

ASIAN AMPERES: CHINESE ELECTRIC POWER

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Synopsis: The development of the electric power industry in China and of its regulatory milieu follows in many respects the pattern established in the United States and in most of the rest of the world. But while the emergence of competition in lieu of direct regulatory intervention is ideologically in harmony with capitalism in the United States, it may be less consistent with Chinese “market” socialism. In addition, environmental requirements in China to be effective must be merged to the degree possible with economic regulation. It may be easier to impose environmental requirements in a system featuring direct regulatory intervention than in one relying primarily on market competition. In related regulatory areas, there has been heavy emphasis on the need to make prices reflective of costs, but in this respect, theory may make demands that practice cannot fulfill.

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I. INTRODUCTION

I am the co-author of the current edition of *The Nutshell of Energy Law*¹— a condensed text summarizing the key tenets of the law of energy in the United States. In that capacity, I received a request from a law firm in Beijing to

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1. JOSEPH P. TOMAIN & HON. RICHARD D. CUDAHY, *ENERGY LAW IN A NUTSHELL* (THOMSON WEST 2004).

authorize a Chinese Edition of the Nutshell and to write a preface for this new Chinese Edition. I took a stab at the preface and in that connection started to explore recent developments in electric power in China and the prospects for further legal and regulatory arrangements there. Particularly, I wanted to find out how closely China was attempting to pattern its system after the one that was developing in the United States, which, of course, was an important topic covered in our Nutshell. From there, I explored the consistencies and inconsistencies in applying a Western system in China.

II. THE IDEOLOGY OF CHINESE ELECTRIC POWER DEVELOPMENT

A. *Ideological Matches and Mismatches*

China, I thought, would be a particularly interesting subject for this kind of study. China purports to have a socialist economy (rhetorically modified into a “socialist market economy”²); and we all know how capitalist (market) features and practices have come to dominate it in recent years. Growth in China has been driven by private enterprises, owned both domestically and by foreigners, building and operating for profit all manner of manufacturing and other facilities, so that the rate of economic growth has been phenomenal (and the capitalist features highly evident).³ I thought these developments would provide an intriguing background for the approach China proposed to take in building and regulating its electric power industry. Typically and traditionally in capitalist economies electric power providers—whether privately or publicly owned—have been regulated on a basis calling for a great deal of direct governmental intervention. In fact, for this reason, these industries are referred to as “regulated industries.” Thus, electric power has not, at least until recently, been typical of capitalist institutions generally and its management has not exemplified in important ways capitalist principles, and, specifically, has not relied on competition to control price and output. In large part, these tendencies have reflected the view of electricity as a natural monopoly, intrinsically inhospitable to competition.

But recently, these aspects have been sharply modified as competition has been promoted in a way which has made the electric power industry more closely resemble the rest of the capitalist economy. It has been my view that these moves toward deregulation and competition in the electric power industry have been motivated in considerable part by ideological considerations—by the desire to remove governmental fiat from the operation of the electric power industry and to substitute the workings of the market. Ideologically, this makes

2. Michael A. Gheleta, *Sustaining the Giant Dragon: Rational Use and Protection of China's Water Resources in the Twenty-First Century*, 9 COLO. J. INT'L ENVTL. L. & POL'Y 221, 223 n.10 (1998). In 1978, China launched a concerted policy of economic reforms characterized as a “socialist market system” in which most prices have been deregulated and market attitudes and institutions have flourished. How much of Mao's economic thinking, direct or by implication, has survived these developments is unclear. *Id.*

3. From 1985–1997, the private sector's share of China's national industrial output increased from 2% to 34.3%. See Phillipa Webb, *The United Nations Convention Against Corruption: Global Achievement or Missed Opportunity?*, 8 J. INT'L ECON. L. 191, 212 (2005). A 2006 report by the Chinese Academy of Social Sciences predicted that in five years, “at least 70 per cent of the country's firms will be privately owned” and will contribute three-fourths of China's GDP. Zhao Huanxin, *Private Firms Powering the Economy*, CHINA DAILY, Sept. 22, 2006, available at http://www.chinadaily.com.cn/china/2006-09/22/content_694432.htm.

perfect sense in the context of the United States. But how does it suit China, which at least in theory is still a socialist state?

My interest in China focused on how it, coming from a socialist past and with a purportedly socialist perspective, would react to developments in electric power that seemed to be moving the United States and the world electric economy away from what might be seen as similar to a socialist approach toward something closer to the principles of capitalism. Significantly, the United States in electric power had been moving since the 1980s and 1990s from systems where price was governed by government regulation to methodologies where competition controlled. I found that, despite its different ideology and history, China may be moving along the same path. Of course, reliance on competition is not the only dimension along which the ideological tendency of the electric power industry in the United States or in China can be measured. There are other indicators, which we will explore, of where electric power lies on the Chinese ideological spectrum.

One of these significant indicators was the posture of electric power in China as entirely state-owned after the nationalization of the industry in 1953 under the First Five-Year Plan. Later, power shortages beginning in the Eighties led to efforts to attract local and provincial governments, as well as domestic and foreign private companies, to build and own generation facilities. But the idea that these developments rendered a large part of the industry “independent” may be misleading because generators remained closely linked to government (e.g., are owned by sub-central governments).⁴ In 1997, most of the electric plant, including nearly all of the grid and about 40% of the generators, was transferred to the newly created State Power Corporation (SP).⁵ In 2002, 90% of the system’s transmission capacity was re-distributed to the State Grid Corporation of China (SG) and to the China Southern Power Grid Company Limited (CSG), the latter covering five southern provinces of China.⁶ In the same year, the 46% of generating capacity owned by SP was reallocated to five regional generating companies. Each of these generating companies had about twenty gigawatts of capacity.⁷ These restructurings removed the central government as sole owner of the system and amounted to steps in separating it from market and regulatory activities, at least on paper. These steps could be interpreted ideologically as restructuring the electric power system in a direction away from socialism as described in theory and as practiced in the Soviet Union.

Thus, in the early days, China’s electric power system was under the direct ownership and control of the central government, which owned all the assets. This is what I have characterized as a pure socialist context. But more investment was needed, from different sources, directed at first simply to more generating capacity and later to specific issues: cleaner generation, together with transmission, distribution, and energy-efficiency functions on both the supply and the demand sides. In 1985, China liberalized investment by encouraging

4. INTERNATIONAL ENERGY AGENCY, CHINA’S POWER SECTOR REFORMS: WHERE TO NEXT? 33 (2006), <http://www.iea.org/textbase/nppdf/free/2006/chinapower.pdf> [hereinafter IEA, CHINA’S POWER SECTOR REFORMS].

5. *Id.*

6. *Id.* at 34.

7. *Id.*

“local government and companies to invest in new generation capacity, thereby gaining the right to control and benefit financially from this new capacity.”⁸ With these moves and others that followed, non-socialist influences entered the picture.

The 1990s were marked, among other things, by three trends: “the progressive involvement of a wider range of enterprises in [electric] power generation; the creation of power financing companies such as Huaneng and China Power International; and the increasing use of domestic and foreign stock markets.”⁹ These developments did not, of course, spring from the socialist roots but represented recourse to capitalism and its culture.

B. Foreign Investment

However, the five large generating companies that were carved out of the State Power Corporation are not, for the most part, state owned. In 1985 China had broadened the sources of investment by encouraging local governments and various companies—domestic and foreign—to invest in new generating capacity, and to thereby gain control of this new capacity. There was a surge of investment, so that local sources soared from 14% of the total in 1987 to 40% in 1991–1995 but declined after 1995.¹⁰ In the early days of change, the source of electric power financing gradually switched from the central government to state-owned development banks and, later to domestic commercial banks. Foreign investment also became a bigger part of the picture. In the 1990s, as demand projections rose, the government set the remarkable target of 50% of projected needs for foreign direct investment in power plant construction.¹¹ This was a long stretch from socialism.

However, some of the problems of foreign investment were addressed by the build-operate-transfer policy, under which a foreign concession holder acquired a right to build a plant and run it for a specified number of years while collecting power revenue under contract. When the concession expired, the plant ownership reverted to the state.¹² This was a touch of socialism, but not unlike the New Economic Policy in the Soviet Union in the 1920s.¹³ The first of these concessions was awarded to Electricite de France (EDF).

C. Unbundling of the Grid

Current Chinese electric power policy is contained in its presently operative eleventh Five-Year Plan, which outlines formidable strategic objectives including a Chapter 34, as follows: “Advance electricity price reform, gradually set up a system with competitive markets for generation and retail power, while government sets prices for transmission and distribution.”¹⁴

8. *Id.* at 36.

9. *Id.* at 36–37.

10. *Id.* at 36.

11. *Id.* at 37.

12. *Id.*

13. For a discussion of foreign investment under the Soviet Union’s 1921 New Economic Policy, see Adam J. Albin, Comment, *Joint Venture Law in the Soviet Union: The 1920s and the 1980s*, 9 NW. J. INT’L L. & BUS. 633, 634–39 (1989).

14. IEA, CHINA’S POWER SECTOR REFORMS, *supra* note 4, at 12.

The phrase “competitive markets” in the above quotation constitutes an anomaly in what might otherwise be a perfectly orthodox statement in a model Five Year Plan—the very trademark of socialism. However, price reform based on competitive markets is not the only, or the first, deviation from orthodox socialist procedure. Perhaps a less obvious, if indecisive, move away from the socialist model has been the disaggregation of the grid from generation. This has already been described in the process of establishing two grid companies and five major generators. This “unbundling” process is not complete but it is a partial step in the direction of competitive markets and in that sense a move away from an orthodox socialist scheme. An unintended effect of unbundling has been to further exacerbate the problems of planning by aggravating the lack of cooperation between generators and grid companies.¹⁵

Another move away from undifferentiated government control, a la socialism, was the establishment of the State Electricity Regulatory Commission (SERC) in 2002.¹⁶ The intent here is to have an independent regulatory body patterned after similar federal and state institutions in the United States and like bodies in other countries. The creation of the SERC and the disaggregation of the grid from generation, although their intent is not definitive, seem to be steps in the long-term direction of a competitive market. A major role is foreseen for the SERC at the time of its creation, which has not yet been achieved.¹⁷ An obvious function is that of price controller and, ultimately, to establish rules and methods for creating competitive markets. Currently, the price-setting role is still filled by the National Development and Reform Commission (NDRC).¹⁸ According to critics, what is needed is cost-reflective pricing across the whole value chain—that is separate pricing for transmission, for generation and for end-users.¹⁹ Although experiments in fully competitive markets are taking place in China, no one seems to be strongly advocating their broad implementation at this time.

There are a number of other reforms that are being urged on China in the direction of creating a market-based system, but one that fully recognizes environmental factors. All of these changes seem to mirror measures that have been increasingly adopted in the West. Thus, fundamental to reform, there should be a complete separation of generation interests from the owners of the grid.²⁰ This should be accompanied by an unbundling of generation accounts from other state accounts and a termination of all government subsidies to the system.²¹ Separate pricing for the grid reflecting costs should be instituted.²² Cost-based pricing and the elimination of government subsidies may create a need for a lifeline support mechanism aimed at the poorer parts of the population.²³ Such a mechanism would, of course, be more in the socialist

15. NOUREDDINE BERRAH ET AL., SUSTAINABLE ENERGY IN CHINA: THE CLOSING WINDOW OF OPPORTUNITY 116-17 (The World Bank 2007).

16. IEA, CHINA'S POWER SECTOR REFORMS, *supra* note 4, at 13-14.

17. *Id.* at 18; BERRAH, *supra* note 15, at 128.

18. IEA, CHINA'S POWER SECTOR REFORMS, *supra* note 4, at 51.

19. *Id.* at 20-21.

20. *Id.* at 24.

21. *Id.* at 31.

22. *Id.* at 29.

23. *Id.* at 29-30.

tradition than the capitalist, and its adoption would contradict the thesis that modern approaches to the operation of the electric power system reflect capitalist influences. However, a lifeline approach would simply be a more finely targeted form of subsidy and would, of course, be internal to the electric power system. It would thus have a zero impact on the overall ideological slant of the system.

D. A Mixed System

So, although progress is being made, much of electric power remains trapped in a governance system that consists of an uneasy mix of socialist style planning and more market-based regulation. Hesitancy about relying more heavily on price in a competitive market presents an obstacle to the movement away from socialism. Structural unbundling—the separation of generators from the grid—is progressing but is not complete. And another major area of concern, involving issues alien to socialism, concerns arrangements to redress anti-competitive conduct. This regulatory role is properly assigned to the SERC, at least until some more specialized agency dealing with competition and antitrust is developed. All these approaches, including antitrust, are unique to capitalism and departures from socialism as generally understood.

China has suffered periodic shortages of electric power supply during its three decades of modernization. Bottlenecks, caused in part by limited transmission capacity between regional grids, contribute to supply shortages and threaten reliability.²⁴ Weak interconnections between regional grids can reduce the stable limit of bulk power transmission. Interconnections have grown since 2000, and today five of the six main grids are interconnected.²⁵ But there is room for improvement. Additional construction must be undertaken to develop a strong, interconnected grid.

The most recent electric power shortages began in 2002 as the rate of growth of electric demand rose to 11%. Demand rose by an astounding factor of 15 to 16% in each of the succeeding years, 2003 and 2004.²⁶ Shortages were ascribed to inadequate construction of generation and transmission capacity to meet the escalating demand of a too-energy-intensive economic boom.²⁷ What was called for, in addition to increased capacity, was a program to moderate demand and to conserve energy—to reduce energy intensity. Thinking in China, stimulated by supply shortages and environmental crises, moved to the damping of demand and the promotion of energy efficiency as means to balance supply and demand.²⁸ Chinese authorities were convinced that the decline in energy intensity, which had characterized earlier periods of growth, must be restored as a dominant trend if the proper balance of supply and demand was to be re-established.

Of course, these efforts to align supply with demand are not unique to a socialist or to a capitalist approach, but the means used may be somewhat indicative of that direction. At least in the early days of the electric utility industry in the United States, as developed by pioneers like Insull, the marketing

24. *Id.* at 42.

25. *Id.* at 41.

26. *Id.* at 58.

27. *Id.*

28. *Id.* at 58–59.

of power was dominated by price, which affected its availability for various uses.²⁹ A striking example of this phenomenon was in the use of electricity for home heating. Drastic reductions in price were required to make this use economic. Price, however, seems not strongly relevant to an energy-intensive boom, such as we have described in China. But rather than simply build capacity to increase production and swell volume in order to eliminate shortages, it would have been possible to manipulate demand to bring about the same sort of balance. Depending on circumstances and the means employed, those tactics might be more consonant with a capitalist than a socialist tradition.

E. Demand Management

Another aspect of demand-management to promote efficiency involves the management of load shapes. Time-of-use pricing is an example of this approach, attempting by price incentives to shave the peaks and fill in the valleys of demand. It might be helpful in the use of this technique for China to join the International Energy Agency (IEA)'s Demand Side Management Implementing Agreement (IA). Current members of this group actively encourage China's participation, both to share IEA country experiences with China and to develop a procedure for sharing experiences between China and other countries.³⁰

Of course, efforts to achieve energy efficiency take many forms. However, the essential thrusts should focus on reducing load over the longer term. China has a long history of policies and programs to promote energy efficiency from direct support for investments to consumer education. Proposed changes still lack a broad and sustained commitment to energy efficiency through demand-side management and demand participation (i.e., responsiveness of customers through operation of a price mechanism).³¹ Consumer participation would seem to reflect a capitalist more than a socialist tendency.

III. ENVIRONMENTAL PROTECTION, POTENTIALLY LINKED TO ECONOMIC REGULATION

A. Market Competition and the Environment

There are other developments of the Chinese electric energy economy which may not have repercussions of any special kind for its socialist past or for its apparently capitalist future. One of the most crucial of these involved measures to protect the environment against pollutants like sulfur dioxide (SO₂), acid rain, particulates, nitrogen oxides (NO_x), and carbon dioxide (CO₂). The heavy dependency of electrical generation in China on coal as a fuel, particularly with climate change as a looming issue, makes environmental issues of rising importance. Also of importance from an environmental point of view is the question of thermal efficiency. Every 1% improvement in overall efficiency results in coal savings of eight million tons per year, offsetting the need for three

29. See Hon. Richard D. Cudahy & William D. Henderson, *From Insull to Enron: Corporate (Re)Regulation After the Rise and Fall of Two Energy Icons*, 26 ENERGY L.J. 35 (2005).

30. IEA, CHINA'S POWER SECTOR REFORMS, *supra* note 4, at 118.

31. *Id.* at 112.

gigawatts of new capacity, and abating about four million tons of carbon emissions.³²

This article will now explore the ramifications for environmental protection of the tentative approach to market competition by the electric power industry.

Before market competition began to be substituted for regulatory intervention in the United States and preliminarily in China, there was no difficulty in simply undertaking whatever additional interventions had to be made for environmental reasons. However, as market competition potentially supplanted regulatory intervention, it sometimes became more difficult—notably in pricing—to integrate the economic and the environmental aspects of control.

An important aspect of pollution control plans urged on China by international advisors and monitors was the merging of economic and environmental regulation so that, for example, the SERC, the economic regulator, could include environmental considerations in such matters as pricing.³³

In this respect, the Hong Kong government recently agreed to have two electric power companies raise or lower their allowed rate of return depending on whether they exceeded or missed certain pollution targets. The companies could also charge slightly more by using more renewable energy. These flexible standards, integrating economic limits with environmental, won critics' praise with the hope mainland regulators would emulate them. Mainland regulation has focused only on inflexibly forcing tariffs lower, leaving no choice for fuel beyond cheap, but polluting coal.³⁴

The integration of environmental objectives with economic regulation includes attention to certain activities and measures, such as establishing fees or emissions standards to help effect the dispatch of cleaner plants, incorporating environmental costs and benefits in power pricing and performing a review of investment planning methodologies and licensing rules to encourage less polluting investments.³⁵ China is to review its institutional structures to ensure that they are capable of promoting policies that ensure consideration of environmental goals as competition develops. Here one must emphasize the risk of losing the thrust of intrusive environmental regulation when market competition is substituted for direct economic regulation. For it is sometimes easier to integrate environmental controls with comparable direct economic regulation than with a system of market competition, which does not include intrusive rules imposed from the outside. This problem becomes more evident in designing a regulatory scheme for a developing electric power system, like the Chinese, than for a developed system like that of the United States. But before exploring the reasons why efficiency-focused competition may deal inadequately with pollution, we will examine the specific problems of a coal-based system.

32. *Id.* at 61.

33. *Id.* at 92.

34. See Keith Bradsher, *Hong Kong Power Regulations Based in Part on Emissions*, INT'L HERALD TRIB., Jan. 8, 2008, available at <http://www.iht.com/articles/2008/01/08/business/08power.php>.

35. IEA, CHINA'S POWER SECTOR REFORMS, *supra* note 4, at 92.

B. Dominance of Coal

Regardless of origin, all forecasts, scenarios, and plans concerning electric power generation in China point to decades more of the dominance of coal. A major strategy study completed in 2004 is typical, finding that under various assumptions, “coal may account for between 59% and 70% of generation capacity in 2020.”³⁶ For this reason, electric power generation will remain the heaviest emitter of the most significant airborne pollutants in China. Some of these are sulphur dioxide, where power plants account for 44% of the national total and particulates, where electricity is responsible for about 19% of the total.³⁷ Hence, efforts to deal with emissions in the electric power sector loom large in the environmental big picture. Policies aimed at coal-based emissions include: renovation of existing coal-fired power plants; broader support for more efficient and cleaner coal-fired power plants; expanded government support for gas-fired plants; heavier support for generation based on renewables; policies to promote combined heat and power; and more government attention to nuclear power and hydropower.³⁸ One of the most significant factors in the reduction of coal-based pollution is, of course, slower growth in the use of coal and a relative decline in coal-based generating capacity. There is considerable room for these reductions in China springing both from conservation of energy and from replacement of coal by other fuels.

Improvements in the environmental performance of power plants arise from three main sources: changes in fuel; improvements in efficiency; and emissions controls that either reduce the amount of pollutant precursors in the fuel (e.g., washing of coal) or take pollutants out of the waste stream (e.g., flue gas desulphurization (FGD) or “scrubbers”). These latter two technologies meet the definition of clean coal technologies, which comprise a range of techniques that contribute to reduced emissions.³⁹

Switching away from coal is, of course, highly problematic in a country where coal is both plentiful and relatively inexpensive. All alternatives to coal present difficulties that prevent their rapid adoption on a scale that would significantly displace coal.⁴⁰ Natural gas, for example, may make the largest gains in fuel share in the future, largely due to environmental concerns.⁴¹ If the government gives priority to the natural gas sector, natural gas could enhance China’s energy security and improve air quality in many major cities.⁴² But natural-gas prices are high and policies favor use of this premium fuel for high-value employment in homes, businesses, and industry.⁴³ International pipeline gas from Russia or its borderlands is years away pending construction of the

36. *Id.* at 86.

37. *Id.* at 87.

38. *Id.*

39. *Id.* at 88.

40. *Id.*

41. *China’s Energy Needs and Strategies, Hearing Before the U.S.-China Economic and Security Review Commission*, 108th Cong. 16–17 (2003) (statement of Guy Caruso, Administrator, Energy Information Administration) [hereinafter *China’s Energy Needs*].

42. *Id.* at 34–35 (statement of Amy Myers Jaffe, Wallace Wilson Fellow for Energy Studies, James A. Baker III Institute for Public Policy, Rice University).

43. IEA, CHINA’S POWER SECTOR REFORMS, *supra* note 4, at 89.

lines. Imported pipeline gas from Russia or Central Asia awaits, among other things, a route determination for delivery to competing consumers in Northeast Asia—China, Japan, and South Korea.⁴⁴

C. Nuclear, Hydro, and More About Coal

On the other hand, supporters of natural-gas-fired electric power generation have been calling for preferential policies for natural gas for this use, as have supporters of non-hydro renewables for similar preferences. Oil is, like gas, relatively expensive and is particularly valued for transportation and petrochemical uses. Nuclear power is expensive and involves very long construction times but it promises to be an increasing source of energy in China in the twenty-first century. Nuclear power has the potential to address two significant energy-related problems in China: air pollution and energy shortages.⁴⁵ China's first nuclear power plant became operational in 1991.⁴⁶ Fifteen years later China had nine operational nuclear power plants that had a total capacity of 7,010 megawatts and provided 48.3 gigawatt-hours of power.⁴⁷ China has announced plans to spend \$50 billion constructing thirty-three nuclear plants by 2020. To keep things in perspective, however, nuclear can provide only 4% of China's electricity.⁴⁸

Hydropower is also long in construction, capital-intensive, and beset with environmental and social issues, but the Three Gorges Dam Project and other hydro efforts have been impressive. Wind power is on the move but will continue to face environmental and other objections and is sporadic in its operation. Other generation options can help to reduce the emissions burden but it is inescapable that major improvements are also needed in coal technologies.⁴⁹

The efficiency of coal plants in China has improved steadily but is still not impressive in international comparisons. Net generating efficiency has improved from 30% to nearly 33% in the last ten years.⁵⁰ By comparison, a typical average worldwide is about 37%, suggesting that China is about a decade behind.⁵¹ As has been suggested, at current rates, every 1% of improvement in power generation efficiency results in the avoidance of about thirty-seven million tons of CO₂ emissions per year.⁵² Much of the recent improvement comes from the addition of relatively large generating units—300 megawatts or

44. China has already been competing with Japan and South Korea over access to Russian oil supplies. See Associated Press, *Russia to Push Ahead with Pipeline Despite Environmental Concerns*, Feb. 26, 2007 (noting that a proposed trans-Siberian oil pipeline is "a bone of contention between Japan and China as they jostle for priority over access to Russia's vast oil reserves."). Competition between China, Japan and South Korea over Russia's gas reserves seems likely to increase over the next few years. See *China's Energy Needs*, *supra* note 41, at 57 (statement of Dean P. Girdis, Director, PFC Energy).

45. ROBERT E. EBEL, *CHINA'S ENERGY FUTURE: THE MIDDLE KINGDOM SEEKS ITS PLACE IN THE SUN* 66 (The CSIS Press 2005).

46. *Id.*

47. *Id.*

48. *Id.* at 4. See also Robert W. Gee et al., *China's Power Sector: Global Economic and Environmental Implications*, 28 ENERGY L.J. 421, 428 (2007).

49. IEA, *CHINA'S POWER SECTOR REFORMS*, *supra* note 4, at 89.

50. *Id.*

51. *Id.*

52. *Id.*

higher.⁵³ The government periodically bans smaller, less efficient generators but they are still being installed at a substantial clip—especially diesel generators.⁵⁴

Pulverized coal-fired plants, sub-critical and supercritical, will comprise the bulk of additions for some time. Accordingly, there is acute need for improved emissions controls, particularly of particulates and sulfur-dioxide. Control of particulates is not difficult or expensive and is practiced widely in China. But control of sulfur dioxide is another matter and requires the installation of “scrubbers,” which is expensive, uses a great deal of electric power, otherwise available for sale, and produces an additional stream of solid waste. “For more than ten years, China has been subjecting a larger number of [electric] power plant projects to [a] requirement to install” scrubbers, or at least requiring a design for plants that can be easily retrofitted for them.⁵⁵ However, this demand has met with limited response, and only a few dozen Chinese plants are so equipped.⁵⁶ The hope is that in the future, all coal-based plants, including integrated gasification and combined-cycle (IGCC) generation plants and other facilities that produce an array of coal-based energy and chemical products, will be subject to requirements for carbon sequestration technologies to control carbon dioxide emissions.⁵⁷ The experience with scrubbers should be instructive when the time comes for sequestration. It will be a challenge for China, even more than for the rest of the world to make the environmental changes required for tomorrow.

Scenarios for less pollution are not to be developed through rapid deployment of exotic new power plants. Instead, what is needed is additional emphasis on demand-side policies, together with well-known technologies that in many instances are significantly superior to China’s typical new plants. Of course, China has been deeply engaged in the general effort to develop and apply clean coal technology.⁵⁸ China needs to move expeditiously to adopt proven technologies that have been successfully demonstrated in other countries. But, to accomplish this, China will have to expedite the growth of an appropriate regulatory environment together with incentives, which comprise the means to strengthen environmental protection. This requires the thorough integration of environmental issues with the rest of electricity policy and regulation.⁵⁹ As has been pointed out earlier, integration becomes more difficult as economics escapes the dictates of regulation and is consigned to market competition.

Does this mean that IGCC has a promising future in China? There is no doubt that this technology can bring dramatic efficiency gains and pollution improvements. However, this technique has encountered head winds in other countries—even in developed countries—because of costs, technical problems, and possible risks. The effort for less polluting coal technologies, as well as alternative generation sources, is an element of the supply side push. This effort includes the integration of environmental objectives into economic regulation together with institutional structures that bring environmental and economic

53. *Id.*

54. *Id.*

55. *Id.*

56. *Id.*

57. *Id.* at 90.

58. *Id.*

59. *Id.*

needs together.⁶⁰ All this also demands the strengthening of the enforcement powers of the State Environmental Protection Administration (SEPA)—the guardian of the environmental regulations. In line with efforts toward transparency, improvement of environmental quality benefits from public awareness and participation. For this reason, the SEPA has become concerned with public disclosure. The time may be ripe for formalized means of involving citizens via public hearings, advisory committees, information meetings, and reviews of environmental impact assessments and other documents.⁶¹

D. Price and the Environment

The present efforts to introduce competition raise questions of the impact of this change on environmental protection. Indeed, the relationships here are crucial. Unless there are strong incentives to adopt options friendlier to the environment, the effect of a framework that exclusively involves competition may frustrate environmental protection.⁶² This is the essence of why competitive markets, which reward only efficiency, are hard to combine with environmental goals. If there is to be cleaner electric power, competition must be impacted by an adjustment of the regulatory framework.

Incorporating environmental costs and benefits in the price of electric power in a competitive milieu may distort investment decisions and plant dispatch. Thus, plants with higher operating costs because they incorporate pollution costs will in a competitive order be built and run less than plants where these costs are not internalized. For example, plants with scrubbers will be run less on a competitive basis and plants without scrubbers will be run more. Natural-gas-fueled plants have higher operating cost than coal plants and hence will be run less. These conclusions are consistent with the principles of competitive cost-efficiency. Environmental considerations must be recognized with care. Uniform generation performance or a pollution fee would put the responsibility on the market to seek the most efficient mix of pollution control options.⁶³ Similarly, investment decisions and licensing requirements need to reflect environmental costs and benefits. And new competitive markets should seek to incorporate emissions tracking systems.⁶⁴

These environmentally friendly policies, of course, require a favorable institutional framework. Especially because environmental principles do not bond easily with competition. The NDRC and particularly the SERC, as the seat of Chinese economic regulation, must be closely linked with the work of the environmental agencies. The SERC should have the task of integrating environmental objectives into the economic regulatory framework, and the SERC should have a close working relationship with the SEPA.⁶⁵ These two agencies should have joint staff meetings and staff exchanges. The SEPA could also have the key task of evaluating proposals—such as those involving market competition—for electric power to determine their compatibility with

60. *Id.*

61. *Id.*

62. *Id.* at 91.

63. *Id.*

64. *Id.*

65. *Id.* at 92.

environmental protection. The advancement of energy efficiency through demand-side policies and other policies is also an important part of the environmental picture.⁶⁶ The less power required to be generated, the less disruptive the environmental impacts. Accurate and cost-based pricing is fundamental.

IV. THE THEORY AND PRACTICE OF PRICING AND OTHER REGULATORY ELEMENTS

A. *Pricing and Related Concerns*

Other regulatory trends of broad application have also been advancing in China. Of these, the importance of efficient and cost-reflective pricing for the future of the Chinese electric power industry cannot be over-emphasized. This development is necessary, first of all, for adequate output control. China, like other developing systems is plagued by power shortages and surpluses.⁶⁷ Price helps to provide signals to trigger efficient investment and to curb consumption. Together with other incentives for demand management and more accurate investment planning, a more efficient pricing framework is key. In addition, cost-based pricing can reduce or eliminate the opportunity cost to society of subsidized power and inefficient investment. Since electric power investment in China is largely from the public sector, excessive expenditures in power may uneconomically preempt funds from other essential investment—such as that in health and education. An important goal for Chinese electric power should be to place it on a self-sustaining basis. China's electricity sector still relies heavily on public funds and it would be remarkable if an infrastructure industry in an economy purporting to be socialist was not heavily subsidized.⁶⁸ Cost-reflective pricing may have the additional benefit of encouraging electric customers to consider ways to reduce their electric consumption.⁶⁹

So far progress in China in pricing has been most successful in encouraging investment in additional output but less so in promoting investment related to demand management as well as that related to efficient operation by generators. Incentives to lower costs and increase productivity have been neglected, as well as incentives for end-use energy efficiency.⁷⁰

Current practice does not encourage investment in end-use energy efficiency as an alternative to supply-side investments. A main goal of generators, which are largely publicly owned (by sub-central governments), is to build market share and make profits.⁷¹ Some generators can make super-normal profits in the present framework, resulting in the misallocation of resources. Since there is no effective pass-through of generator costs to end users, generators are increasingly squeezed by rising coal prices. The regulation of end-user prices is used to meet social and economic objectives rather than to promote efficiency in the electric power sector itself. Grid pricing does not exist

66. *Id.*

67. *Id.* at 93.

68. *Id.* at 13, 30.

69. *Id.*

70. *Id.* at 93–94.

71. *Id.* at 94.

apart from combined grid and wholesale power tariffs. Power tariffs are complex and the central government retains tight control of power prices.⁷²

The State Council's 2003 policy document Scheme for Power Price Reform rejected further moves toward regional competitive power markets. But a follow-up document in 2005 set out plans in more detail. Several of its elements are praiseworthy, notably the proposals to establish separate grid tariffs and arrange generator tariffs in two parts: a capacity component to encourage investment in new plants and an energy charge, set by competition.⁷³ But only modest changes in end-user prices are suggested.⁷⁴ It is proposed that residential users continue to be subsidized by other customers, and therefore generator costs cannot reliably be passed through to these users. Potentially at least, this weakens the incentive to build transmission and generation.⁷⁵

B. Political Factors

Institutionally, the proposed arrangements call for the government to remain in charge through the NDRC pricing department (suggesting political control) rather than control through a professional regulator like the SERC. This indicates the dominance of political considerations rather than factors favoring the competitive market.⁷⁶ This, however, is not surprising considering that China is a socialist state with the strong government control of the economy that that implies. It is of interest that there is such strong emphasis in critiques of China on the need to base prices on costs. This suggests the persistence for some time to come of a regulated electric power economy as distinguished from a competitive one. In a workably competitive economy, prices would be closely related to costs, not as a matter of calculation, but as a result of competition. But the critiques of China and the prescriptions for it seem to contemplate, at least in the short run, calculation and therefore regulation.

There have been substantial delays in implementing a transition to cost-reflective pricing—three years since an intention to achieve this goal was first announced. This kind of delay suggests political problems in accomplishing this transition—not surprising in view of China's socialist background with its preference for the achievement of political goals.⁷⁷ There are three main issue areas where adjustments are most urgently needed for the Chinese electric power system to improve efficiency short of a competitive approach. These are: more transparency in pricing; more accurate cost-reflective pricing applied across the whole value chain with separate pricing for each service component; pricing with incentives for demand-side investment, end-use energy efficiency, and preference for the least environmentally damaging options; and grid investment planning in the most efficient way.⁷⁸ Without competition in the near term (although this remains a long-term objective), these arrangements mean regulated pricing, pass-through of costs and incentives for energy efficiency, and

72. *Id.*

73. *Id.*

74. In China, the grid is the single buyer of electricity from generators. End users buy from the grid.

75. IEA, CHINA'S POWER SECTOR REFORMS, *supra* note 4, at 95.

76. *Id.*

77. *Id.*

78. *Id.*

clean investment. Currently, pricing and dispatch arrangements do not reward efficiency.

C. Grid Pricing

China is proposing to put into effect a two-part generation rate with a capacity price (reflecting capital cost) and an energy price (reflecting variable operating cost).⁷⁹ This approach helpfully promotes efficient dispatch based on marginal cost, but capacity pricing in fully competitive markets is controversial. Another project in need of development is separate pricing for the grid, based on a postage stamp approach for user charges and a cost-plus approach for grid revenues. The postage stamp method does not promote economic and energy efficiency and economic investment, but it favors simplicity, which is important.⁸⁰ Another area of evolution has been end-user pricing, which has been greatly simplified and where time-of-use methods have been applied to shift load in response to supply shortages. In more or less the same vein, there has been an increase in interruptible tariffs. Although prices, in general, have been allowed to rise, residential, heavy industrial, and agricultural customers continue to be subsidized. These subsidies are at the expense of the commercial sector, which includes many small and medium-size enterprises.⁸¹

D. Other Pricing Schemes

However, end-user pricing decisions by the NDRC have reflected a variety of considerations without a particular emphasis on cost-reflectiveness. To enhance energy efficiency, China might consider so-called inclining block rates, where unit charges increase with volume of usage. This approach also has the advantage of keeping prices low for low-volume (presumptively poor) users.⁸² Absence of cost-reflectiveness has led to some problems arising from higher coal prices. Inability to pass on these prices has created a price squeeze. Rising coal prices has also been associated with coal supply shortages. Another possible issue is that automatic coal price adjustment mechanisms may make coal-fired generation appear less risky than other options and may distort comparisons with these alternatives.⁸³ Similar proposed automatic adjustments of retail prices for the effect of various generation costs may distort decisions comparing power purchases to investments in energy efficiency. There are significant issues of social discontent to be weighed against price increases based on cost-reflectiveness, which can be ameliorated through “lifeline” support, perhaps subsidized by a “system benefit charge.”⁸⁴

79. *Id.* at 96.

80. *Id.* at 97.

81. *Id.* at 99. The subsidy rate for electricity has been estimated in the range of 30%. INTERNATIONAL ENERGY AGENCY, WORLD ENERGY OUTLOOK: LOOKING AT ENERGY SUBSIDIES: GETTING THE PRICES RIGHT 104 (1999), <http://www.iea.org/textbase/nppdf/free/1990/weo1999.pdf>.

82. *Id.* at 100.

83. *Id.*

84. *Id.* at 101, 103.

V. CONCLUSION

China's electric power and regulatory system is moving gradually to be patterned after that in existence and in prospect in the United States and in most of the rest of the world. The projected shape of things to come in the United States envisions ultimately a competitive market system. This means a system with generators organized as a pool and subjected to a regime of economic dispatch so as to produce the lowest cost electricity on a competitive basis. Such an approach has been promoted in the United States and elsewhere primarily on the assurance that it would result in cheaper power. This promise, however, has not been universally fulfilled and, in my opinion, the fundamental attraction of the competitive market for electricity is ideological. It follows the same pattern as the rest of the capitalist economy, where competition purports to drive costs down to a marginal level. Competition has broad emotional appeal in any capitalist society, and monopoly is correspondingly abhorred. In theory so far in the United States, competition may replace government regulation as a control mechanism in the electric power economy and thereby make electric power of a piece with the rest of the economy. Thus far, however, China has not, except as an experimental model in a few regions, adopted the competitive market model, and this remains for China only an aspiration, although a clear one.

There is a contradiction here, however. The Chinese economy, unlike the American, is in theory socialist although in recent years it has adopted capitalist practices wholesale. Nonetheless, it still purports to be in broad concept socialist, and there is an ideological contradiction in its aspiring to adopt market competition in lieu of regulatory intervention for control of its electric power economy. This development will presumably not tend to further ideological uniformity but, perhaps, the opposite. The first part of this article illustrates this tendency in the progress of Chinese electric power.

The article has also examined some developments and tendencies in Chinese electric power in the environmental and other regulatory arenas. This examination does not center on market competition—the presumed ultimate goal of the Chinese system—but on various regulatory aspects preliminary to market competition. In some respects, environmental values are harder to impose on a competitive system, where efficiency is king, than on an economically regulated one. We may speculate that whether China goes on to a universal system of market competition will depend on the success or failure of competition pragmatically as it is adopted elsewhere. Presumably, China will not adopt market competition merely for reasons of ideological symmetry—as may have been the case from time to time in the United States—but for the reason that it works, or does not, as the case may be.