an opportunity to provide suggestions or objections; but time constraints and a lack of expertise mean that local people and concerned NGOs have very little input, if any.

The future

Eventually, hydropower generation capacity in China will run into its natural limits of about 450 to 500 GW, still more than double the 230 GW at the end of 2011. Thus, its contribution remains most essential for achieving medium-term national goals of meeting electricity demand and reducing the negative environmental impact of coal burning. However, our research showed that the direct positive and negative local impacts of hydropower construction, eighty percent of which is located in poor mountainous areas in China's southwest, play a most important role in the local and national decision-making processes concerning electricity generation. In addition to local impact itself, Chinese politicians high and low seem anxious to avoid intractable political and public discussions about negative social and environmental effects of large hydropower stations. While some keep dreaming about the technological solutions of wind and solar power, the construction of thermopower stations goes on, locking China into a carbon economic mode.

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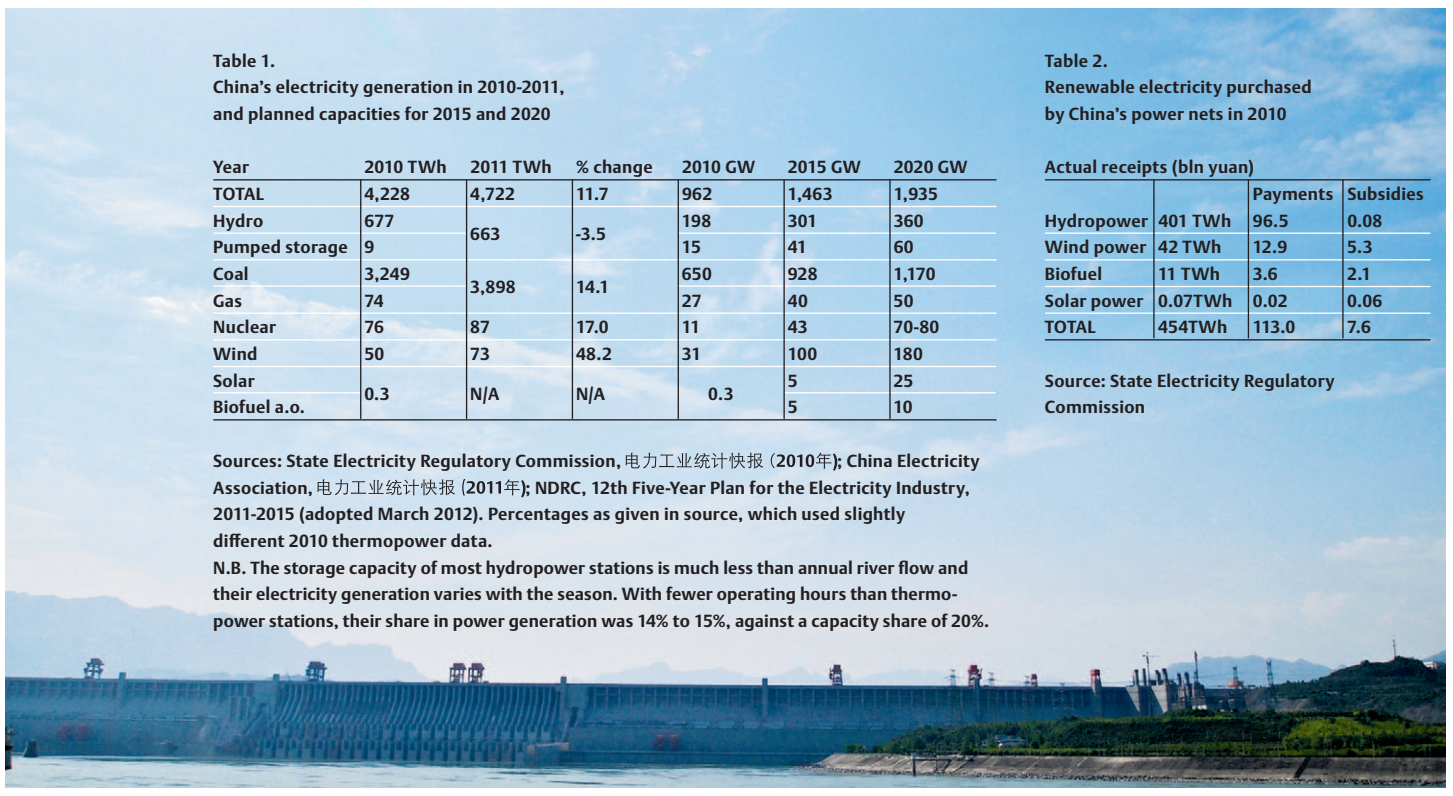

Below: Three Gorges Dam in the Yangtze River, Hubei, China. Photo reproduced courtesy Creative Commons/Flickr.

Table 1.
China's electricity generation in 2010-2011, and planned capacities for 2015 and 2020

Year	2010 TWh	2011 TWh	% change	2010 GW	2015 GW	2020 GW
TOTAL	4,228	4,722	11.7	962	1,463	1,935
Hydro	677	663	-3.5	198	301	360
Pumped storage	9			15	41	60
Coal	3,249	3,898	14.1	650	928	1,170
Gas	74			27	40	50
Nuclear	76	87	17.0	11	43	70-80
Wind	50	73	48.2	31	100	180
Solar	0.3	N/A	N/A	0.3	5	25
Biofuel a.o.					5	10

Sources: State Electricity Regulatory Commission, 电力工业统计快报 (2010年); China Electricity Association, 电力工业统计快报 (2011年); NDRC, 12th Five-Year Plan for the Electricity Industry, 2011-2015 (adopted March 2012). Percentages as given in source, which used slightly different 2010 thermopower data.

N.B. The storage capacity of most hydropower stations is much less than annual river flow and their electricity generation varies with the season. With fewer operating hours than thermo-power stations, their share in power generation was 14% to 15%, against a capacity share of 20%.

Table 2.
Renewable electricity purchased by China's power nets in 2010

Actual receipts (bln yuan)

		Payments	Subsidies
Hydropower	401 TWh	96.5	0.08
Wind power	42 TWh	12.9	5.3
Biofuel	11 TWh	3.6	2.1
Solar power	0.07TWh	0.02	0.06
TOTAL	454TWh	113.0	7.6

Source: State Electricity Regulatory Commission

Notes

1 China Electricity Company Association, 电力工业 "十二五" 规划滚动研究报告, 9 March 2012.

2 State Electricity Regulatory Commission, 十一五" 期间投产电力工程项目造价监管情况通报, 2012.

3 Vermeer, E.B. 2011. "The benefits and costs of China's hydropower: development or slowdown?" *China Information* 25:1, pp.3-32.

4 Chinese Academy for Environmental Planning. 2010. *China Green National Accounting Study Report* 2009. Beijing.