

OPTIONS FOR THE INSTITUTIONAL REFORM OF CHINA'S ELECTRIC POWER INDUSTRY

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The China Sustainable Energy Program



The Regulatory Assistance Project

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I. INTRODUCTION

China is in the midst of a significant restructuring of its electric power sector. As its economy grows, its reliance on electricity also grows. China now faces the many challenges of expanding its electric system to meet the needs of its rapidly expanding and high technology economy: improving reliability, increasing efficiency, and protecting the environment. The policy choices that China makes, and the ways in which it implements those policies, will determine how sustainable the reforms are.

Over the past year and a half, a number of Chinese research institutions, in conjunction with their counterparts in government and industry, have been engaged in a wide-ranging study of the Chinese electric sector – its capabilities, its needs, its future – for the purpose of developing a comprehensive set of recommendations for restructuring it to better meet the demands of the changing economy. The results of this study will shortly be published as a “White Paper” analyzing a variety of interrelated topics – law and regulatory reform, environmental protection, renewable energy, taxes and fees, investment, end-use energy efficiency, and tariffs – and it will be made available to policymakers as they consider actions to be taken.

This paper is, in part, a synthesis of the White Paper, but it also takes into account experience with restructuring in other parts of the world, and lessons from those experiences. The aim is to present a summary of the most important considerations in restructuring and to offer some guidance to China's top policymakers as they consider how best to reform their country's electric sector.

II. BACKGROUND

China is the world's second largest consumer of energy, after the United States. Coal dominates China's energy mix, accounting for over 70 percent of all energy use. Of overall energy consumption in the world, coal consumption in China accounts for approximately 27.9% of the total, petroleum for 5.6%, natural gas for 0.01%, and hydro power for 6.4%. Of China's total energy consumption, the electric generating sector accounts for about 30%. In 1998, total installed generation capacity was 277 GW, of which 75.6% was thermal power generation, 23.5% hydro-electric, and less than one percent nuclear and other resources such as renewables. By the end of 2000, installed capacity totalled approximately 315 GW (again, second in the world to the United States), with the increase coming primarily in the form of coal-fired thermal units.

Although coal is the main fuel source in China's energy structure, coal used for electricity generation only accounts for about 33% of the coal consumption, a ratio which is much lower than the roughly 80% found in more developed countries. Most coal in China is consumed in commercial and industrial boilers and in residences (for cooking and heating). The net thermal efficiency of coal use in the country is quite low. China has become more efficient in its use of coal, but large opportunities for much greater efficiency remain underdeveloped.

With economic development and technological improvement, China's energy consumption per RMB 10,000 of GDP has steadily decreased from 5.58 tons of coal equivalent (or 3,465 kWh) in 1990 to 1.71 tons (1,426 kWh) in 1999. However, there is still room for much improvement: China's energy output efficiency of 69 MJ/US\$ is nearly six times greater than the average of 11.7 MJ/US\$ of the seven most highly developed economies in the world. In the electric generation sector, improvements in efficiency have been made, in part by retiring older plants and in part by new capital investment. As a consequence, the consumption of coal-burning power plants in China has decreased from 431g/kWh in 1985 to 404g/kWh in 1998. However, this is still 60-70g/kWh higher than in more economically advanced countries.

Recognizing the need to improve economic efficiency and reduce environmental damage, China began to implement institutional reforms in the power sector. These reforms introduced independent power producers and the separation of governmental and business functions of the Ministry of Electric Power. There were two significant reforms in the 1980s and 90s. To combat a shortage in supply in the 1980's, the government opened the market in 1987 to independent power producers, operating under long-term contracts. This, along with other

efforts, proved to be successful, so that by the mid-90s, the power shortage was largely resolved.

As supply and demand came into balance, Chinese policymakers considered new reforms to improve the efficiency of the electric sector. On April 1, 1996, the current Electricity Law which separates of the governmental and business functions of the Ministry of Electric Power went into effect. In 1997, the former Ministry of Electric Power was abolished and, in its place, the State Power Corporation was created. The aim was to separate utility business management from government oversight and to establish independent utility entities. The former Ministry's governmental, or regulatory, responsibilities were allocated to the State Development and Planning Commission (SDPC) and State Economic and Trade Commission (SETC).

Further reforms are being contemplated. The separation of generation from transmission and distribution, the creation of wholesale power markets, and the promotion of interregional electric trade are key features of policies under consideration today. Pilot wholesale markets are currently operating in two provinces, Shanghai and Zhejiang. Competitive suppliers are being encouraged to enter the markets as demand for electricity is expected to continue growing at significant rates during the next decade. A comprehensive and integrated set of policies and reforms is needed if China is to meet its energy needs sustainably in the years to come.

III. KEY ISSUES IN ELECTRIC INDUSTRY RESTRUCTURING

Restructuring an entire sector of the economy, especially one upon which all other sectors so critically depend, is a formidable task. Countries on every continent have initiated electric sector reforms during the past decade. Some, such as England, Norway, Argentina, New Zealand, Australia, and parts of the United States have created competitive markets at wholesale and, in certain cases, at retail. Others, such as Egypt and India, have begun the process of privatizing their state-owned electric companies and creating regulatory institutions to supervise the industry in ways that serve the country's broad public policy goals. Each approach is unique in certain ways, tailored to each country's particular history and circumstances, but common among them are the drive to improve efficiency, encourage innovation, develop independent regulatory and market institutions, and promote environmental protection.

The National Perspective

Discussions of reforming the electric industry are often narrowly focused on the industry itself, ignoring other, broader issues that are in fact greatly affected by the industry. Failure to address restructuring in a fashion that integrates relevant national considerations into the process will lead to a set of objectives and policies that could do more harm than good. For national and provincial policy makers, two facts about electricity explain the important connection between the electric industry and the greater Chinese society and economy. First, electricity is an input to a productive economy, not an output. Second, the environmental impact of the industry is very large in absolute terms and also very large in relation to the industry's contribution to the economy (typically 2-4% of GDP).

Electricity is an Input

The Chinese economy uses electricity and other inputs to produce goods and services to meet the demand of domestic and international consumers. Using more electricity than necessary to produce a given amount of goods and services is just as wasteful and uneconomic

as using too much steel to build a car, too much cement to build a dam, or too much fabric to make a shirt. The economy is improved if China expands its production and sales of cellular telephones, but using more electricity than needed to make cellular phones and all of China's other goods and services would be inefficient, wasteful, and polluting.

From a national perspective, the Chinese economy is best served by making more products and improving the standard of living while using fewer inputs. However, when viewed from the much narrower perspective of a coal supplier or an electric company, one reaches a very different conclusion. The coal supplier's first interest is in selling more coal and the electric company's interest is in selling more electricity, neither of which may be consistent with the national interest. The challenge is to create policies that will align the interests of individual (both firms and consumers) with the national interest – which is to say, will make it beneficial for individuals to act in ways that promote the general good.

Providing China's energy services in the least-cost manner should be the guiding principle governing reform of the electricity sector. This energy service perspective recognizes that electricity is an input which, when combined with a light bulb, produces light and, when combined with a motor, produces torque or motor drive. The cost of the energy service is the combination of the price of the kilowatt-hours (kWhs) that provide light, drive a motor, or operate a refrigerator, and the number of kWhs needed to produce the desired light, motor drive, or cooling. This means that how efficiently the motor or refrigerator converts kWhs to mechanical energy or cooling is important. Thus, if the energy service needed is refrigeration, the best outcome is the least-costly mix of investments to make refrigerators more efficient and to provide the electricity to operate the refrigerator.

We have learned that the potential to decrease the cost of energy services through increased investments in energy efficiency is very large. The cost of increasing energy efficiency is far less than the cost of increasing electricity supply. The lesson for restructuring is to be sure that the reforms use competitive forces to lower supply cost and increase investment in energy efficiency.

Large Environmental Impact

The second fact is that there is an inescapable linkage between energy consumption and the environment. Pollution from electric power plants affects the air, lakes and streams, agricultural crops, land, animal habitat, and human health. The environmental impacts of electricity production are large and they are experienced locally, nationally, and globally. For most countries, the environmental harm caused by producing electricity is rivaled only by that of the rapidly growing transportation sector. Electricity production is almost always the single largest stationary source of air pollution in an economy. In the United States the electricity production sector makes up about 2% of the overall economy, yet it causes more than one-third of all air pollution. Electricity production in China already accounts for more than 40% of the nation's acid rain-causing emissions, and the percentage is growing.

While many governments wish to provide abundant low-cost electricity for their citizens and economy, to do so by ignoring its environmental consequences only creates other large costs for society, such as degraded public health and reduced agricultural production. It is far more efficient to take environmental impacts into account at the time an electricity system is planned, expanded, and reformed rather than after the fact when the environmental harm has occurred and large vested financial interests resist change.

IV. CHINA'S GOALS AND CONSTRAINTS

Broadly speaking, restructuring is a response to changes in an economy and in a particular sector of that economy. Technological changes in the production, delivery, and use of electricity over the past several decades, coupled with other economic and institutional reforms generally, have challenged older methods of managing the industry and providing service. New means of increasing efficiency, reducing the environmental impacts of production, and improving reliability and service quality have emerged, but capturing their benefits requires the implementation of a wide range of interrelated reforms. Identifying the objectives of reform and understanding the factors that may constrain the reform effort are critical to its success.

Lessons learned from experience in the US and other countries demonstrate that there are a handful of policy options that can assure that China expands and reforms the electric sector and the economy it fuels in a sustainable fashion. International experience also demonstrates that there is no single right or wrong way to restructure the sector. The best approach for China will be the one that best serves China's goals within the economic and political constraints it faces. Successful restructuring depends less on the particular approach taken than on how well the

reforms, both market and institutional, are designed and implemented.

There are several important goals of restructuring that China has identified. The goals, their implications for restructuring and recommended actions to assure that they are met are described in the sections following.

Goal #1 - Improved Efficiency and Reduced Costs

Lowering energy costs while increasing efficiency constitutes one of China's high priority goals. Based on our knowledge of China's power sector, there are large costs savings that can be achieved for existing and new power plants through the increased use of provincial and regional competitive market mechanisms, restructuring existing power contracts, and rationalizing power plant dispatch.

Increased end-use energy efficiency, however, offers the greatest opportunity for cost reductions. International experience shows that the cost of end-use efficiency invariably is less than the cost of operating existing power plants and far less than the cost of new power plants and associated transmission and distribution. Chinese energy efficiency experts confirm that these same opportunities exist in China.

The California experience demonstrates the ability of investment in end-use efficiency to address critical power needs, restrain market power, and reduce high market prices. The experience in California and elsewhere also shows that retail competition has not worked well and, in some cases, has complicated the operations of wholesale markets.

Recommendations

1. Full separation of generation from transmission and distribution, expansion of provincial market pilot programs into regional wholesale markets, and implementation of policies that will assure smooth transitions while meeting environmental and other goals. Study, but do not implement, retail competition in the near term.
2. Limit the size of spot markets, pay more attention to market power, and fully incorporate demand response in wholesale market rules.
3. Implement a wide range of policies to promote increased end-use efficiency, such as system benefit charges and performance-based regulation designed specifically to encourage utility investment in DSM.

Goal #2 - Lower Prices

Related to the goal of lower costs is the goal of lower electricity prices. China, like many countries, believes that electricity prices are already too high and that restructuring will fail if it results in price increases for consumers.

Almost any approach to restructuring and increased use of markets offers the opportunity to lower costs, but lower costs do not lead to lower consumer prices. Lower costs can result in higher profits for generators or lower prices for consumers, or both. Lower costs will only produce lower consumer prices if a number of other steps are taken. Especially important are (1) a well-designed transition for existing plants from the current pricing system to competitive market pricing, (2) power markets designed to attract investment and produce stable prices, and (3) control over market power problems.

The California crisis provides a useful example of what can happen if goals and constraints are not clear and if the regulatory agency does not have sufficient authority to fix problems.

The California experience, as well as experience in many other countries, shows that market power in competitive generation markets is a very serious problem. Even concentration of generation far below the level of 20% can produce serious market power problems, preventing the lower costs created by competition from translating into lower prices for consumers.

Recommendations

1. Establish and train a strong central regulatory body with sufficient authority and resources to oversee the development of the markets, to solve the very serious market power problems in the existing pilot programs, and to regulate all monopoly-provided services.
2. Increase the competitive pressure on power contracts to help reduce consumer prices.
3. Encourage the use of long-term power contracts and other tools to reduce price and revenue risks for investors and consumers, and also help protect against the abuse of market power.
4. Reform tax policies.

Goal #3 - Economic Development of Western China

The economic development of Western China is a high priority goal. Western China is blessed with large amounts of renewable resources including hydro and wind, as well as clean burning natural gas. Developing this region means restructuring the power sector in ways that assure the renewable and clean resources are developed.

Recommendations

1. Adopt proven policies such as the Renewable Portfolio Standard, or Mandatory Market Share, to promote the development of renewable resources.
2. Improve tax policies to promote renewables.
3. Design competitive generation market rules and transmission pricing and access rules to allow full participation of renewable resources in the market.
4. Design better environmental policies, such as Generation Performance Standards and expanding existing regulations, such as the “polluter pays” levy.

Goal # 4 - Environmental Improvement

Environmental improvement is also high on China's list of priorities. Restructuring an electric power system invariably affects the environment. For a nation alert to these effects, restructuring is an opportunity to improve both sector's economic performance and the nation's environmental quality. If environmental and other national goals are not addressed comprehensively and systematically, restructuring will result in unnecessary damage to the public health, to the environment, and to the nation's ability to meet other important goals.

Many national energy-related policies are aimed at improving the environment. These include increased use of wind and natural gas for power generation, installation of more than 10,000 MW of flue gas de-sulphurization, and new total emission control and “polluter pays” regulations. Without careful restructuring of the power sector, the environmental improvement sought by increased use of natural gas and flue gas de-sulphurization can easily be undermined. For example, in all competitive generation markets, plants are dispatched based on bid prices. Coal fired units with FGD and plants fuel by natural gas generally have higher operating costs and, as a result, unless special care is taken, these kinds of plants will be dispatched less than they otherwise should be, or not at all. Reduced dispatch of cleaner plants will mean that the desired environmental benefits will not be achieved. Transmission planning and pricing, if not carefully undertaken, can also hinder development of cleaner resources, particularly those found in remote locations.

Existing pollution fees are well below the cost of pollution control. The pollution fees are a small fraction of the cost of the damage the pollution imposes on China's economy.

Recommendations

1. Revise environmental rules including stronger Total Emission Control policies and more effective polluter pays policies.
2. Redirect funds collected through pollution fees to a clean energy and energy efficiency fund.
3. Adopt output-based generation performance standards for power plants.

4. Incorporate environmental policies in the market rules for competitive generation markets.
5. Reform tax policies.

Goal #5 - Attract Investment

Attracting increased investment in generation, transmission, distribution, energy efficiency and load control technologies is another important goal. Currently China's transmission and distribution system suffers from under-investment and demand growth is creating huge demands for capital. Those who can provide capital to expand the system of electrical services must have confidence in the underlying integrity and stability of the rules by which the electricity sector is governed. One essential step is the creation of a sound regulatory structure that ensures consumers are treated fairly and that both competitive and monopoly companies are able to recover costs and attract new investment.

Recommendations

1. Create effective regulatory agencies that use transparent and predictable pricing and investment policies for new generation, transmission, distribution, energy efficiency and load control technologies.
2. Encourage the use of long-term contracts, capacity markets and other trading mechanisms that will reduce the risks of short-term price volatility, which is good for neither consumers nor investors.
3. Adopt policies that increase investment in energy efficiency, clean energy, and pollution control such as Mandatory Market Share for renewables, System Benefit Charges for energy efficiency, and GPS.

Constraints

Understanding the practical and political constraints to restructuring is equally important to understanding the goals. Two constraints in particular have emerged in discussions among Chinese policymakers.

Constraint #1 – Limit Price Increases

What are the practical and political consequences if restructuring the power sector results in price increases? Policymakers in most countries believe that if restructuring results in price increases to consumers, the public and political reactions will cause the benefits of restructuring to be lost. Thus, many countries and many states have required that price reductions or price freezes be part of a restructuring law. If this is one of China's constraints, it

must be clearly stated and understood at the outset. If existing consumer prices must be adjusted (with respect, for example, to transmission and distribution), it is important that any needed changes be made well before restructuring begins.

Constraint#2 – Limit Tax Revenue Shifts

Another common constraint is that local and state or provincial government tax revenues should not change abruptly. If this is a constraint in China, restructuring will have to be designed to assure a continued level of tax and other revenues without distorting the competitive generation market. Many states and countries have faced and resolved this issue.

V. SPECIFIC REFORM POLICIES AND ACTION STEPS

A. Law

Reform of China's electric sector will require reforms in the existing legal and regulatory frameworks, regardless of the industry structure that China ultimately chooses.

One critical legal reform is the creation of an independent governmental body to oversee and regulate the sector. The electric sector, because of its central role in society and because of its unique economic characteristics, requires strong governmental oversight. In the vertically integrated system, government regulators have jurisdiction over rates, long-term planning, quality of service, the siting of new facilities, and environmental protection. As the electric system evolves certain aspects of it can become more competitive, therefore the role of regulation also will evolve, but it is no less critical in maintaining the system. In a competitive generation sector, regulators' primary role is to assure that the market operates efficiently and fairly and that the benefits of the market flow to consumers. To fulfill this role, the regulatory agency must be established very early in the restructuring process; it must have sufficient scope of authority and responsibility to oversee the market structure, design, rules, and operation; and it must have the authority to correct problems quickly.

The transmission and distribution components of the electric industry will remain monopoly services for the foreseeable future. Here, the regulatory role is to protect consumers from monopoly behavior, assure fair and non-discriminatory pricing and access, and assure that needed capital can be attracted at reasonable costs. Whether there is retail competition or not, the regulatory agency remains responsible for consumer protection.

The creation of an independent regulatory agency (or agencies) is a critical aspect of any reform in China, but it is not the only aspect. Other reforms would affect property rights, the rights and obligations of electric utilities, environmental law, and contract law (allowing for, among other things, performance contracting in non-financial sectors, such as the electric sector).

Recommendations

It is imperative that a strong regulatory body (or bodies) with broad jurisdiction be created and charged with, among other responsibilities, implementing the necessary reforms to meet

China's objectives for the sector. This regulatory agency should be set up early and should be directly involved in the restructuring process.

Institutionally, the regulatory structure should be designed to minimize the possibility of future conflicts between central, regional, and provincial levels of government. Initially, electricity markets in China will be regional in nature and some of these markets may be relatively small. Over time, as the system grows and as transmission expands, markets will combine to form fewer and fewer markets with the distinct possibility that a single national market may ultimately develop. Structuring the regulatory institutions as well as the transmission institutions in ways that minimize the possibility of provincial conflicts between different regions will make the transition to larger and larger markets easier to accomplish.

The scope of the regulatory agency's authority should be broad. It should include oversight of competitive generation markets; anti-monopoly authority; pricing for monopoly services (distribution and transmission, but also generation where there are no functioning competitive markets); access; service quality, reliability, and resource planning for captive customers; and environmental performance.

The State Council and National People's Congress are now considering amendments to the nation's comprehensive Electricity Law and other regulations that will facilitate reform in the sector. While those changes must obviously reflect China's unique social, political, and economic circumstances, some general observations can nevertheless be made. At the same time, it is important that the new legislation create a broad industry and regulatory framework that is flexible and not overly prescriptive. What the future holds in store is unknown, and regulators will need the authority to respond quickly and decisively to new and unforeseen circumstances. Changes in the law will need to address the following issues:

1. *The objectives of reform.* The law should describe the overall national objectives, or goals, of the reform of the electric sector: developing resources in western China and delivering power to the east, promoting nationwide interconnections, optimizing resource allocation, promoting sustainable development and environmental protection, and establishing and perfecting a unified nationwide power market with fair and orderly competition.
2. *The rights and obligations of the government and the various participants in the electric market.* In separating the business functions from the governmental functions of the state-owned power companies, the legal status of the generators, grid operators, transmission and distribution companies, consumers, and other market participants will have to be established.
3. *The regulatory agency.* The law should establish an independent regulatory body, its scope of authority, and the obligations of the companies that are subject to the regulator's jurisdiction. The law should clearly delineate the responsibilities of other governmental agencies that have jurisdiction over the electric industry, with an eye to

- limiting potential conflicts, overlapping authority, and administrative inefficiency. The law should also set out how the regulatory commissioners are appointed, the length of their appointments, their removal from office, and related requirements, all of which are critical to determining the agency's degree of independence from both the political process and the industry it regulates.
4. *Market structures.* The law should set out the general parameters of the market structure, but give regulators broad authority to develop the detailed technical rules and policies governing participation in and operations of the market. Included here, for example, would be rules on open access to the transmission network.
 5. *Environmental Protection.* The law should, either directly or by reference to other laws, establish the requirements for protection of China's natural resources and public health. The roles of the regulatory agency, environmental protection agencies, and other departments of the government should be delineated. The law should also make it clear that environmental improvement is one of the major goals of restructuring.
 6. *Pricing.* The law should set out the general criteria by which the regulatory agency will set rates for monopoly services and also by which it will determine that prices set in competitive markets are fair and reasonable. This means that the regulatory agency must be empowered to oversee market operations and protect against abuses of market power. In addition, the regulatory agency should be able to employ ratemaking methods that best suit particular needs (*e.g.*, rate-of-return regulation, performance-based regulation, etc.).
 7. *End-use energy efficiency.* The law should establish requirements for investments in end-use energy efficiency.
 8. *Renewable energy.* The law should establish requirements for investments in generation powered by renewable energy.
 9. *Planning.* The law should set out the planning obligations of market participants, in particular the providers of monopoly services (the grid operators and T&D companies).
 10. *Consumer Protection.* The law should establish general standards for consumer protection.

B. Energy Efficiency

Energy efficiency and environmental protection must be incorporated into the reform process. For the most part, supply-side efficiency improvements are market and profit driven. Reductions in the costs of generation and delivery flow directly to a firm's bottom-line. This gives firms a very strong incentive to make investments in supply-side efficiency and, as a consequence, little in the way of public policy or financial support is needed to encourage those investments. However, demand-side efficiency, because of its potential effects on sales and profitability, does not receive much investment in either monopolistic or competitive markets. Therefore, new investment mechanisms and policies, alternative ratemaking methods, and related changes in the law must be established in order both to foster the creation of an end-use efficiency market and to support direct investment in efficiency.

In the early 1980s, China began to implement policies promoting efficiency improvements in electricity production and end-use consumption. Since then, production efficiency and electricity saving have increased considerably. Coal consumption decreased from 448 gce/kWh per unit of power supplied in 1980 to 401 gce/kWh in 1999; and the efficiency of appliances, lighting, motors, and other end-uses has increased significantly over that time.

Even so, compared to those of the more advanced economies, production and end-use efficiencies in China is still relatively low. For example, the 401 gce per kWh of energy supplied in 1999 was 77 gce/kWh higher than that of Japan in 1997 (324 gce/kWh). Transmission and distribution losses in China are estimated to be some 5% greater than in other countries. The weighted average efficiency of all types of motors in China is 3-5% lower than that of foreign countries. There is still vast room for efficiency improvements in China. China has outstanding opportunities to build efficiency into the system as electricity use increases in all sectors of the economy.

Reform of the Chinese electric sector is intended, among other things, to set it on a path to long-term sustainability. Enhancing both production and end-use efficiency are critical components of sustainability, and they will have the effect of decreasing reliance on coal, reducing the environmental impacts of electric generation, and improving the overall competitiveness of the Chinese economy.

Recommendations

There are a number of policies that can overcome the disincentives to end-use efficiency. The set that follows is proposed in light of the current circumstances in China:

1. *Enact laws that stipulate the electricity saving obligations of power companies.* The requirements can be stated generally in law, with broad authority given to the regulatory agency to enforce them through the integrated resource planning and ratemaking processes.
2. *Formulate and implement policies that remove barriers to investment in end-use efficiency.* Where regulated utilities are required to make demand-side efficiency investments, the costs of those investments should be included in utility rates, in the same way that supply costs are. Higher rates of return can also be given for efficiency investments, as an added incentive. In addition, alternative ratemaking methods, such as revenue-cap performance-based regulation, that reward companies for improving their customers' end-use efficiency should be implemented.
3. *Create an electricity-saving trust fund.* A complement, or alternative, to utility investment in end-use efficiency is public benefits fund, or electricity-saving trust fund. A pool of money is raised through a small charge per kilowatt-hour and it is used to support efficiency investments. Those can be made by distribution utilities or, preferably, by an independent organization whose sole responsibility is to maximize end-use savings.
4. *Formulate and implement energy-efficiency standards for electricity-using equipment.* Appliance standards and building codes are one of the most cost-effective methods of improving the overall efficiency of energy use in an economy. China should set stringent energy requirements for new construction, appliances, motors, etc., and should set out a schedule and process for regularly updating the standards.
5. *Foster the market for energy services.* China should make it possible for energy service companies (ESCOs) to compete with electricity companies. The commercial code should be modified to allow performance-based contracting in the electric sector.
6. *Strengthen dissemination of energy-saving information.* Consumer education is an important tool for improving efficiency. Programs should be developed and funded to inform consumers about savings opportunities.

C. Renewable Energy Resources

China has an abundance of renewable energy (RE) resources, consisting primarily of hydro, solar, wind, biomass, and geothermal. By the end of 1998, the energy supplied by various modern renewable energy technologies had reached 29.10Mtce, equal to 1.8% of the traditional energy consumption of the country in 1998 and exceeding the share of natural gas consumption in the traditional energy system. The electricity provided by various modern renewable energy technologies had reached 65.748 billion kWh, equivalent to 5.8% of the total power generated in China that year.

However, by comparison to international standards and in light of the enormous potential resources available to China, the country's RE development rate is disappointing. There are a variety of barriers to RE development. Chief among them is the generally higher cost of renewables, relative to conventional thermal (primarily coal-fired) technologies. Chinese energy policy, as expressed in the *Ninth Ten-Year Plan*, supports renewables, and some financial support has been given to renewables, but overall there has been a lack of concerted action to encourage their development: pricing policies have not favored renewables, nor do market structures and dispatch rules, and there is no formal planning process or methodology that enables policymakers to assess the value of alternative resources.

There are many benefits from renewable energy resources, the value of which often justifies their higher costs. Most RE resources have relatively little environmental impact, particularly in the form of incremental increases in the emission of air pollutants. Wind, solar, and hydro resources have no fuel costs, and thus provide significant protection against fuel price volatility. Renewables also are generally smaller in size and widely dispersed throughout a network, thereby reducing the risks of unplanned outages and network failures. In addition, renewables development has local economic benefits, primarily in the form of new jobs.

There are a number of policy initiatives that China has already taken to promote the development of renewable energy resources.

- *Reduction of and exemption from import tariffs.* Reduction of and exemption from import tariffs is the most visible support given by the Chinese government to renewable energy. Although there are no clear regulations on preferential reductions of import tariffs, wind power and photovoltaic equipment are treated preferentially. For example, the tariff rate charged for wind power components is 3%, while no tax is charged for complete wind power generators. The tariff rate is 12% for imported PV systems.
- *Value-Added Tax Preferences.* There is no uniform regulation to reduce the value-added tax burden. The rate is normally 17% for renewable energy technology

products, but there are two exceptions: artificial mash gas is subject to a VAT rate of 3% and hydropower is subject to a 6% VAT.

- *Reduction and exemption of income taxes.* Currently, the average income tax rate for businesses is 33%. While overall tax policy is determined by the central government, provincial governments do have limited authority over the taxes. Two local governments, the Inner Mongolia and Xinjiang autonomous governments, have enacted preferential policies to support the development of local renewable energy.
- *Preferential policies for financing and grid interconnection.* In 1999, with the approval of the State Council, the SDPC enacted *The Notice Addressing Problems Related to Enforcing Wind Power Development*, which responded to the implementation of *The Regulation on Management of Wind Power Connecting to Grid* that the former Ministry of Power issued in 1994. The notice stressed that RE power projects will receive priority in obtaining loans, mainly from the State Development Bank, for capital construction. At the same time, commercial banks are encouraged to actively participate in these kinds of businesses. For medium- and large-scale RE power projects with a capacity of 3,000 kW approved by the central authorities, SDPC will assist in obtaining loans from banks, with a 2% discount interest subsidy on the power projects using capital loans arranged by the banks. The Ministry of Finance (MOF) subsidizes national projects, and local projects are subsidized by local government agencies. The notice also made it clear that renewably generated electricity must be allowed to connect to the grid. The regulation also specifies that the cost of the project will be included in the average grid price.
- *Discounted interest rates.* Beginning in 1987, the Chinese government made available special loans with discounted interest for rural energy projects mainly mash gas, solar thermal, and wind power applications. By 1996, the loan amount had risen to 120-130 million Yuan each year. Central fiscal departments assist the projects through loans with discounted interest rates, *i.e.*, paying 50% of loan interest costs to commercial banks. In addition, the central government set up low interest loans for small hydropower construction.
- *Subsidy policies.* The central government has funded some R&D and pilot projects for renewable energy. Funding from local governments is mainly used for the deployment and application of solar energy and wind energy technologies.

Recommendations

The restructuring of the Chinese electric sector offers an important opportunity to expand the nation's policies towards renewable energy. The overall objectives would be to further reduce the costs of renewable generation, to create a stable policy environment in which renewables can further develop, and to create a market system in which renewables can compete fairly.

There are several additional policies that China can implement to support renewables.

1. *Adopt a mandatory market share (MMS) policy.* (MMS also referred to as the renewable portfolio standard or RPS). The MMS is simply a legal requirement that every supplier meet its customers' overall demand for electricity with a specified

percentage of renewably generated electricity. It can satisfy the requirement by generating the electricity itself, by contracting for it with other suppliers, or by purchasing renewable energy credits (RECs). A REC is a proof that electricity has been produced by a renewable energy facility: for each kilowatt-hour of electricity produced by such a facility, a REC is produced. The renewable facility can sell its electrical output into the market or under a bilateral contract. It can also sell its RECs, but not necessarily to the same firms or customers to whom it is selling its electricity. Suppliers who do not have enough of their own renewable energy resources with which to satisfy their MMS obligations will purchase RECs.

A system of tradable RECs gives suppliers a great deal of flexibility in meeting their MMS requirements. It frees them from having to own, or have contractual entitlements to, their own renewable energy facilities. Simultaneously, it imposes cost discipline upon renewable generators: the market for RECs will provide a premium above the market price of power to cover the additional costs of renewables, but the premium will be the same for all renewable generators. Thus, lower cost, more efficient renewable generators will be more profitable. This competition among renewables will keep the price of the RECs as low as possible.

2. *Adopt a system benefits charge, or SBC policy.* This is a small surcharge on all kilowatt-hour sales, and it can be used to fund research and develop and other commercialization efforts. (It can also be used to fund investments in end-use energy efficiency.) The SBC is not a substitute for an MMS, but rather is a complement to it. The MMS will support mature technologies that can compete in electricity markets. The SBC instead can be used to support technologies that show promise but which are not yet commercially viable (that is, whose unit cost exceed the sum of the market price for electricity and the market price for RECs).
3. *Improve the existing polluter pays policies.* China has adopted the “polluter pays” policy, which imposes a tax on every pound of sulfur dioxide that is emitted into the air. Renewables, which are generally non-polluting, avoid the pollution tax and are therefore more price-competitive. Currently, the amount of that tax is low – low enough that it is cheaper for polluters to pay the tax than it is to invest in pollution reduction. China should significantly increase the pollution levy, thus giving polluters a strong incentive to clean up. In addition, a similar levy could be charged for other pollutants, such as nitrogen oxides, which would give polluters the added incentive of addressing all of their emissions in coordinated fashion. A “multi-pollutant” approach is invariably less costly than attacking emissions one pollutant at a time.

D. Environmental Protection

There is an inescapable linkage between energy use and the environment. Pollution from electric power plants affects the air, lakes and streams, agricultural crops, land, animal habitat, and human health. The environmental impacts of electricity production are large, and they are experienced locally, nationally, and globally. For most countries, the environmental harm caused by producing electricity is rivaled only by that of the rapidly growing transportation sector. Electricity production is almost always the single largest stationary source of air pollution.

While many governments wish to create abundant low-cost electricity for their citizens and economy, doing so by ignoring the environmental consequences risks creating other large costs for society such as higher health costs and reduced agricultural production. It is far more efficient to take environmental impacts into account at the time an electricity system is planned, expanded, and reformed rather than after the fact when the environmental harm has occurred and large vested financial interests resist change. Studies have reported that the pollution from power plants and other sources currently costs China between RMB 30 and 100 billion. This cost is far greater than any estimate of the cost of reducing pollution.

Restructuring an electric power system invariably affects the environment and, as discussed later, many of the environmental effects of restructuring are the result of market structure and design rules that often appear to have no obvious environmental connection. For a nation alert to these effects, restructuring is an opportunity to improve not only economic performance but environmental quality as well. For a nation either unaware of these effects or indifferent to them, restructuring may well result in unnecessary damage to public health and the environment.

Coal is, and will remain well into the future, the main source of China's energy. China's air pollution, especially SO₂ emissions, is most directly related to this feature of the country's energy mix. By 1997, there were 47 cities where the concentration of SO₂ exceeded the national Grade II standard. Acid rain has appeared in 82% of the cities and has reached 30% of the country's total area. Between 1990 and 1997, SO₂ emissions increased from 15.71 millions tons per year to 20.914 million tons, of which 40% were emissions from thermal power plants.

Approximately 80% of China's total emissions of nitrogen oxides (NO_x) are produced by coal-burning power plants. NO_x emissions have not, until recently, been an object of environmental policy. In January 1997, however, national standards limiting the NO_x emissions for newly built large-scale coal-burning power plants were adopted.

China is second in the world in annual energy consumption, after the United States, and likewise is the second greatest producer of carbon dioxide (CO₂), the primary cause of global climate change. It is estimated that, in 1998, approximately 730 million tons of CO₂ were produced by coal combustion in China, of which some 26 percent came from the electric generation sector. China's energy consumption per capita is currently rather low when compared to the industrialized nations. However, given the rapid and large expected growth in China's economy over the coming years, the country's CO₂ emissions have become an issue of national, and international, concern.

There are a number of policy initiatives that China has already taken to require or encourage investments in environmental protection:

- *The Environmental Protection Law and related regulations.* These rules lay out the broad range of environmental protection requirements that the various sectors of the economy must obey. For example, specifications for the ash and sulfur content of coal are set out in this law. About 92% of the coal used by the thermal power plants with a capacity of 6 MW or more and which were directly under the former Ministry of Power Industry burn medium- or low-sulfur coal (<2%). Low-sulfur coal (<1%) is used in 56.4% of this generation.
- *The Air Pollution and Control Law and related regulations.* These rules set requirements for, among other things, the control of SO₂ and dust emissions from new and expanded thermal generating units.
- *Shutdowns of small-scale thermal generation.* In 1997, China made plans to shut down approximately 9,630 MW of smaller-scale, inefficient coal-fired generation. Some 7,700 MW of such power were shut down by SPC alone during this time.
- *The Pollution Declaration and Pollution Levy.* All thermal power plants must pay a charge for every ton of SO₂ they emit.
- *Total Load Control.* In 1996 the State Council approved the Total Load Control Plan for Emission of Key Pollutants. The Air Pollution Prevention and Control Law, as revised in 2000, sets out the administrative means for determining what regions have not met their atmospheric quality standards and remedial actions to be taken.

Recommendations

China has made significant progress in controlling the environmental effects of energy production and use, particularly in the emission of air pollutants. The restructuring of the Chinese electric sector poses serious challenges for environmental protection. There are a number of policies which, if implemented, will yield large reductions in air emissions while promoting increased productivity in the sector.

1. *Strengthen environmental requirements.* Rules, such as the total emission control policies and the pollution levy, should be strengthened to cover more pollutants and impose more stringent standards. "Polluter pays" policies have been quite effective at reducing pollution, but only when the price of the pollution fee is high enough to give firms an incentive to invest in more economical methods of prevention.
2. *Encourage investment in energy efficiency and renewables.* Policies that increase

investment in end-use efficiency and renewables should be implemented. Funds collected through pollution fees should be used to support investments in clean energy and energy efficiency resources.

3. *Adopt output-based generation performance standards (GPS).* China should implement emissions standards that are based on units (kWh) of electrical output, rather than on units of fuel input. Because such standards apply equally to all generation, they give generators very strong incentives to be more efficient, both in production and in the methods by which they reduce emissions. Emissions cap-and-trade programs are a market-based example of a GPS, and have proven very successful in other countries.
4. *Assure market rules are compatible with environmental reforms.* It is critically important that the rules for competitive markets be consistent with and support the nation's environmental policies. Information disclosure, demand-side bidding and response programs, and output-based emissions standards are examples of such policies.

E. Tariff Reform

A critical aspect of electric sector reform is reform of the tariff system and the methods by which tariffs are set. Any system that depends on private investment must, over the long run, generate sufficient revenues to cover the total costs of providing service. This is true whether service is provided by monopoly utilities or by competitive markets. In either case, regulatory oversight is necessary in order to assure that electric service is being provided at the least overall cost to society.

Currently tariffs in China are set in a variety of ways. Provincial power companies purchase power from independent power producers (IPPs), which include joint-venture power plants and investor-owned power plants. Generation prices are determined on a plant-by-plant (and sometimes even on a unit-by-unit) basis and are intended to provide sufficient revenues for the repayment of loan capital and interest within a relatively short term, generally 10 years. The central government approves the generation prices of power dispatched by provincial or higher-level power networks, while provincial governments approve generation prices for local power networks. For power plants constructed before 1985 (totally funded by the central government) and power plants constructed between 1985 and 1992 (using subsidized government loans), there are no generation tariffs. Instead, the costs of power plants are recovered through a “catalogue” tariff, approved by the State Development and Planning Commission. These tariffs only cover depreciation and direct operating costs such as labor, fuel, and maintenance, but they do not cover returns on investment.

Transmission and distribution companies pay the tariffs for generation companies, and their costs are included in retail prices. Retail prices in China are generally determined on a provincial basis, according to a complex and non-transparent catalogue tariff system. The central government approves retail prices for both individual and wholesale customers provided for by provincial- or higher-level power networks; provincial governments approve retail prices for customers of independent power networks in rural areas.

The current system faces several challenges as China moves toward a more competitive market based electric sector. Generation prices vary widely, depending on a region's mix of older and newer plants. Quantifying and deciding how to address stranded cost for some generators will be difficult. In addition, pollution control requirements are stricter for newer plants, thereby raising their capital and operating costs. This reduces the amount of hours that they are dispatched, since they cannot compete with the less costly, but more polluting, plants.

T&D tariffs do not cover the network's full cost, thus making upgrades and expansion difficult even under the current industry structure. Once generation is fully separated from T&D the revenue shortfall will become a more serious problem.

The structure of the rates themselves, both retail and wholesale, will also need to more closely reflect the economic costs of production. Rates generally have not been structured to reflect differences in production costs, *i.e.*, peak and off-peak (daily or seasonally) or demand and energy. In the case of T&D, rates have not been set to optimise network utilization and the siting of new facilities. Furthermore, retail rates do not fairly allocate cost burdens among the residential, commercial, and industrial customer classes. In particular, many large energy intensive industries purchase electricity at well below the cost of service. Finally, the criteria by which tariffs are set are inconsistently applied across the country.

Recommendations

The objectives of tariff reform are (1) to use market competition mechanisms to establish reasonable, economically efficient tariffs for generation, transmission, and distribution; (2) to establish tariffs that will promote electric sector development; (3) to reduce the costs of investment and operation; (4) to stimulate energy efficiency; and (5) to establish an independent and effective regulatory system.

The specific policy recommendations include:

1. *Reform the tariff setting process.* A major task of a new regulatory body is to create and administer a transparent cost-based tariff setting process. The separation of generation from T&D will have to be accomplished in a manner that addresses stranded generation costs without adversely affecting T&D prices.
2. *Adopt revenue-based PBR.* Transmission and distribution service will remain monopolies and will be regulated. T&D can be regulated under the traditional rate-of-return (ROR) method or under alternative, performance-based (PBR) methods. There are two main types of PBR: price caps and revenue caps. Both PBRs give companies strong incentives to reduce costs in order to increase profits. Price caps also give companies an incentive to increase sales, which will increase revenues. Revenue caps PBR breaks the link between sales and profits, and therefore gives companies a strong incentive to improve the efficiency of their customers' usage.
3. *Pursue retail competition with great caution.* Retail service can remain monopoly regulated or be opened to competition, depending on China's overall policy objectives. Experience in other parts of the world – Argentina, the UK, the United

States – has shown that most of the benefits of competition (improved efficiency, lower generation costs) can be achieved through well-designed wholesale markets.

4. *Adopt a System Benefit Charge (SBC) to fund energy efficiency and renewables.*
The existing tariff system has historically included a wide variety of extra charges and taxes imposed by many different levels of government. Most of these charges are being eliminated. International experience shows, however, that a SBC to fund energy efficiency and renewables can be an effective means of overcoming market barriers and market imperfections.

F. Investment and Financing

The system of private investment and governmental oversight most commonly used throughout the world relies on a regulatory process whose primary function was to balance the society's many and sometimes competing interests – the public, the investment community, economic growth, environmental protection, and so on. The system succeeded in deploying sufficient generation and transmission to meet steadily growing demand over a long period of time, in large measure because it managed to produce reasonable and steady returns on investment. The prospect of those fairly constant returns meant that the investment community remained willing to put capital into the industry over many decades. In the years since 1979, China has experienced a similar period of significant new investment, when rates and revenues were set to cover the full costs of that investment.

Any restructuring of the industry, if it is to be sustained, must meet several criteria. First, investors must be given a reasonable opportunity – but not a guarantee – to earn a fair return on their investment. This means that the industry and regulatory rules for participants (whether monopoly providers or competitors) should be clear, fair, and enforced. Government behavior, through the regulatory and other processes should be predictable and consistent with overall policy objectives. Second, the regulatory and market structures should be designed very carefully, with an eye to the kinds of behavior that they will encourage. Policymakers must be specific about the objectives that they seek to achieve and then should implement policies that will meet those objectives. How companies make money, how markets operate, whether all firms face the same legal and regulatory requirements, and other similar considerations all affect how the industry behaves and whether the country's policy goals will be met.

Between 1949 and 1978, all investment in the Chinese electric sector was made by the government, financed through state-owned lending institutions. The costs of financing were not accounted for the conventional manner: depreciation was recognized but interest was not paid. Net revenues, however, flowed back to the government. Retail prices remained relatively low as a consequence. Investment priority was given to generation, and network expansion lagged behind. By the end of the 1970s, the inability of the sector to adequately meet demand had begun to seriously inhibit economic development.

In 1979, the government began to implement various economic reforms. These reforms resulted in a fundamental change in China's investment and financing system. Alternatives to government financing emerged: state budget funds, bank loans, foreign capital, firms' internal

funds, and other financing methods. New financing tools, including equity and commercial and government bonds were created. And, with an eye toward increasing foreign investment, the government further eased investment restrictions in Dalian, Tianjin, Shanghai, and 14 other coastal cities. While these reforms helped significantly, it was nevertheless necessary in the mid-1980s to impose a two-cent per kWh surcharge on sales, to give the central and local governments additional funds for electric sector investment. These policy initiatives achieved their objectives, and by 1997 there was sufficient generating capacity in the country to meet overall demand.

In 1997, the government began to consider and implement additional sector reforms aimed at creating competitive markets, shifting risk to individual enterprises, and further reducing the government's share of investment. The Ministry of Electricity was dissolved. Its business functions were assigned to the new State Power Corporation and its various governmental responsibilities were assigned to the State Development and Planning Commission and the State Economic and Trade Commission.

Between 1977 and 1999, total generating capacity increased at an average annual rate of 8.32%. Production increased at 8.07% per year over that time. Total installed capacity at the end of 1999 was 298.77 GW, and generation in that year equaled 1233.1 TWh. Investment in end-use efficiency, renewables, and environmental protection, however, lagged, as described in other sections of this paper.

Recommendations

1. *Create an independent regulatory body.* The regulator should set rates for monopoly services, oversee competitive markets, and implement other policies set out in its authorizing legislation.
2. *Tariff reform.* Where regulators set rates, they must be sufficient to give investors a reasonable opportunity to earn a fair rate of return.
3. *Fair and open competitive markets.* When service is to be provided by competition, there should be open access and protections against the abuse of market power.
4. *Continued expansion of private investment in the sector.* One objective of electric industry reform is to better allocate risk among investors and consumers. However, markets by themselves undervalue environmental protection and other societal benefits. Therefore, there must be explicit policies that favor investment in environmental protection and sustainable development, specifically a renewable portfolio standard, a system benefits charge to fund end-use energy efficiency, and a generation performance standard to reduce air pollution.

G. Taxes and Fees

As in other countries around the world, power companies in China are subject to a number of taxes and fees. Some of the revenues generated are targeted for specified uses; others support general governmental spending at the central, provincial, and local levels.

Restructuring of the electric industry can have a profound impact on revenue collection and allocation, while poorly designed taxes and fees can greatly affect the efficiency of the new markets. Consequently, any attempt to rationalize the tax and levy system should, for the near term at least, maintain the levels and allocations of governmental revenues while simultaneously minimizing the fee's distortional impacts on the markets and consumers.

There are a number of taxes imposed on power companies in China: the Valued Added Tax (VAT), Enterprise Income Tax (EIT), City Maintenance and Construction Tax, Education Fee, Land Usage Tax, Property Tax, Stamp Duty, Vehicles and Ships Usage Tax, and Business Tax (BT), to name the most significant among them. Briefly, their purpose and revenue impacts are as follows:

- *Value-Added Tax*. The VAT generates revenues as a function of the value that a firm adds to the production or manufacture of goods and services. Currently in China, the calculation of the VAT is based on the cost of inputs deducted from the sales. Small power enterprises are subject to a tax rate of 6% and others have a tax rate of 17%. The VAT accounts for approximately 80% of the total tax burden on the electric sector.
- *Income Tax*. The tax base is the realized profit of enterprises, and the tax rate is 33%. The income tax accounts for about 10% of the sector's taxes.
- *City Maintenance and Construction Tax*. This tax is calculated as a percentage of the VAT, and the rate varies by region. The average tax rate is approximately 7%. This tax makes up about five percent of the sector's total taxes.
- *Education Fee*. This tax also is based on the VAT, and the rate varies regionally. It averages about 3% of the VAT.
- *Land Usage Tax*. This tax is calculated as a function of the area of land used by a firm. The methods of calculating the tax vary from region to region, as do the tax rates.
- *Property Tax*. This tax is based on the residual value of property, and the tax rate is 1.2%.
- *Business Tax*. This tax is based on the income of non-operation businesses. The tax rate is 5%.

The central and local governments share VAT revenues, with 75% going to the central government. Income tax revenues are allocated according the ownership of the enterprises. If the firm is owned by the central government, then the income tax collected from that enterprise will go to the central government; if the firm is locally or foreign-owned, the tax revenues will go to the local government. All other tax revenues go to the local governments. Given these allocations, the central government receives approximately 60% of the electric sector's total

tax revenues.

There are several fees that electricity users pay through their bills. The first is the levy for the power fund or, more accurately, a set of power funds, of which the first was set up in 1985. They have been used to underwrite a number of projects of the central and local governments, but most of these levies have been terminated. Those that remain are the following:

- *Power Fund*. This is a national levy of RMB 0.02/kWh, paid by all users except agricultural. It raises about RMB100 billion per year and, prior to 1998, was used primarily to cover some of the costs of local government power plants. Since 1998, the local and central governments have shared the fund equally. The Ninth Ten-Year Plan states that the levy should be eliminated, however, beginning in 2001, the fund will be used to finance expansion of the grid in agricultural regions.
- *Sanxia Project Fund*. This fee raises approximately RMB 4 billion per year to fund a RMB 71.2 billion construction program of the Sanxian Construction Company. The rate differs from region to region, ranging from 0.04 yuan/kWh in the Northeast and Northwest, to 0.15/kWh in Zhejiang, Shanghai, Jiangsu, and Hubei, to 0.13/kWh in Sichuan, Chongqing, Anhui, Henan, Jiangxi, and Hunan, and 0.07/kWh in the rest of the country.
- *Shanxi Power Construction Fund*. This fund is used to support construction of power facilities in Shanxi province. The fee of RMB 0.01/kWh is paid by users in the province. It raises approximately RMB 0.2 billion per year.
- *ShanxiYinHuang Hydro Resource Fund*. This levy of RMB 0.015/kWh, paid by users in the province, funds the Shanxi Yinhuang Project.
- *Utilities Fee*. This fee pays for streetlighting and similar public services. The levy is RMB 0.01/kWh for industrial users and 0.02/kWh for non-industrial users.

Pollution levies make up the second set of fees applied to the electric sector. There are several (refer also to the section on the environment). The two primary fees are on sulfur dioxide (SO₂) and wastewater. The fees are charged on a per-kilogram or ton of pollution emitted basis, and they vary by region. The SO₂ fee ranges from RMB 1.2/kg in Beijing to 0.2/kg elsewhere, and the waste water discharge fee is 0.05yuan/ton for pollution discharged beyond the set pollution standard. All SO₂ emissions from a unit are subject to the fee; however, in the case of wastewater, only discharges greater than a specified maximum (per period) are assessed the levy. All revenues from the pollution discharge fees go to local governments (primarily county and territorial) of the areas in which the payer is located. Only a small part of the revenue goes to provincial governments, and none goes to the central government. Approximately 80% of the monies raised by the pollution discharge fees is used for treatment of important pollution sources, and the other 20% funds environmental protection bureaus.

Recommendations

A critical challenge that China will face in restructuring its electric industry is how to reform its

system of taxes and levies to maintain adequate revenues to support appropriate governmental activities and policies while at the same time mitigating the potential anti-competitive effects of those taxes and fees. This is further complicated by the need to preserve, in the short term at least, the current allocation of those revenues among the various levels of government. There are several principles that should guide the tax and levy reform effort.

1. *Simplicity*. To the extent possible, reduce the number of different fees and taxes. A wide variety of differing taxes and fees is both confusing and administratively burdensome.
2. *Competitive neutrality and fairness*. A particular fee should be applicable to all producers or users. Exempting specific classes (or regions) of producers or users from having to pay a particular tax or fee gives that class a competitive advantage over its rivals elsewhere. In the case of pollution levies, competitive neutrality is maintained through the use of electrical output-based requirements, which reward producers for cost-effective reductions in their discharges. To the extent possible, taxes and fees should be designed to give users and firm's incentives to act in ways that advance China's overall public policy objectives.
3. *Reasonable allocations of revenues*. A suitable allocation of revenues among local, provincial, and central levels of governmental should be established. In the short-term, this generally means that the current allocations should be maintained, although changes in allocations over time may be appropriate. It is critical to understand how industry restructuring will affect ownership, sales, and investment, all of which will in turn affect governmental revenues.