*The Regulatory Assistance Project*

# *SERC During the 11th Five-Year Plan: Building an Effective Regulatory Framework*

Prepared for the

## State Electricity Regulatory Commission

Prepared by
The Regulatory Assistance Project

Revised December 2004
under a contract with the World Bank and the Energy Foundation

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# Part 1. Introduction

China's electricity industry is in the midst of a monumental reform. Over the past decade, government ministries and power enterprises have been restructured, eliminated, and newly created, all as part of the country's plan to modernize and expand the industry to meet the rapidly growing needs of the economy. One critical aspect of the reform has been the creation, in March 2002, of the State Electricity Regulatory Commission (SERC). Establishing the regulatory agency was a major but relatively easy first step. International experience shows that the success of newly established regulatory agencies will depend on the agency having the necessary scope of authority, a reasonable set of practices and procedures, and a professional and well-trained staff.

The State Electricity Regulatory Commission must simultaneously oversee the creation of China's electricity markets and establish itself as an agency making prompt and fair decisions on complex technical and economic matters. To do these things effectively, it must have a clear sense of its goals and plans for their implementation. While it must always be ready to modify its direction as events and new knowledge require, the proposed roadmap is a crucial management tool to enable SERC to focus on a distinct plan in order not to find itself in constant turmoil as it reacts to the agendas and demands of others, as well as to events that it cannot control.

This need is particularly acute because SERC must take form during a time of anticipated power shortages. During times of shortage, regulators everywhere are under constant pressure to take shortcuts in order to bring new capacity online. In China, these pressures are likely to take the form of postponing regulatory innovation in order to continue to operate under a power supply regimen that, however inefficient and inimical to private capital it may be, is at least familiar. These pressures will be compounded by the inevitable temptation for regulators to allow their priorities to be set by the requests made of them by other entities with urgent permits to be granted or disputes to be resolved.

Everything about SERC will be new for China. The regulatory agency is new. The introduction of competition into the electric sector is new. Regulatory practices and procedures are new. SERC will need to focus on a clear and achievable workplan in order to carry out the tasks assigned to it in the Electric Power Sector Reform Plan (State Council Decree #5). The preparation of this roadmap is therefore a task of great urgency to the future functioning of SERC and of the electric energy sector.

The World Bank's October 2002 working paper "Establishment of a State Power Regulatory Commission in China: A Suggested 'Roadmap'" concluded that "the goal of the (Roadmap) project should be to establish a 'best practice' regulator; ….and the prioritization of tasks to this end should be based on, and synchronized with, the restructuring of the power sector". The prioritization and synchronization that the Bank stressed form the core purpose of the roadmap.

This report, a joint effort of the World Bank and Energy Foundation, builds on the earlier Roadmap efforts and provides SERC with a more detailed outline of the steps needed to build an effective regulatory framework during the 11th Five-Year Plan.

## 1.1. Contents of the Roadmap

The report has four parts:

- Part 1 is the Introduction
- Part 2 describes SERC's mission, its fundamental goals in the restructuring of the Chinese electric sector, and the actions that it will take to realize those goals.
- Part 3 consists of a detailed outline that will describe and show in graphical form all major tasks and subtasks that SERC will need to undertake to fulfill its mission. The tasks will be divided into three categories: substantive, procedural, and organizational. The outline will cover the next five years and will provide a list of the tasks, an estimate of the minimum time needed to complete them, and a sequencing and prioritization of them.
- Part 4 is a series of short papers describing key issues, options, and relevant international experience. These papers relate to the particular tasks listed in Part 3.

We believe that this report can serve internal and external purposes. Internally, it can guide the work of each Division and the work of outside consultants. The outline can be a management tool. Regular reports to the Commissioners will show where progress is being made and where more effort and resources may be needed.  Externally, the report can provide the public and stakeholders with a clear understanding of SERC's priorities and schedules.

The roadmap, however, is a management tool to help SERC meet its basic goals and purposes. As such, it must remain flexible and allow changes as needed to meet unanticipated events. The roadmap must also be reevaluated continuously to assure that it remains consistent with SERC's priorities and with those of China.

# Part 2. SERC Mission and Goals

## 2.1. SERC Mission

The necessary first step of any workplan is to articulate SERC's goals for power sector reform. We begin with a possible "mission statement:"

> **The purpose of power sector reform is to ensure that all the people of China have access to reliable and reasonably priced electric utility services provided safely, cleanly, and efficiently.**
>
> **China's electric sector reform agency seeks to excel in all aspects of this mission. It will be fair, expeditious, transparent, and responsive to public concerns and to individual consumers.**
>
> **Power sector reform seeks to stimulate excellence in Chinese utility operations. The profitability of China's privately-owned utilities should reflect their efficiency, their sensitivity to their customers and to the environment, and the reasonable expectations of their investors.**

Below we describe China's goals in two sections. First, we list fundamental goals that relate to the power sector. Second, we describe important policy choices concerning power sector reforms. Together these goals and policies will influence the number and content of the workplan.[1]

## 2.2. Goals

Fundamental goals for the power sector are:

1. **To meet rapidly growing demand for energy service in a reliable manner.** The reforms must assure that the sector can attract needed investment for generation transmission, distribution, and energy efficiency.
2. **To lower costs.** Electricity is a vital input to many goods and services produced in China. It is also essential for a well-off and prosperous society. Reforms must produce an optimal mix of investment in generation, transmission, distribution, energy efficiency, advanced technology, and pollution control. Prices must cover costs if resources are to be used efficiently and utilities are to be financially healthy. Reforms must also provide incentives for efficient operation throughout the electric sector and must not reward inefficiency.
3. **To make service available at reasonable prices for consumers.** 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 (1) the transition for existing plants is well

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[1] The main problems power sector reform seeks to address are well known and include: 1) inefficient dispatch due to existing grid prices, contract structure, ownership structure, and tax revenue distribution; 2) inefficient planning and investment incentives; 3) an inefficient and non-transparent pricing system; 4) insufficient trading; and 5) a lack of incentives to invest in energy efficiency and other least-cost options.

designed, (2) the restructured power sector does not have market power problems, and (3) all costs are considered.

4. **To lower risk.** Restructuring of the power sector in other countries has sometimes led to serious reliability and price volatility problems. China's reforms should minimize the risk of similar occurrences here.
5. **To achieve universal service.** At least **t**hirty million people lack access to electricity. Many more people have very low incomes and cannot afford electricity. Making electricity available and affordable to these consumers has been a long-standing Chinese goal.
6. **To support regional development.** The economic and power supply development of Western China is a high priority goal for China. Market design and market rules will influence what plants are built, where they are built, and what plants are dispatched. Western China is blessed with large amounts of natural gas and renewable resources, especially hydro and wind. Market rules will determine the pace at which the transmission gets built and the manner in which it is operated in ways; China must be careful in designing those rules so as to support – and not inhibit – the desired development in western China.
7. **To improve the environment**. Air pollution is a serious economic and health problem in China, and environmental improvement is high on China's list of national priorities. The power sector is a major part of the problem. How SERC reforms the power sector can increase or decrease air pollution created by the sector. An electric sector compatible with public health and environmental objectives can best be achieved if prices reflect the full costs of each type of generation. If this goal is attained, the utility industry will have the best incentives to use advanced technology to good advantage, as well as to encourage the use of energy efficiency.

### 2.3. Policy Choices

China has adopted several basic policies that will influence how SERC and others implement power sector reforms. These policies, however, are not goals; they are a means of achieving the goals. Policies must constantly be adjusted and revised to meet the goals. The policies include:

1. **Market-based mechanisms.** Market-based methods will be used when possible to increase efficiency and reduce unnecessary government involvement.
2. **A competitive market structure**. China has separated generation from the grid and will gradually introduce competitive bidding for grid access. Regulators will design rules and oversee the markets to assure fair competition and to assure that development and environmental goals are met. Generation will become competitive but transmission and distribution will remain combined initially and the grid company will be the single buyer (at the provincial or regional level). Next, transmission and distribution will be separated, creating multiple buyers, and then large consumers will be allowed to buy power directly from the market. (Given China's size and diversity, we do not expect that these reforms

will occur simultaneously across the country's many regions and provinces, but rather will be effected as circumstances and experience dictate.)[2]

3. **Pricing**. Initially, pricing and tariff-setting responsibility are shared by SERC and NDRC. SERC's role is to advise NDRC by suggesting prices and pricing methods for consumers and generators that will bring about more efficient system operations and will be more reflective of costs.
4. **Employment of advanced technology.** Because China's very high growth rates will result at least in a doubling of the electric sector by 2020 and because the stated goals cannot be attained without technological advances in the electric sector, policies that encourage the use of best available technologies from throughout the world should be adopted as long as the impacts on the national energy bill are acceptable.
5. **Efficient, open, and transparent regulation**. Elements of the electric sector that are not competitive (e.g., transmission and distribution) will be regulated in an efficient, open, and transparent manner. Where multiple governmental agencies are involved, their activities will be coordinated to be efficient, fair, and predictable. Regulation will be implemented so that operations that produce the lowest bills for their customers should earn the highest profits. Prices to consumers and generators will be more efficient and more reflective of costs. Efficient regulation also means SERC's regulation will be coordinated with other government policies and programs. (For example, building codes and pollution-control laws).

As an adjunct to the roadmap, this document contains a compilation of short discussion papers touching on the broad range of sectoral and institutional issues facing China and SERC, with suggestions on policies and regulatory actions suited to them. The papers are grouped loosely according subject matter. The first six address general regulatory responsibilities: revenue- and price-setting, auditing, and licensing. The remaining seven look at market issues: market structure, system operations, generation contracts, single- and multi-buyer systems, market power and monitoring, retail access, and sustainability.

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[2] The separation of generation from the grid and the creation of competitive bidding systems are often described as goals. We view market competition as a tool to achieve the objectives of increased efficiency, lower costs, and environmental improvement. This view can be tested by asking whether separation and bidding would be retained if these policies led to higher prices and a degraded environment.

## Part 3. The Map

# Part 4. Regulatory Policy Papers

## 4.1. Power Shortages: SERC's Regulatory Challenges

### 4.1.1. Introduction

SERC's performance is being tested by a very tight power supply situation in more than twenty provinces in China. The current power shortage is a defining moment for SERC. For many people, SERC's handling of the situation will form a lasting impression of what SERC is and what it can do. It will also determine the utilities' perception of SERC.

The purpose of this paper is to provide SERC and NDRC with useful examples of international experience with electricity shortages and what that experience suggests for SERC.[3] Many countries and states have experienced different types of crises. Examples include California and other regions of the U.S., Brazil, Chile, Indonesia and New Zealand. More chronic shortages have persisted in parts of the former Soviet Union and in some African countries.

The basic lessons can be summarized as follows:

- Regulators will have a critical role in solving an electricity crisis and in preventing future problems. They are also likely to be held responsible if the crisis is not resolved.
- The most effective, quickest, lowest cost and cleanest options to address the shortages are energy efficiency, new supplies with short construction periods such as renewables and distributed generation, demand response programs and innovative pricing reforms, and emergency planning. SERC must focus on these options because these options are not well known and may not be obvious or attractive options to the utility companies.
- Power shortages frequently lead to poor decisions and lost opportunities. There are many examples of power shortages leading countries to commit to too much of the wrong kind of power supply at prices that are too high. The result has long-term and undesirable economic and environmental consequences. Poor decisions can also lead to short-term fixes that eventually lead to another power shortage cycle.
- The most desirable responses to a short-term crisis are those that contribute to long-term solutions, and provide additional benefits to the power sector or to society as well. For example, efforts to accelerate energy efficiency deployment will provide economic and environmental savings long into the future, even if shortages do not persist. Interruptible load programs will help meet needs during a shortage, and will also help to mitigate market power of generators in China's future wholesale power markets.

### 4.1.2. What is the role of regulators?

China's current power shortage has occurred during a transition period. Generating companies, grid companies, and the regulator are all newly created. In a time of crisis, agencies tend to react as if they were still under the old organizational structure. But the new structure is very different from the old

[3] The recent blackouts in the U.S. and U.K. will teach other lessons, some of which may be the same as lessons learned from power shortages. The exact causes of these blackouts are still being studied.

structure, and each entity has a new and very unique role.

The regulator's role is very different from the role of the power companies. Regulators do not run or manage the power companies; they oversee the industry and protect the public's interest, including the public's interest in having access to safe, reliable, and reasonably priced power. Regulators establish and enforce the duties and responsibilities of the utility. Regulators establish service standards, and oversee the utilities' performance to assure that they are meeting the standards and that they are performing their jobs in an efficient and non-discriminatory fashion. Regulators also must assure that they, the government, and the public are getting accurate information as promptly as possible.

For China, identifying SERC's role is a special challenge for several reasons. First SERC is new and inexperienced in its role as a regulator. Second, although increasingly separate, SERC, the grid companies, and most generating companies are all government entities.[4] Third, many of the normal functions of a regulatory agency, especially authority over pricing, investment, and planning, are shared between SERC and NDRC.

Describing the difference between SERC and NDRC is especially difficult because some of the most important regulatory functions are assigned to NDRC.[5] The division of responsibility may lead to one of several results: 1) SERC and NDRC will be able to work together in a coordinated way but the important distinction between SERC and NDRC will be lost; 2) SERC and NDRC will each take steps to address parts of the problem but coordination will be lost; or 3) the problem will not be solved as quickly or economically as possible and each agency will blame the other.[6]

### 4.1.3. What should regulators be doing to prepare for a crisis?

Regulators need to take four steps:

- collect needed information,
- learn from international experience,
- take action to address the current problem, and

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[4] A World Bank report, "The California Power Crisis: Lessons for Developing Countries" John Besant-Jones and Bernard Tenenbaum concludes, "the inescapable reality is that most public enterprises, despite lengthy and expensive programs to 'commercialize and corporatize' them, still usually act like public enterprises."

[5] In the U.S., we could compare the role of a regulatory agency, the Federal Energy Regulatory Commission (FERC) and a government agency, the Department of Energy (DOE). FERC sets and enforces prices and market rules for electricity and gas that is sold at wholesale (not directly to end use customers). FERC also licenses hydroelectric dams on navigable waterways and gas pipeline facilities. FERC, however, lacks all the authority needed to address power shortages and reliability issues.

In contrast, the DOE makes policy recommendations to the President and to Congress but has little direct decisionmaking authority as to electric and gas markets. DOE does have extensive operational authority with regard to such subjects as the development of a nuclear waste repository and the operation of U.S. national laboratories

[6] This third alternative is what occurred in California. The energy crisis lingered as California regulators blamed FERC and FERC blamed state regulators.

- adopt measures to reduce the chances of similar problems occurring in the future.

Clearly, SERC has already been collecting information and plans for as much as 30 GW of additional generating capacity have been approved. Therefore, the discussion below is brief in some sections and more expansive in other areas that need more attention.

#### 4.1.3.1. Collect information

SERC needs to be fully informed on the nature, cause, and severity of the problem.

SERC needs to fully understand the geographic and temporal nature of the power shortage. Is it limited to a few hours per year, or is the problem more persistent? What end-uses (e.g. air conditioning, etc.) are contributing most to the problem? How does the transmission system contribute to the problem? Are areas not presently experiencing a power shortage at risk from shortages occurring in the next few years?[7]

SERC needs to collect information on the existing and potential use of available price and price related options. This includes interruptible programs, where large consumers are paid to curtail use during specific periods.[8] SERC also needs to collect information on the status and use of existing generation, including standby and emergency generation located in buildings, factories, and hospitals.

SERC needs to be familiar with new technologies and how these technologies are affected by existing and proposed market rules. For example, massive urban construction and plans to use more natural gas mean China could benefit greatly from increased use of combined heat and power applications, including air-conditioning.

Renewable resources offer several advantages. First, most renewable generation options are modular and can be built and brought into operation in a very short period of time (six months to a year). Second, adding renewables reduces risks by diversifying the sources of supply.

Increased energy efficiency can substantially reduce the rapid growth in electricity demand and improve the economy. Reducing the rapid demand growth is an important way to reduce the likelihood and frequency of power shortages.

A June, 2003 study by Chinese experts estimates that the implementation of minimum energy efficiency standards and information labeling programs for common domestic appliances and major energy-using industrial equipments in China can save almost 60 gigawatts of power by 2020. This eliminates the need to build and fuel 200 average power plants (300 megawatts each), and reduce growth in residential electricity use substantially over the next 17 years.[9] Adoption of the standard

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[7] The New England ISO has identified energy efficiency investment and demand response options as vital options to solve reliability problems in parts of Connecticut. See, http://www.dpuc.state.ct.us/dockcurr.nsf/Web%20Main%20View/Search%20Electric?OpenView&Start=42

[8] See RAP's August 2003 paper prepared for SERC entitled "Discussion of Electricity Price Reforms and Other Regulatory Options To Effect Efficient Consumption"

[9] See "Prediction of Energy Conservation Potential for China Major Energy-using Products Through Standards and Labels" June 2003 http://www.efchina.org/documents/FnlRpt-EngO!EcaC.pdf for the English version.

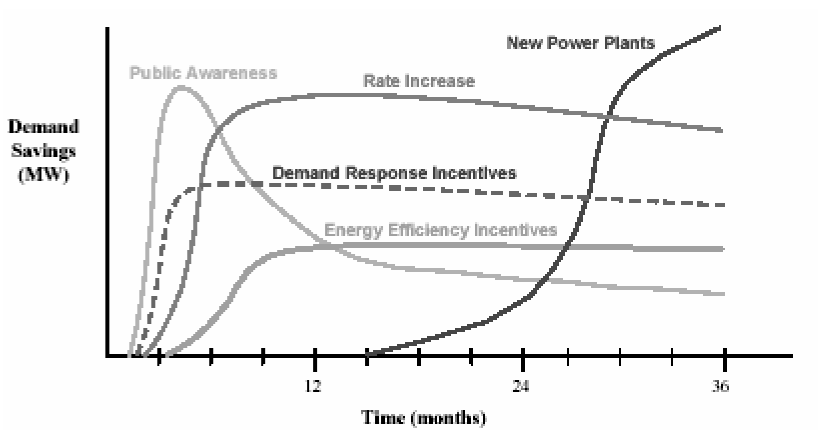
would be very cost effective saving China's economy about $540 billion RMB over the 2003-2020 time period, discounted to 2000. The standards also reduce emissions in the year 2020 by 104 million tons of carbon, 1.6 million tons of NOx, 20.6 million tons of $SO_2$, and 9.6 million tons of $PM_{10}$.

SERC needs to review how the pilot competitive markets have been performing during this period. There is a great deal of international experience with competitive generation markets that work well during times of surplus capacity, but that show evidence of serious market power and structural problems when supplies are tight. SERC needs to better understand if similar problems are arising in China.

#### 4.1.3.2. Learn from international experience.

There is a great deal of recent international experience of regulators addressing crisis situations. High priority should be placed on training and workshops focused on this topic.

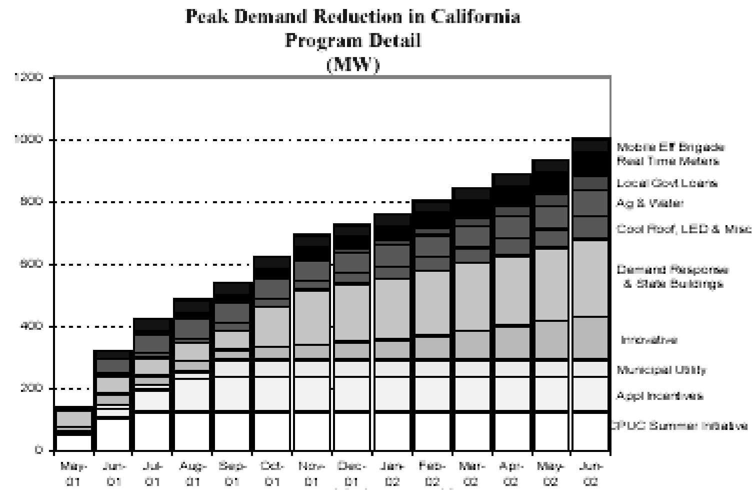
The scope and effectiveness of the government's response to the California crisis and similar problems elsewhere in the U.S. has been analyzed in depth.[10] One lesson is that the best response requires a coordinated mix of actions, some that deliver immediate help and others that deliver help over a longer time period. The following graph from the California Energy Commission shows the mix of actions and response times:




California adopted a wide range of immediate and medium-term supply and demand-side options. The major California demand-side programs and their contributions to solving the crisis are summarized below:

[10] See http://www.aceee.org/conf/prsntatn.htm for the detailed presentations delivered at a conference that review the responses to power shortages in California, the Pacific Northwest, and New York.

See also "Efficient Reliability: The Critical Role Of Demand-Side Resources In Power Systems And Markets", prepared for The National Association of Regulatory Utility Commissioners, Regulatory Assistance Project, June, 2001. See, http://raponline.org/Pubs/General/EffReli.pdf. As that report states," a narrow focus on fixing today's weakest links in supply and delivery alone will ultimately be less resilient and more expensive than a strategy that also targets reliability-enhancing demand-side investments."




The California crisis was felt throughout the entire western U.S. The response in the Pacific Northwest, which has many energy intensive industries, and where a large fraction of the power generation is government owned, may be of special interest to China.

Demand reductions in the Pacific Northwest exceeded 4000MWs. As shown below, the reductions were achieved through a mix of innovative economic incentives and accelerated energy efficiency efforts.

- 2,500 MWs: Curtailment of energy intensive industries (includes 1,160 MWs from BPA's buyback program and 1,200 MWs of remarketed power).
- 300 MWs: Irrigation load buyback (seasonal).
- 500 MWs: Industries responding to high prices (includes operating their own generation).
- 160 MWs: Suppliers paying consumers to reduce demand.
- 150 MWs: Consumers responding to rate increases.
- 390 MWs: Accelerated conservation programs and appeals to the public to reduce demand, and other influences.

New York experienced power shortages during the past two summers. The State responded with the following mix of policies (the data refers to MWs):

| | Summer 2001 TOTAL | Summer 2002 TOTAL | Two-Year Cumulative |
|---|---|---|---|
| Long-Term Energy Efficiency | 77.1 | 103.00 | 180.1 |
| Customer Generation | 28.1 | 38.00 | 66.1 |
| Public-Facility Load Control | 9.8 | 28.00 | 37.8 |
| Direct Load Control | 0.0 | 14.00 | 14.0 |
| Voluntary Load Control | 155.6 | 206.00 | 361.6 |
| Public Awareness/Appeals | 5.6 | 37.00 | 42.6 |
| **SUBTOTALS** | 276.2 | 426.00 | 702.2 |

In the late 1980s, when parts of New York had inadequate reserve margins, the affected utilities undertook extensive maintenance programs to assure that all of their generators operated during the summer peak periods. They succeeded in reducing the normal unplanned outages for their system from about 11% to less than 3% of their generating capacity during the most critical periods.

The six New England states in the northeastern U.S. have recently concluded a two-year effort to identify the best practices in improving reliability through demand response programs, improved wholesale and retail pricing, energy efficiency, and planning.[11] Participants in that effort, which included regulators from six states and both the New England and New York ISOs, concluded that the potential for both peak load and energy reductions was quite large, even in a region with decades of experience in demand management. They also concluded that efforts should focus on energy efficiency, on demand response by customers (interruptible loads), and on efficient customer-based generation (e.g., combined heat and power). These efforts should proceed together, not in isolation.

If there is a real likelihood that blackouts will occur in any area, the damage done will be much less if utilities are able to warn citizens ahead of time, to identify facilities (such as hospitals) that should not be without power unless they have their own generation and to inform customers accurately of the length of the power outage.

In the U.S., the emphasis was on energy efficiency, customer load response because these options were fast, low cost, and most likely to be overlooked by utility planners. A detailed U.S. study of the energy efficiency and DSM response to the California crisis and similar situations elsewhere in the US

[11] The New England Demand Response Initiative ('NEDRI') is aimed at developing a comprehensive, coordinated set of demand response programs for the New England regional power markets. NEDRI's goal is to outline workable market rules, reliability standards, and regulatory criteria to incorporate a demand response capability into the electricity wholesale and retail markets. The Initiative will promote best practices and coordinate policy initiatives, not replace the functions that the ISO and other organizations must perform to design and implement demand-side programs. See "Dimensions of Demand Response: Capturing Customer-Based Resources in New England's Power Systems and Markets," (Report and Recommendations of the New England Demand Response Initiative, July 2003), posted at www.raponline.org.

concluded:

> "The results suggest that the potential for the use of energy efficiency programs to help address electric reliability concerns may be greater than is currently being realized.[12]

The following Table presents the estimated demand savings impacts from these efforts. For China, the two most important lessons are 1) energy efficiency solutions are fast and effective, and 2) the energy efficiency solutions are low-cost and clean.[13]

| Estimated 2001 Costs and Impacts from Energy Efficiency and Conservation Related Programs[14] | | |
|---|---|---|
| | Program spending ($million) | Estimated Savings (MW) |
| California | 971 | 3,668 |
| Northwest | 150 | 390 |
| New York | 72 | 263 |

Brazil and Chile both experienced power shortages, in part caused by prolonged severe droughts. In both cases however, the regulatory response contributed to the problem. Regulators in Brazil were blamed for failing to take the needed reform steps to encourage new investment. They were also

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[12] Energy Efficiency and Electric System Reliability: A Look at Reliability-Focused Energy Efficiency Programs Used to Help Address the Electricity Crisis of 2001, Martin Kushler, Ed Vine, and Dan York, April 2002, ACEEE. See http://aceee.org/pubs/u021full.pdf

[13] For an excellent discussion of how energy efficiency investment can increase reliability see http://nedri.raabassociates.org/events.asp?type=typ. The report concludes, "…cost-effective energy efficiency programs make electricity markets more competitive and more efficient, significantly improve the reliability of the electric system in New England, and reduce the costs and environmental impacts of electric service. Therefore, the states and region should consider regulatory, institutional, and market reforms that would increase the region's reliance on energy efficiency as a resource, together with other beneficial demand-side resources. "

[14] Energy Efficiency and Electric System Reliability: A Look at Reliability-Focused Energy Efficiency Programs Used to Help Address the Electricity Crisis of 2001, Martin Kushler, Ed Vine, and Dan York, April 2002, ACEEE. See http://aceee.org/pubs/u021full.pdf

blamed for failing to develop and implement effective emergency plans.[15]

Chilean regulators were blamed for slow and ineffective action.[16] Regulators in both Brazil and Chile were also criticized for taking actions based on short-term political considerations.17 Chilean regulators failed to implement effective demand-side options and Brazil's demand-side action was rationing combined with taxes and fines.[18]

These examples also serve to remind us of the importance of continuous progress on efficiency and other distributed resource options even when there is *not* a current crisis. In Brazil, an ineffective regulatory program for energy efficiency, coupled with utility incentives to increase sales, had led to higher rates of load growth over the years. Thus, when the drought arose, the power system was more rapidly thrown into a crisis situation.

A similar situation preceded the crises in California and New York. In California during the mid-1990's utility energy efficiency programs were cut back significantly and 1100 MW of potential savings were lost. That extra load on the system greatly exacerbated California's price spikes and power supply problems when shortages later arose. In New York, utility efficiency programs were cut by nearly 75% in the mid-1990's as part of the response to utility restructuring. After the shortages arose, these programs had to be re-started, but valuable opportunities had been lost and the shortage made worse as a result.

U.S. regulators have also recognized the importance of demand-side resources for reliability. They have by resolution urged state regulators, power pools, and Congress to "encourage and support programs for cost-effective energy efficiency and load management investments as both a short-term and long-term strategy for enhancing the reliability of the nation's electric system."[19]

Power shortages can lead to outages, high prices, and poor decision-making that have negative long-term economic and environmental consequences. For example, power shortages have led to decisions to delay or waive environmental rules and to the acceleration or construction of uneconomic power plants. Many countries, including the Philippines, India, Indonesia, and the U.S. (most recently California), have entered into expensive long-term power contracts that have lasting economic and political problems.

In China, power sector reforms during the period 1985 to 1996 were aimed at addressing the last power shortage. Although the power shortage was addressed, one result was the "one plant one price

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[15] See "The Electricity Crises of California, Brazil and Chile: Lessons to the Chilean Market", David Watts & Rafael Ariztía. See http://www2.ing.puc.cl/power/paperspdf/wattsariztia.pdf

[16] Id.

[17] Id. See also, "Regulatory Governance and Chile's 1998-1999 Electricity Shortage", Ronald Fischer and Alexander Galetovic, July 2000, http://www.worldbank.org/wbi/regulation/pdfs/2704.pdf

[18] Id

[19] See, "Resolution Supporting Energy Efficiency and Load Management
As Cost-Effective Approaches to Reliability Concerns, July 1999. Adopted unanimously by NARUC, July, 1999

policy" that led to many of China's most expensive new power plants.

Signing overly expensive contracts is not unique to developing countries. One of California's responses to the power crisis was to sign numerous long-term contracts, mostly with new gas-fired plants. As the crisis passed, the contracts were widely seen as being far too expensive. Efforts to nullify and renegotiate the contracts became a high priority. The original long-term contracts were expected to cost the state about $43 billion over a ten-year timeframe. Most of the contracts have now been renegotiated and the total cost is now about $33 billion, which is still considered to be above the market price.[20]

#### 4.1.3.3. Take action.

Based on the conditions in China and international experience, there are a series of actions SERC should take.

SERC needs to review the utilities' plans to address the problem in the short and long-term. Short-term plans include all efforts to obtain additional sources of supply, all efforts to target maintenance in ways designed to prevent unplanned outages during peak periods, all efforts to reduce consumer demand through tariff changes,[21] demand response programs and policies, direct investment, appeals to the public to conserve at particular times, mandatory load reduction in government facilities, public education, and all contingency plans to address energy shortfalls. SERC needs to assure that all available options are being considered and that least-cost options are being implemented.

SERC needs to integrate its response to the power shortage with the next steps in power sector reform. SERC should identify steps in power sector reform that should be accelerated to help address the power shortage. These include the following:

- Remove regulatory barriers and obstacles to utility investment in energy efficiency and distributed resources.
- Rules relating to entry should be a top priority. Easing entry barriers for private construction of new power supply, especially high efficiency cogeneration and renewables, will help reduce future market power concerns. Requiring competitive bidding for all new supplies will increase the number of suppliers and deliver the lowest cost and most efficient new supply.
- SERC needs to establish rules describing how future power sector reform will apply to new plants.

Transparency needs to be stressed throughout the process. SERC's evaluation of the situation and plans to address the problem should be published and updated periodically. The public and stakeholders should be invited to comment on all preliminary findings, conclusions, and recommendations.

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[20] For a summary of key events and an accounting of contract costs see http://wwwcers.water.ca.gov/pdfFiles/Financial%20Statments/063002dwrElectricPwrFndAnnualRprt.pdf. For an analysis of the relative risks of gas-fired versus renewable based contracts see http://eetd.lbl.gov/ea/EMS/reports/50965.pdf

[21] High priority pricing reforms are discussed in a separate paper.

SERC needs to be communicating with stakeholders and the public about the nature and cause of the power shortage and steps being taken to solve the problem. Communicating with the public is especially important. These communications will help determine whether the public sees SERC as being part of the problem or part of the solution. SERC's long-term success depends on consumers seeing SERC as the protector of the public interest, and not just the protector of the industry.

#### 4.1.3.4. Reduce chances of future problems

SERC should create a process to assure regular and frequent reviews of utilities' long-term plans. The current power shortage was not entirely unforeseeable. In May 2000, we observed,

> *"China's electricity sector is undergoing very rapid growth. Any perception that the country is currently in a surplus capacity condition quickly evaporates when one looks at the rate of growth of electricity use. This is the time to begin designing and implementing aggressive end-use energy efficiency programs. It is important to implement and integrate the conservation and clean production laws to reduce energy growth while expanding the economy."*[22]

Our experience shows that regular reviews of long-term plans are the best way to assure that growing consumer demand is met in a reliable and least-costly manner.

Develop infrastructure for energy efficiency and renewable energy. The U.S. experience shows that

> "…having an established program infrastructure in place for pursuing energy efficiency is extremely important in providing the ability to roll out accelerated programs in an emergency. Existing institutions with authority and experience are crucial to achieving a rapid ramp-up of activity in the field."[23]

In China, it is also clear that more than one agency is responsible for overseeing and reforming the power sector. Coordination among the various Chinese agencies is needed.

The most recent international example of the type of cooperation needed is the California Draft Energy Action Plan. To help prevent future power shortages, California utility regulators and two other California government agencies worked together to prepare the Energy Action Plan.[24]

The Energy Action Plan sets forth goals and specific plans, beginning with the following goal:

> "To ensure that adequate, reliable, and reasonably-priced electrical power and natural gas supplies, including prudent reserves, are achieved and provided through policies, strategies, and actions that are cost-effective and environmentally sound for California's consumers and

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[22] See "Comments at the International Symposium on Restructuring and Regulation of China's Electric Industry, hosted by the State Council Office for Restructuring Economic Systems (SCORES), Regulation or Competition: The California Experience Shows Both Are Needed", Regulatory Assistance Project, May 2001, http://www.efchina.org/documents/RegOrCmp.pdf

[23] Energy Efficiency and Electric System Reliability: A Look at Reliability-Focused Energy Efficiency Programs Used to Help Address the Electricity Crisis of 2001, Martin Kushler, Ed Vine, and Dan York, April 2002, ACEEE, http://aceee.org/pubs/u021full.pdf

[24] See http://www.cpuc.ca.gov/PUBLISHED/REPORT/26305.htm

taxpayers." [25]

### 4.1.4. Conclusion

SERC has a critical role to play in solving an electricity crisis and in preventing future problems. China's current power shortage presents SERC with a special challenge and opportunity. How SERC fulfils its role will determine it future reputation with utilities and consumers.

How SERC fulfills its role is also different from how the utility fulfills its role. SERC's response to the power shortage needs to be done in an open and transparent fashion. All stakeholders need to be involved in defining the extent of the problem and in suggesting and commenting on the solution

SERC, the public, and the environment would be best served by SERC considering the following:

The most effective, quickest, lowest cost, and cleanest options to address the shortage are energy efficiency, renewables, and innovative pricing reforms. SERC's focus on these options is needed because these options are not well known and may not be attractive options to the utility companies.

SERC should establish entry regulations to permit easy entry by all potential competitors including developers of power supply projects, providers of energy efficiency and demand reduction, and developers of renewables and CHP.

In order to prevent the problem from reoccurring SERC must commit to regular reviews of utilities' long-term plans.

## 4.2. High Priority Pricing Reforms

### 4.2.1. Introduction

The purpose of this paper is to discuss pricing and related reforms that will improve electric sector efficiency and help address China's power shortage. These are high priority Roadmap issues especially because of the existing power shortage.

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[25] The Action Plan identifies the following six specific steps they will take to prevent another crisis.

- Meet California's energy growth needs while optimizing energy conservation and resource efficiency and reducing per capita electricity demand.
- Ensure reliable, affordable, and high quality power supply for all who need it in all regions of the state by building sufficient new generation.
- Accelerate the state's goal for renewable resource generation to 2010.
- Upgrade and expand the electricity transmission and distribution infrastructure and reduce the time before needed facilities are brought on line.
- Promote customer and utility owned distributed generation.
- Ensure a reliable supply of reasonably priced natural gas.

SERC does not currently have pricing authority. We include pricing in the Roadmap because SERC may (and should) have this authority in the future and because SERC has the responsibility to recommend prices and pricing policies to NDRC.[26] It also has the authority to adopt market rules and other innovative programs that can achieve many of the benefits of improved pricing.

Our essential conclusions and recommendations are:

1. Prices should reflect costs including, to the extent possible, all externalized environmental costs. These reforms should be implemented in ways that are consistent with other stated objectives, such as consumer protection, economic efficiency, equity, and environmental protection.

2. Existing retail and generation prices are inefficient. Reform of generation and retail prices should be coordinated.

3. There are many pricing and other economic policy tools that are available to address the power shortage. The best combine higher prices, surcharges, or fines on inefficient electricity use or use during critical periods with lower prices, rewards, and incentives for efficient use and demand reductions. These approaches will address the power shortage more effectively and efficiently than will involuntary electricity curtailments.

### 4.2.2. Statement of the Problem

China can achieve significant cost savings and efficiency improvements by reforming electricity pricing, both wholesale and retail. In addition, the current power shortage makes it especially important to use innovative pricing programs that give consumers the incentive to use electricity more efficiently, to invest in more efficient buildings, appliances, motors, and processes.

There are many pricing-related issues unique to China. The most important are discussed below.

#### 4.2.2.1. Generation and Consumer Power Prices are Inefficient

Pricing at both the generation and consumer levels is economically irrational and inefficient, and the means by which prices are set are far from transparent.

Under current generation pricing practices, each generating plant receives a single energy-based price for its output. The price covers capital and energy-related costs. The price is reviewed and changed periodically.  For example, prices for coal generation were increased in January 2004.

The one-part pricing approach is not consistent with international practices and is currently under review. The current generation pricing practices lead to several types of inefficiencies. First, dispatch of generation is inefficient. Plants with low running costs but high capital costs may be dispatched after plants with high running costs, but lower total costs.

The second inefficiency relates more closely to retail pricing. With current generation pricing practices there is little, if any, time-of-day difference in generation costs incurred by the grid company. This leads to a serious mismatch between the costs the grid company's incur and the prices they charge end-users.

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[26] The need for consolidating pricing authority in a single, independent regulatory agency is discussed in a separate paper.

For example, In Shanghai, many consumers pay TOU prices with on-peak prices of about 1 RMB/kWh and off-peak prices about 0.20 RMB/kWh. The generation costs of the grid company, Shanghai Municipal Power Company, range from 0.30 to 0.50 RMB/KWh. This means that on-peak sales at 1.0 RMB/kWh are very profitable and off-peak sales at 0.20 RMB/kWh are made at a substantial loss. Customers responding to TOU prices by shifting load to off-peak periods cause significant losses to the grid company.

Third, generation prices do not fully reflect environmental costs. Many studies have identified the significant environmental cost of air pollution.[27] The failure to recognize environmental damage costs in generation prices means that prices that are too low in general and that the highly polluting plants have an unfair competitive advantage over the less polluting plants.[28]

As for consumer prices, they do not reflect reasonable estimates of actual capacity and energy costs. Nor do they reflect differences in voltage levels of service or load factors. Also, as mentioned above, current TOU prices do not correctly reflect actual TOU costs.

#### 4.2.3. Recommended Reforms

Consumer demand responds to prices and other economic signals. There are many times when consumers – residential, commercial, and industrial – are willing to reduce their demand when prices are high or when they receive benefits by reducing or delaying consumption. Methods for inducing customer demand response include:

1. Short-term customer load curtailments in response to direct payments from utilities or the system operator;

2. Short-term customer load curtailments in response to changes in retail prices; and

3. Long-term improvements in end-use energy efficiency in response to retail prices or other incentive programs.

Broadly speaking, there are two ways to give consumers better economic signals. The first is through changing the level and structure of retail prices – for example, by raising on-peak energy prices. Changing the level and structure of retail prices is a traditional regulatory action, but it may be more difficult in China because pricing authority is not a SERC function and because significant changes in electricity prices must be phased in gradually.

The second approach is to make use of a wide range of market rules, incentive and penalty schemes, and other innovative programs – for example, a market-based payment to consumers who reduce demand during peak periods. This second approach can include more targeted ways of sending better economic signals to suppliers and customers, which are currently within SERC's authority. Moreover,

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[27] Environmentally Friendly Pricing Solution For Coal-Fired Power Plants. Chinese Academy For Environmental Planning Chinese Research Academy Of Environmental Sciences, 2003

[28] International Experience: Incorporating Environmental Costs in Prices, Regulatory Assistance Project, 2003. http://www.efchina.org/documents/environmental_costs.pdf

consumers tend to be more accepting of these approaches than they are to significant changes in prices.

Both approaches can produce more efficient results and both approaches can be used to address power shortages. Given conditions in China, we suggest focusing on the following reforms. Some work by raising prices or imposing fines or surcharges. Others work by lowering prices or providing incentives or rewards. A combination of rewards and penalties can be powerful and effective. It is also in this way that funding needs (i.e., investment in energy efficiency) find funding sources (i.e., higher prices, surcharges, fines, etc.)

#### 4.2.3.1. Adopt High-Reliability Price Option

Optional high-reliability prices should be made available to large industrial and other customers that are willing to pay higher prices to avoid service curtailments.[29] The price premium, or surcharge, could be used for three purposes:

1. First, the funds could be used to pay other consumers to voluntarily curtail their electricity use.
2. Second, the funds could be used to provide financial incentives for consumers to purchase and install more energy efficient appliances, motors, and other devices.
3. And, third, if an electricity curtailment can be avoided by grid company purchases of emergency sources of power, the funds can be used to cover the grid company's incremental cost for that emergency power.

The allocation of funds to these three purposes should be on a least-cost basis.

#### 4.2.3.2. Critical Peak Prices For Large Industrial Customers

Many large commercial and industrial customers are already on TOU prices, but the prices extend to many hours and days that during which there is not a high risk of power curtailments. For large customers with real-time metering or other similar communication capabilities, very high prices could be charged for critical time periods. This pricing approach could apply to large consumers that do not elect interruptible service or the high reliability option described above. Funds collected under this option could also be used as described above.

#### 4.2.3.3. Adopt Price Surcharges For New Construction

New commercial and industrial construction is fueling the rapid growth in China's electricity demand.[30] Typical electricity pricing options do not give developers of these projects efficient price signals. In many cases the project developers make decisions concerning the efficiency of the building and major mechanical systems but the project developers do not pay the power bills. Building users and occupants that pays for electricity. There are several pricing approaches that can address this market failure. For example, development of hook-up fees can be designed to give builders and

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[29] The use of this option may be limited to consumers connected to the grid that allow their load to be isolated from other customers.

[30] For new industrial facilities, energy efficiency targets developed as part of China's Clean Production Law could provide a benchmark.

developers efficient market price signals. China used this pricing approach in the past but it was eliminated in 2002 together with many other electricity fees.

Also, much of the new construction fails to meet reasonable energy efficiency performance standards. Adopting a two-tiered pricing approach under which customers whose building meet the efficiency standards would pay a lower price than those whose buildings are inefficient (in effect, the inefficient customers pay a fine) could be a very effective way to improve the efficiency of new buildings.[31] The additional funds could be used for the same, or similar, purposes as listed above.[32]

#### 4.2.3.4. Inclining Block Prices For Residential And Small Commercial Customers.

"Block" prices are typically energy-only rate designs in which the unit price for incremental consumption changes as defined thresholds of usage within a period (usually a month) are passed. For example, the first 200 kilowatt-hours of monthly usage might be priced at RMB 0.35/kWh, and all consumption in the month above 200 kWh would be priced at a higher rate, say RMB 0.45/kWh. Prices of this sort are referred to as "inclining block prices" because the initial amount (or "block") of energy usage is priced at one rate and the next amount is priced at a higher rate. They have the effect of discouraging energy waste because, as a general matter, there is a significant correlation between the timing of usage in the high-cost blocks and the incidence of high-cost periods on the system as a whole.

The initial block should be set so as to cover the average minimum consumption of a consumer in each rate class. The second block (often called the "tailblock") would be priced at a higher rate to discourage inefficient demand. The intent is not to penalize customers for demand that they cannot avoid (for example, for basic services such as refrigeration and lighting), but to encourage them to turn off end-uses that they do not value highly. The inclining block rate design could be limited to only peak season (i.e., summer) months. Funds from the higher tail block price could be used as discussed above.[33]

#### 4.2.3.5. Adopt Price Reductions For Consumers That Interrupt Or Reduce Electricity Use

China has already adopted interruptible pricing programs. These should be expanded to include more customers. As discussed in other reports, one of the more successful pricing programs in California was the "20/20 program."[34] This gave individual consumers a 20% price reduction if they lowered their consumption during the summer months by 20% compared to their consumption in the previous

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[31] Before 2000, China's "Three-E Offices" used fines for the excessive use of power to reduce energy use and provide incentives for DSM and energy efficiency. For example, the Beijing Three-E Office, invested 20 million yuan annually to shift peak loads in 1997~1998; 60 million yuan to improve power-saving efficiency and 60 million yuan in technical transformation. It provided support for the renovation of high-cost electric appliances such as motors and transformers.

[32] Other uses of the funds could logically include upgrading building efficiency and providing price discounts to building that exceed energy efficiency performance standards.

[33] Argentina is adopting this approach to address its power shortage. Families that use up to 600 kWh per two months will not face surcharges, but those which consume more than 600 kWh per two months may face electricity bills up to four or times higher. Consumers who manage to reduce consumption by 5% or more will be rewarded.

[34] See forthcoming World Bank DSM paper

year. One-third of residential customers qualified for this rate reduction, and the program provided about two-thirds of the demand and energy savings captured in the first year of the California crisis response program.[35]

Funds used to compensate consumers for voluntary curtailments and electricity use reductions should be linked to the premium-priced services described above.

[35] Similar economic incentives for demand reductions could be targeted to geographic areas where transmission and distribution facilities are stressed.

### 4.3. Pricing Authority

#### 4.3.1. Introduction

The question of who has pricing authority is very important. This paper summarizes the strongest reasons for why pricing in China's restructured power sector should be wholly a function of SERC. To address the question we will draw on some of our previous work in China.[36] Pricing includes:

1. Setting generation prices for non-market-based units,
2. Setting or approving generation contracts during the transition to wholesale competitive markets,
3. Establishing transmission, distribution, and other grid prices, and
4. Setting retail prices.

Current restructuring plans in China limit SERC's pricing responsibility to making "suggestions" to NDRC. Leaving the pricing authority with a government agency instead of transferring it to an independent electricity regulatory agency is unique among the world's regulatory structures, and it poses serious risks.

Setting tariffs, or prices, for distribution and end-use sales is a basic function of electric sector regulation everywhere in the world. We have found no country where basic utility regulation is done by one agency and pricing by another.

There are four strong reasons the pricing authority needs to be transferred to SERC:

1. Pricing should be a function of an independent agency, such as SERC;
2. Pricing and pricing methods affect the behavior of generators, grid companies, and consumers;
3. Consumer protection depends on pricing authority; and
4. Separating pricing from design and control of the market is not conducive to integrity of the markets or financial health of the grid companies in the long run.

#### 4.3.2. Pricing Should Be a Function of an Independent Agency, Such As SERC

##### 4.3.2.1. International Background

In most countries, the electric utility has been operated by a government agency which is often organized under a ministry of energy or other ministerial-level body. In this framework, the utility fulfills a government responsibility of providing utility service, acting as an agency of the government. Pricing decisions are often premised on social welfare or political criteria. Underlying cost structures are not closely related to prices. Prices are often set using an "ability to pay" theory. Almost universally, there is an assumption that industrial and large commercial consumers are the ones that

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[36] See the following: Best Practices Guide: Implementing Power Sector Reform http://www.efchina.org/documents/ChinaBPGd.pdf ; Report on the Establishment of SERC: The State Electricity Regulatory Commission (January 2003), http://www.efchina.org/documents/SERC_Final.pdf; RAP Additional Comments on Draft Revisions to the Chinese Electric Power Law, February 24, 2004, and RAP Comments on Questions Raised in Mr. Yang's September 17, 2003 Presentation

are most able to pay, while household and agricultural customers are least able to pay. Prices below cost are often given to specially favored industries or other favored consumer groups. This has been the history in China as well.

When the government retains pricing responsibility, pricing tends to be a highly political process, unsupported by rational economic and environmental policy. As a result the operations of the electric utility sector may experience financial problems: low levels of reliability, inability to serve total consumer demand, and little or no access to global capital markets.[37] These conditions have led to a widespread effort to reform the electric sector in many developing countries.

Electric sector reform usually involves two major reorganizations of the industry. First, the utility operations are transformed from a government agency into an enterprise format. Utility operations are separated from the government structure and budget process and placed on a stand-alone enterprise basis.

The other major reorganization involves the creation of an independent regulatory commission to regulate and control the reformed utility. The functions and responsibilities of a commission include:

- Price- setting (often called tariff-setting or rate-setting);[38]
- General regulatory rulemaking;
- Utility system resource planning;
- Mitigation of the environmental impacts of resource utilization;
- Conservation and efficient use of utility and societal resources; and
- Consumer protection.

The single most important characteristic of a successful regulatory commission is its independence. A commission should be independent of political and industry influence. Independence is needed to protect the interests of utilities, investors, and consumers.

Capital markets are very concerned with the political and regulatory environment faced by any company. Because the electricity sector cuts across virtually all strata of the public, it has the potential of becoming the focus of political interest. Because of this, the capital markets have a heightened concern over regulatory and political risk. Capital markets have higher confidence in the utilities' financial health where the commission has greater independence from the political process, both as a matter of explicit policy and through the demonstrated track record of the commission.

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[37] The financial viability of power sector reform rests on prices that recover reasonably incurred costs. Consumer benefits are realized if prices reflect the costs of an efficient, competitive, and environmentally sustainable industry. Consumers should be protected from the excessive cost of inefficient suppliers and from the exercise of market power.

[38] We use the terms "price-setting," rate-setting," and "tariff-setting" interchangeably. Typically, tariffs are public documents that describe all the terms and conditions by which regulated services, including prices, are made available to customers. While price is generally considered the most important of the terms, it is by no means the only one the needs to be regulated. Others, for example, include power and service quality standards, billing and payment obligations, and the conditions under which disconnections can occur.

#### 4.3.2.2. China's Situation

Pricing authority continues to reside with a government agency, NDRC. One reason for this allocation of authority is that NDRC has broad economy-wide pricing responsibility and electricity is a key input to so many goods and services. The government is concerned that giving electricity pricing authority to SERC may lead to price increases that will adversely affect other important parts of the economy.

This is precisely the kind of government reasoning that causes the financial community to believe that political considerations will continue to govern pricing decisions. It is the very reason pricing authority should be transferred to SERC.[39]

Independence and transparency are two of the critical features of SERC that make it different than other government agencies. One primary purpose of reform is to attract capital to meet growing demand. Independence and transparency in pricing give investors confidence that the regulatory process is equitable and predictable, and thus that they have a fair opportunity of earning reasonable returns on their investments.

Making SERC independent and transparent will do little good if pricing is done by agencies that lack both independence and transparency. Chinese experts have repeatedly said the existing pricing process is complex, irrational, and lacking in independence and transparency.[40]

One option to address this problem is to create two separate regulatory agencies, one overseeing pricing and another – i.e., SERC – overseeing everything else. This is not, however, a preferred solution: it is inefficient and it assures fragmentation and confusion. Dividing the retail pricing function (state regulators) from the wholesale pricing, market development, and monitoring functions (federal regulators) was one of the main problems during the California crisis.

### 4.3.3. Pricing and Pricing Methods Control Behavior

The manner in which prices are set is the fundamental means by which meaningful incentives are established. How prices are set, the level of the prices, and the structure of the prices will determine the utility's incentives for:

1. *Investment in generation, transmission, distribution, and end-use-energy*. If tariff-setting is done in a manner that is inconsistent with the setting of other regulatory policies, confusion and inefficiency are certain to result. This leads to undesirable under- or over-investment in utility plant. As an example, we have seen instances in other countries when, because of poorly designed distribution pricing, industrial customers have invested in direct connections to transmission lines instead of using existing distribution lines that have adequate energy transfer capacity.

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[39] This discussion is not intended to mean that SERC, as an independent regulatory agency with pricing authority, would lead to significant increases or restructuring of prices. SERC's pricing authority should be guided by principles set forth by the government in an electricity law or State council decree. The objectives of pricing should include economic efficiency, fairness, simplicity, stability, among others.

[40] "Strategies for China's Electricity Reform and Renewable Development" 2002, Industrial Economics Research Department, Development Research Center of the State Council of the P.R.C. http://www.efchina.org/documents/WhitePaper_Fnl_EN.doc.zip.

2. *Operational efficiency cost reductions*. One of the main purposes of power sector reform is to reduce costs and improve efficiency. The pricing methods need to be carefully designed to accomplish this purpose.
3. *Customer service and service quality*. Increased incentives to cut costs can lead to reductions in customer service and quality of service. Consumer protections must be built into the tariff-setting methods.

Currently, pricing methods do not provide a desirable set of incentives to the grid companies, to generation, or to consumers. Prices and pricing methods are irrational and inefficient.[41] These inefficiencies are of particular importance due to the current power shortage and the effect on DSM and consumer behavior.

#### 4.3.3.1. Pricing At the Grid Company Level

There are several difficulties with the current pricing methods. First, because grid companies' revenues are determined by electricity sales, they provide very strong incentives for the companies to promote sales and to discourage DSM and energy efficiency. This is a serious problem for China's long-term sustainable development. It is an especially serious problem during the existing power shortage. Second, because retail prices cover all the costs electricity production and delivery and because of stated policies to maintain or reduce price levels, the need to provide adequate funding for transmission and distribution is causing designers of the wholesale markets to create structures focused exclusively on reducing generation prices. As a consequence, market designs that favor long-term sustainability and least-cost outcomes are being overlooked. Lastly, pricing structures do not adequately reflect the different drivers of generation costs on the one hand and transmission and distribution costs on the other.

The combination of the current tariff setting methods with China's recent efforts to move to time-of-use (TOU) prices to help address the power shortage leads to some very bad incentives. As described below, there is little, if any, time-of-day difference in generation costs incurred by the grid company under current generation pricing practices. High on-peak prices adopted to address the power shortage means grid company profits from on-peak sales are very high. Off-peak sales are made at a loss. This means that the grid company has very powerful incentives to favor on-peak sales. This is the wrong incentive to have during a power shortage.[42]

By the same token, transmission and distribution costs are driven primarily by peak demands on the wires (which may or may not coincide with system (generation) peaks. It may be that the most efficient retail pricing structure is one that separates generation from delivery, thus enabling consumers to more clearly understand what is causing their costs and to make better consumption and on-site investment (e.g., energy efficiency) decisions.

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[41] The problem of inefficient pricing was noted in World Bank Discussion Paper No. 416, Fostering Competition in China's Power Markets. See page 10. This paper was prepared in cooperation with State Power Corporation.

[42] For example, In Shanghai, many consumers pay TOU prices with on-peak prices of about 1 RMB/kWh and off-peak prices about 0.20 RMB/kWh. The grid company, Shanghai Municipal Power Company's generation costs range from 0.30 to 0.50 RMB/kWh. This means on-peak sales at 1.0 RMB are very profitable and off-peak sales at 0.20 RMB/kWh are made at a substantial loss. Customer's responding to TOU prices by shifting load to off-peak periods cause significant losses to the grid company.

#### 4.3.3.2. Pricing At the Generation Level

Under current generation pricing practices, each generating plant receives a single energy-based price for its output. The price covers capital and energy-related costs. The price is reviewed and changed periodically.

The one-part pricing approach is not consistent with international practices and is currently under review. The current generation pricing practices lead to several types of inefficiencies. First, dispatch of generation is inefficient. Plants should be dispatched on the basis of their marginal (running) costs, not their total cost which includes their historic, fixed costs (which are unavoidable and not affected by dispatch). In China today, however, plants with low running costs but high capital costs may be dispatched after plants with high running costs, but a lower total cost. This raises the total cost of electricity.

Second, with current generation pricing practices there is little, if any, time-of-day difference in generation costs incurred by the grid company. This causes the grid company to favor retail prices that do not vary by time-of-use (TOU). If TOU prices are imposed at the consumer level, the result is a serious mismatch between the grid company's TOU revenue and the underlying generation costs.

Third, generation prices do not fully reflect environmental costs. Many studies have identified the significant environmental cost of air pollution.[43] This leads to generation prices that are too low in general and to unfair competition between high polluting plants and low polluting plants.[44]

#### 4.3.3.3. Pricing At the Consumer Level

An important purpose of efficient consumer prices is to encourage consumers to adjust the ways they use electric power to reflect the real cost of power. Better pricing will result in consumers deciding to invest in more efficient homes and appliances and to adjust the way they use appliances at different times of the year or times of the day. TOU, interruptible, real-time, and inverted block prices have all been shown to influence consumer use and investment decisions. In addition to lowering the total cost of power to society, pricing policies directly affect the efficiency and reliability of the electric power system.

A transparent and rational power price system is an important element in the optimization of power resources and it is also a prerequisite to meeting the goal of fair burdens for consumers. There are many flaws in the current pricing system. On the customer side, capacity and energy prices do not reflect actual capacity and energy costs. The classification of power prices and prices at different voltages do not truly reflect the corresponding levels of costs. The current TOU prices do not reflect the TOU costs. Differences in reliability among power suppliers are not reflected in the prices.

Pricing options to address power shortages are discussed in a separate paper.

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[43] "Environmentally Friendly Pricing Solution for Coal-Fired Power Plants," Chinese Academy For Environmental Planning Chinese Research Academy Of Environmental Sciences, 2003

[44] "International Experience: Incorporating Environmental Costs in Prices," Regulatory Assistance Project, 2003. http://www.efchina.org/documents/environmental_costs.pdf

#### 4.3.3.4. Consumer Protection Depends On Pricing Authority

Consumer protection is, or should be, a SERC function. Consumer protection has many aspects, but protecting consumers from price discrimination and enforcing reasonable service quality standards are two basic responsibilities. To protect against price discrimination, SERC must have pricing authority. Otherwise SERC will be in the awkward position of trying to assure that the prices set by NDRC (over which SERC has no control) are not discriminatory.

Other consumer protection efforts will depend on SERC's apparent and real authority. SERC will have very little influence over the utility sector if pricing and pricing methods remain an NDRC function.

### 4.3.4. Separating Pricing From Design And Control Of The Market Does Not Make Sense

SERC has authority over the design of, and market rules for, new competitive generation markets. These markets will use supply and demand to set reasonable prices for energy and other ancillary services. These markets may also establish prices that will be paid for demand response and generation capacity needed to assure short-term and long-term reliability. The level of these SERC-regulated prices has a direct effect on the reasonableness of the prices generators will receive for the part of their output that is not traded in the competitive market.

A regulatory structure in which SERC essentially sets competitive energy and ancillary services prices through the design of market mechanisms and in which NDRC sets prices for the remainder of generation (i.e., contracts) and for retail consumers is confusing, complex, and sure to result in unwanted outcomes. If NDRC sets relatively high one-part prices for generation and relatively low retail prices, there may not be sufficient funds for the operation of grid systems. Also, the terms, conditions, and prices of the generation contracts may significantly limit the latitude for real competition in the day-ahead and real-time balancing markets. If generators are allowed to recover all of their fixed costs, plus a reasonable level of profits, under NDRC-regulated contracts, the retail customers who pay for this production capability should be entitled to the benefits of any sales of excess energy (by crediting off-system sales revenues against the costs of the contracts). Which agency, SERC or NDRC, will ensure that the retail customers receive the benefits of the generating capacity which it has funded?

Every jurisdiction that has attempted to set up competitive generation markets has learned that market power is a very real problem. Pricing controls – both to create a dynamic demand-supply balance and to put caps on generation prices – have been essential tools for controlling market power in those markets. SERC will have the responsibility to control market power but, without pricing controls, will lack some of the most important tools needed to accomplish this critical task.

## 4.4. Principles of Regulation: Revenue-Setting and Pricing

### 4.4.1. General Principles of Regulation

There are two broad, fundamental justifications for governmental oversight – for regulation – of the utility sector. The first is the widely-held belief that the sector's outputs are essential to the well-being of the society — its households and businesses — and the second is that its technological and economic features are such that a single firm often can serve the overall demand for its output at a lower total cost than can any combination of more than one firm. Competition cannot thrive under these conditions and, eventually, all firms but one exit the market. This is called "natural monopoly," and, like monopoly power in general, it bestows upon the surviving firm the power to restrict output and set prices at levels higher than are economically justified. Economic regulation is seen then as the necessary and explicit public or governmental intervention into a market to achieve a public policy or social objective that the market fails to accomplish on its own.

In light of the economic and public welfare characteristics of utilities, two fundamental objectives for price regulation emerge. They are *economic efficiency* and *fairness*. Prices are more or less efficient to the extent that the more or less reflect the costs of the resources used to produce the good.[45] This goes to the question of pricing structure: do the prices appropriately reflect the timing and magnitudes of those costs? Prices are fair (in, at least, one sense of the term) if, on the one hand, they properly allocate costs (and no more than the costs) to the customers who cause them and if, on the other hand, they generate revenues sufficient to give the regulated firm a reasonable opportunity to recover its legitimate costs of providing service, i.e., its prudently incurred expenses (including investment) and a fair return on the remaining cost (the un-depreciated portion) of investment.

### 4.4.2. The Mechanics of Traditional Rate-of-Return Regulation

The long-standing approach to utility regulation has been to set prices that will, given an expected level of energy sales, produce revenues sufficient to cover a company's total cost of service (COS). Because the COS includes a return on the company's investments, this method is often referred to as rate-of return (ROR) regulation.

The general mathematical formula for determining price levels for monopoly services begins with a computation of total revenues (revenue requirement) necessary to meet demand for service, as follows:

$$RR = E + d + T + [r * (V - D)]$$

[45] In the terms of economic theory, this means that prices should equal the marginal cost (preferably, the long-run marginal cost) of production – that is, prices should cover the full costs of producing the next increment of output.

where:

RR = Revenue requirement, or total revenues[46]

d = Annual depreciation expense[47]

T = Taxes

E = Expenses

V = Original book value of plant in service

D = Accumulated depreciation

Note: (V - D) = "Net rate base"

r = Weighted average cost of capital (i.e., return on investment

The period of time under examination is commonly referred to as the "test year." In many places, prices are set using a recent historic test year, adjusted for "known and measurable" changes. The exercise yields an adjusted test-year cost of service that is meant to be a predictor of a company's revenue needs during the period price will be in effect.

The simplest way to set prices would be to divide the revenue requirement by sales volume (kWh), as follows:

Price = RR / Volume of sales

Although actual rate-setting is somewhat more complicated than this (for example, customers are grouped according to their usage patterns, and the revenue requirement is allocated among those classes, according to principles of cost causation), the essential mathematical relationship holds: the product of rates and sales is the revenue requirement: RR = P * Sales.

A very important point must be kept in mind: this exercise assumes that there is a direct relationship between a utility's revenue requirement and the prices it should be allowed to charge. This is, of course, true, but it must be kept in mind that under traditional ROR regulation, regulators set *prices*, not revenues. The revenue calculation is merely a tool for doing so. But this also means that the actual revenues that a company receives will depend on its actual level of sales and, for reasons discussed in more detail in the Roadmap Paper on Performance-Based Regulation, this fact gives a company a strong incentive to increase sales in order to increase profits. This, in turn, can cause a company to take actions that, in many cases, are not societally most efficient. It's critical, therefore, that regulators consider the unintended consequences of their approaches to regulation and, where possible, implement policies that require or reward companies for acting in ways that promote the overall welfare of the society, not merely their bottom lines.[48]

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[46] In this formulation, the revenue requirement is equal to the total cost of service, and thus the two terms are synonymous.

[47] There are several approaches to depreciation. Historic depreciation, based on original plant cost is used in the US and most other countries. Some countries use current cost accounting or replacement cost accounting.

[48] Such policies include alternative methods of determining utility revenues (i.e., performance-based regulation), incentives for end-use efficiency and integrated resource planning, and environmental performance requirements (such as emissions standards or caps).

### 4.4.3. Rate Design: Pricing for Regulated Services

To a regulator, *rate design* is the structure of prices, that is, the form and periodicity of prices for the various services offered by a regulated company. The two broad categories of pricing are usage charges and fixed, recurring charges.

The general objectives of economic regulation inform the rate design process. More specifically, we want to set economically-efficient prices (i.e., prices which reflect, to the greatest extent possible, the long-run marginal costs of service), while simultaneously enabling the regulated firm a reasonable opportunity to recover its legitimate costs of providing service (including return on investment).

The particular problem faced by regulators in this exercise is that the legitimate historic costs that a utility incurs are to be recovered in rates, but these costs may only bear a passing resemblance to the forward-looking long-run marginal costs that form the basis of economically efficient prices. The reconciliation of the need to cover historic costs with the desire to set economically efficient prices, and then to meet other possible policy objectives (such as administrative simplicity, low-income protection, etc.), requires much judgment. The several and sometimes competing rate design goals can be categorized as follows:

Revenue-Related Objectives:

- Rates should yield the total revenue requirement;
- Rates should provide predictable and stable revenues; and,
- Rates themselves should be stable and predictable.

Cost-Related Objectives:

- Rates should be set so as to promote economically-efficient consumption (static efficiency);
- Rates should reflect the present and future private and social costs and benefits of providing service;
- Rates should be apportioned fairly among customers and customer classes;
- Undue discrimination should be avoided; and,
- Rates should promote innovation in supply and demand (dynamic efficiency).

Practical Considerations:

- A rate design should be, to the extent possible, simple, understandable, acceptable to the public, and easily administered.

#### 4.4.3.1. Embedded Costs

As previously stated, prices are intended to recover the prudently incurred costs of service – that is, the costs that the utility actually pays, called the *accounting* or *embedded* costs. These costs are allocated among customer classes, consumer groupings typically formed according to their patterns of usage. Similar usage causes similar costs, thus enabling class-specific assignment of those costs. Among the costs to be identified are energy and capacity, transmission, distribution, customer service, and others. The methods for cost assignment can be complex, but, in the end, the broad objective is to have those customers who cause the costs pay the costs.

Of course, not all costs can be easily categorized (for example, the joint and common costs that are necessary to the overall operations of the firm but are not directly necessary to the provision of any particular service), and so apportioning them among customer classes becomes an exercise in judgment. Regulators may decide in certain instances to allocate a cost according to a class's share of total energy usage, and in others according to class coincident demand for capacity. Notions of reasonableness and fairness when making these decisions guide regulators.

Once the cost of service is allocated among customer classes, rates can be set according to the mathematics already described. Each customer class has its own revenue requirement and expected volume of sales. Typically, however, not all of the costs of service are collected in energy charges, some (usually small) portion of them may be recovered through fixed, recurring fees called customer charges. These are billed whether the customer uses any electricity or not; the charges are intended to cover the costs of utility activities that are unrelated to usage, for example, metering, billing, and collection. In the main, however, the majority of costs are recovered through charges that vary with a customer's usage. There are two categories of these: energy and demand.

Energy charges collect revenues on a per-kWh basis. Demand charges collect revenues on a per kW basis. It is common for low-usage customer classes to pay energy-only charges, and included in those fees are the costs of capacity needed to serve that customer group. High-usage customers often are billed on both an energy and demand basis; their capacity costs are separated from their energy costs. While the costs of metering for this kind of service are higher than energy-only metering, the savings (for both the customer and utility) that flow from the customer's ability to respond to the clearer price signals invariably exceeds those costs.

#### 4.4.3.2. Marginal Costs

The marginal cost of service is the cost incurred to serve an additional unit of consumption at a particular time, and it represents the cost to society to satisfy that incremental demand. By the very nature of monopoly, however, it is unlikely that at any particular time marginal cost will equal embedded cost (which is, in large measure, an average historic cost), and thus setting prices strictly equal to marginal costs will fail to generate the appropriate level of revenues for the company. Whether they are too high or too low will depend on the relationship of the utility's historic costs to the current costs of fuel and new technology, and to changes in loads.[49]

The task of identifying the utility's costs for the purpose of determining its marginal cost of production at specified times is, in many ways, quite similar to the work done for embedded costs. Unlike an embedded cost study, which in effect calculates the average cost per unit of demand for each class and period under examination, a marginal cost study measures the cost of producing a defined increment of demand for each class and period specified. Total cost is only relevant insofar as marginal cost is a

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[49] Where loads are changing rapidly, price-setting can become even more challenging, because it is particularly difficult to estimate costs and sales for period during which prices will be in effect.. Occasionally it happens that a failure to reasonably estimate costs is offset by a corresponding failure to reasonably estimate sales, so that, for example, a utility whose prices are too low is unharmed financially because sales were greater than expected. If the opposite occurs (i.e., prices are too high and sales are lower than anticipated), consumers may be protected against the company's over-earning. But these instances tend to be rare. What's critical is the presence of a regulatory body to monitor the performance and earnings of the electric company, to be sure that prices cover costs and a reasonable profit and to make adjustments in prices when appropriate.

measure of the change in total cost as demand changes. In certain cases, particularly at times of peak demand when additional capacity may be called for, marginal cost will often exceed average cost; at other times, marginal cost may be significantly less than average cost, since typically the only costs incurred to serve incremental demand off peak are variable fuel and maintenance costs.

Once calculated, marginal costs are then treated as prices and are multiplied by expected units of demand in the various periods under study. This yields the expected total revenue that the company would collect under a marginal-cost pricing regime, which can then be compared to the embedded cost revenue requirement. How prices should then be adjusted depends on whether the marginal cost revenues are greater or less than the embedded.

There are a variety of ways to reconcile marginal cost prices with an embedded revenue requirement. Rates differentiated on the basis of time of day, week, or year of use are quite common, and often are designed to reflect marginal costs at times of peak demand (when costs are high) and average costs at other times. In this way, the utility's risk of revenue shortfall is lessened, and consumers see the important cost signals at times of capacity constraints. Inclining or declining tail-block rate structures are another option. With these, price changes (inclines or declines) as volume demanded during a time period (say, a month) increases. These may not send as accurate a price signal as will time-of-use rates, but they are generally seen as an improvement over flat, average rates (because, as a general matter, incremental consumption of electricity – e.g., new air conditioning load – tends to occur more often at peak, rather than off-peak, times.

In the end, regulators must apply their expertise and judgment when designing rates. Considerations that can inform their discretion include fairness, differences in demand elasticities (willingness to pay), and other public policies (such as low-income support and the pricing of environmental externalities). Distortions that hinder economically efficient outcomes will inevitably creep into prices; this disjunction between marginal and average costs is an unavoidable aspect of natural monopoly. What distortions, and in what magnitudes, then are acceptable? This is one of the central dilemmas of regulation, and there are no easy answers.

#### 4.4.3.3. Pricing Structures

Electric service can be priced in a variety of ways. Pricing policy, whether set by firms or regulators, is influenced by the factors and objectives described above, and invariably the choices made represent trade-offs between innovative and more complex pricing on the one hand and information needs and ease of administration on the other. The further one deviates from average prices, the more "dynamic" the price structure becomes.[50] The continuum from simple to complex can be roughly divided into three broad segments:

- *Energy-only pricing*. Rate designs that do not require special metering capability beyond that of the traditional revenue meter, which measures energy consumption only and is typically read once a month: flat, seasonal, block, etc.

[50] "Dynamic pricing" is a term used to describe any rate design that aims to give customers a truer signal of the economic costs of meeting their demand than simple average cost rates. Thus, a shift from average rates to time-of-use rates to demand and energy charges or to the various forms of real-time prices is considered a move toward more dynamic pricing. Others hold a more narrow definition: dynamic pricing "is any electricity tariff that recognizes the inherent uncertainty of supply prices." Stephen S. George and Ahmad Faruqui, Charles River Associates, *The Economic Value of Dynamic Pricing for Small Consumers*, presentation at the California Energy Commission Workshop on "Achieving Greater Demand Response in the California Electricity Market," March 15, 2002.

- *Multi-part and time-of-use pricing*. Rate designs that depend upon more sophisticated metering – multi-part (energy and demand) and time of use (TOU) – but are still mostly read only monthly.
- *Real-time pricing*. Rate designs that send customers different prices on short notice for different hours of the day and for different days, to in some way reflect changing conditions in the short-term market – e.g., real-time pricing (RTP) – and make use of sophisticated metering and communications systems that link them to their suppliers.

In determining whether a potential rate design is appropriate, the regulator must consider its potential effects. Will it induce economically efficient behavior by both the utility and its customers? Will it promote societally least-cost production and consumption? How will it affect customers' costs for energy services? How does it shift revenue burdens among customer classes? What impacts will it have on company revenues? How does it affect the allocation of risk between customers and the utility? Who benefits, who loses? What kinds of special metering and information management systems are required to support particular rate structures, and what are their costs? Regulators must apply their judgment when making these decisions. Seemingly small changes in a rate design can have very significant consequences for different customers. Refer to the Roadmap Paper on Pricing Reforms for a more detailed discussion of pricing structures that China should consider to promote more efficient use of the its electric system, particularly in light of continued power shortages.

### 4.5. Principles of Regulation: Performance-Based Regulation

All regulation rewards behavior of one kind or another. Any method of cost recovery through a regulatory process provides a set of incentives to which the regulated companies will respond. Over the past couple of decades, regulators and policymakers in a number of countries have concluded that the traditional means of regulating utilities (i.e., rate-of-return, or ROR, ratemaking[51]) no longer encourages companies to act in ways that best serve the public good. In its place, they have implemented alternative methods of setting prices and revenues for monopoly services, generally referred to as "incentive" or "performance-based" regulation (PBR). PBR broadly describes regulatory approaches that rely on financial incentives and disincentives to induce desired behavior by a regulated company. The desired behaviors, or outcomes, typically include lower costs, improved service, and more rational allocations of risks and rewards.

Performance-based regulation offers opportunities to improve the utility performance and better match utility actions with public policy goals. But the success of a PBR depends on its design. Most important is a clear articulation of the PBR's goals and the incentives to achieve those goals. Understanding the objectives makes the structural choice – should it be revenue caps or price caps – straightforward. Both options create the same incentives to cut costs, but revenue caps create much better incentives for investment in energy efficiency and distributed resources.

#### 4.5.1. Rate-of-Return Regulation

Generally speaking, the drawbacks of ROR regulation lie in its lack of strong incentives to promote the overall efficiency of electric sector. Under the traditional ROR ratemaking, the revenues of a monopoly electric company are determined by its level of sales (revenues = price * sales). Given this, electric utilities increase their profits by doing two things: (1) improving the efficiency (i.e., reducing the costs) of supply and delivery and (2) increasing sales. While improving the efficiency of utility operations is a good thing, policymakers should be more concerned with the overall efficiency of the electric sector – that is, with the efficiency of both supply and demand – rather than with the supply-side alone. Because electricity is an intermediate good in the economy – that is, it is used to produce other goods and services that consumers demand – it is not the case that increasing production of electricity, though profitable for electric companies, is the most efficient (or least costly) means of meeting demand for the goods and services electricity produces. As experience in Japan, Germany, California, and elsewhere has shown, reducing the energy intensity of an economy (Btu input per unit of GDP output) improves its efficiency and competitiveness.

Because the revenues of a monopoly electric company are a function of its electricity sales, almost any reduction in sales will result in reduced profits for the company.[52] So, for example, DSM investment may be much less costly than new power supply, but, for the grid company, adding supply means increased sales and increased revenue. Generally, the added revenue exceeds the added cost, so the grid utility's profits will increase when it chooses to increase supply. In contrast, the lower cost DSM option reduces sales and revenues. Even if the cost of DSM is zero, the lower revenue means that the DSM option reduces the grid utility's profit. This is a very powerful disincentive for grid utility

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[51] Rate-of-return regulation is also often referred to as cost-of-service (COS) regulation.

[52] This is because, in most hours of the day, the marginal cost to produce and deliver a kilowatt-hour is *less* than the marginal revenue received for that kilowatt-hour. This fact gives utilities very strong incentives to increase sales.

investment in DSM.

The challenge for regulators, therefore, is to design a method of setting utility prices and revenues that rewards utilities for taking actions that also improve the economy and welfare of their customers. Put another way, what manner of regulation will make electric companies most profitable by achieving specified public policy objectives? How can regulators align the financial incentives of electric companies with the interests of customers and the nation as a whole?

### 4.5.2. Performance-Based Regulation

Recent experiments with performance-based regulation (PBR) in the electricity industry have attempted to meet this challenge. In general, PBR describes those approaches to regulation that differ from traditional ROR and are designed to cause the utility, through financial incentives and (sometimes) penalties, to behave in specified ways: for example, to increase the efficiency of their investment and operations, reduce environmental damage, and improve customer end-use efficiency and services. PBR reshapes regulatory oversight of monopolies without eliminating the need for it. It is one tool in the regulatory repertoire for providing incentives for private, regulated companies to behave in ways that promote the public interest. The goals of performance-based regulation should be derived from, and be consistent with, China's public policy objectives.[53]

The fundamental principle behind PBR is that good utility performance should lead to higher profits, and poor performance should lead to lower profits. While this general principle is widely accepted, regulators designing PBR mechanisms will need to identify just what good utility performance is and how a ratemaking formula should be designed to link performance with profits. Whether a PBR plan will be successful depends on a variety of factors – clearly articulated objectives, careful design, utility management, and the economy in general – so we caution that performance-based regulation should not be regarded as a sure-fire answer to all regulatory challenges. Moreover, where the utility industry, its business practices, and its regulatory oversight are new and poorly developed, the potential for a multi-year PBR to yield unwanted outcomes (e.g., over-earnings and under-investment) may be of particular concern, and addressing it may call for the inclusion of special performance standards (in addition to the financial formulas described below) to assure that the program meets its objectives. Such added standards could include specified investment targets, improved management practices, and yearly reviews.

We recognize that government-owned companies do not necessarily have the same profit motives that privately owned companies have, and that in China the government will remain the majority owner of the distribution companies for the foreseeable future. Even so, it is an objective in China that the utilities operate on sound financial bases, and the policy of "corporatizing" the companies (separating their historic government functions from their business functions) is in part a reflection of that policy. We believe that giving the companies strong financial incentives to act in ways that promote stated public policies—lower costs, reduced environmental impacts, system expansion, etc.—make good sense regardless of their ownership structure, particularly if management's performance is measured

[53] For more detailed studies of performance-based regulation, see Bruce Biewald et al., *Performance-Based Regulation in a Restructured Electric Industry*, National Association of Regulatory Utility Commissioners, November 1997; David Moskovitz, *Performance-Based Regulation for Distribution Utilities*, Regulatory Assistance Project, December 2000; and Tom Austin, *Performance-Based Regulation: A Discussion Paper*, Regulatory Assistance Project, September 1994.

by its success in meeting those goals.[54]

There are two general categories of PBRs used to set overall prices: price caps and revenue caps. Whether to implement a price-cap or a revenue-cap plan is the most significant structural decision policymakers face when designing a PBR. Both options create incentives for the utility to cut its costs, but price caps, like cost-of-service regulation, also retain the incentive to increase sales in order to increase profits. Revenue caps, in contrast, remove that incentive because the utility will not be allowed to keep the additional revenues that it receives from incremental sales. Because its total revenues are capped irrespective of sales, the utility has a very strong incentive to cut costs. One of the best ways to cut costs is to reduce its customers' consumption of electricity. Under revenue caps, there are no financial losses to the utility from reduced sales. This approach has been used successfully in Australia, the UK, and parts of the US.

### 4.5.3. PBR Mechanics

The principles of revenue-capped and price-capped PBRs are essentially the same. PBRs are typically multi-year programs (3 to 5 years) during which revenues (or prices) are adjusted according to a pre-determined formula. The formula imposes a cap (or ceiling) on the maximum change in revenues (or prices) that the electric company can make from year to year, and it may also allow the company to vary the revenue contributions (or prices) among customer classes (so long as the sum of the changes for the classes comes in under the overall cap for the company). This gives utilities some flexibility to respond to competitive pressures in the retail markets for energy.

A well-designed revenue- or price-cap program begins by performing the same cost-accounting and price-setting exercise that is used in ROR regulation. The initial annual revenues for the utility are determined on the basis of its total costs (including return on investment), allocated appropriately to each customer class, and prices are set to recover those revenues (given an expected level of sales). The cap is then permitted to be adjusted from year to year according to a formula that recognizes cost increases for inflation and offsetting cost decreases to reflect and encourage improved productivity. The generic cap formula can be written as:

$$\text{Revenues}_{(t)} \leq \text{Revenues}_{(t-1)} * (1 + I - X) + Z$$

[54] In China, the grid companies are government-owned monopolies. Ordinarily, the lack of private ownership would suggest that cost-recovery, performance-based regulation, and financial incentives would be less important than direct government direction. In China's socialist market economy, however, the distinction between government-owned and investor-owned utilities is not as great as it may be elsewhere. The grid companies are expected to be profitable and management's performance is judged on profitability and quality of service.

Where:

| | |
|---|---|
| $Revenues_{(t)}$ = | the maximum revenues to be retained by the company in the current period, |
| $Revenues_{(t-1)}$ = | the revenues retained by the company during the previous period |
| I = | inflation factor |
| X = | productivity factor, |
| Z = | "exogenous"costs; i.e., any incremental costs that are not subject to the cap |

The formula for a price-capped PBR would look essentially the same as that for a revenue cap.[55] Instead of fixing utility revenues in each period, it would only determine the prices that could be set; as with ROR regulation, the actual revenues that a utility would earn would be a function of its actual electricity sales.[56]

#### 4.5.4. Revenue-Capped PBR

For reasons already stated, revenue caps provide a stronger set of financial incentives for utilities to minimize both their costs and the costs of their customers – that is, to find solutions that are more efficient for society as a whole and not just for themselves – than do price caps or traditional regulation. Nevertheless, if the PBR plan is going to achieve its objectives, it has to be carefully designed. What works for one company may not work for another. For example, revenue-capped PBRs for distribution companies will differ in certain important respects from those for transmission companies, because the nature of their businesses likewise differ.

#### 4.5.5. Distribution: Per-Customer Revenue Caps

For distribution companies, the basic revenue-cap formula can be modified slightly to better account for the unique drivers of distribution system costs. As Chinese policymakers are well aware, it is demand for electric service over the long run that drives the need for new investment in poles, wires, transformers, and substations. However, in the short run, changes in distribution utility investment and other costs are more closely correlated to changes in the number of customers served rather than to changes in the overall level of electricity sales. Thus, it makes sense to cap the utility's revenues on a

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[55] $Price_{(t)} \leq Price_{(t-1)} * (1 + I - X) + Z$

Where:

| | |
|---|---|
| $Price_{(t)}$ = | the maximum price that can be charged to a customer class or classes for the current period, |
| $Price_{(t-1)}$ = | the average price charged to the same class or classes during the previous period |

[56] Price-cap regulation has been used extensively in telecommunications in the US and other countries. Insofar as price-caps more closely track telecommunications costs than does some form of revenue caps, price caps regulation works very well. More importantly, unlike the electric sector, the telecommunications industry is not the cause of substantial environmental damages that are unpriced and for which it lacks an incentive to mitigate. Revenue caps, by breaking the link between energy sales and profits, gives electric companies an incentive to find least-cost ways of meeting demand which are, invariably, improved efficiency and resource diversity. Cost-effective investment in these reduces the environmental impacts of the sector.

per-customer basis: doing so retains the incentive for the utility to make sure its customers use electricity as efficiently as possible, while simultaneously giving the utility some measure of protection against changes in its costs associated with changes in the number of customers its serves.[57] A PBR plan of this type is referred to as a *per-customer revenue cap*.

A per-customer revenue cap is not an absolute cap on the company's revenues. Rather, the company's total allowed revenues is determined by the number of customers it has (revenue-per-customer cap * number of customers = total allowed revenues). A PBR plan of this type begins with a traditional calculation of the utility's revenue needs. On the basis of this revenue requirement, an allowed revenue-per-customer (RPC) is determined. The allowed RPC can be an average for the utility or separate averages for each customer class.[58] The PBR formula then becomes:

$$RPC_{(t)} \leq RPC_{(t-1)} * (1 + I - X) + Z$$

The revenue-per-customer is calculated, but it plays no direct role in setting charges for individual customers. Customers are billed for service as usual, using any combination of pricing elements including customer, energy, and demand charges. Charging customers based on existing rate designs accomplishes several purposes, among them assuring that large- and small-volume users contribute their fair shares to total revenues and that customers do not experience significant changes in their monthly bills.

During the PBR term, two key numbers are tracked and then compared on an annual basis. These are actual revenues (the dollars the utility collected from customers) and the allowed revenues (the RPC times the actual number of customers served by the utility). At the end of each year, any disparity between the allowed revenues and the actual revenues is corrected as either a surcharge or refund to rates during the following year.

The effect of following this approach is that the utility will have a specified amount of money to serve customers' needs. With revenues fixed, profits rise if costs are cut. But profits hinge on cost control, not customer usage. This reduces both the disincentive for DSM and distributed resources and the incentive for load building.

At the end of the PBR period, costs are reexamined, and prices are set based on cost-of-service. The original PBR formula is reviewed and revised if needed.

#### 4.5.6. Transmission: Revenue Caps with Incentives for Congestion Management

For the companies that manage the bulk transmission system, the generic revenue-cap plan, which sets an absolute cap on company revenues, will work well, as experience in the UK and Australia has shown. Since transmission costs are primarily capital costs and are driven by peak demands and

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[57] This does not mean, however, that *prices* should be set on a per-customer basis. Prices should continue to be set on a per-unit (per-kW or per-kWh) basis, because they should reflect the long-run value (cost) of the resources used to provide electric service. See *Performance-Based Regulation for Distribution Utilities*, December 2000, at www.raponline.org, for a detailed description of the design and implementation of revenue-capped PBRs.

[58] Which option is preferred will depend on regulators' assessments of the risk that the mix of customers will change and who should bear the risk. If the customer mix stays the same, the utility's overall allowed revenues will be the same under either method. However, if the customer mix changes, the utility's allowed revenues will also change (in addition to the other revenue effects that the PBR formula will have). Depending on how the customer mix changes, the utility's allowed revenues could increase or decrease significantly, to the benefit or detriment of customers and shareholders.

reliability needs, an overall system revenue cap is well suited to transmission companies. The cap creates a strong incentive for the company to find the lowest-cost solutions to transmission needs, which may not be investment in new transmission facilities but, instead, in end-use efficiency or distributed resources. Since a PBR of this sort gives rewards the company for cutting or avoiding costs, it is important to design the plan so as to assure that the transmission company takes appropriate actions when needed, rather than simply defer making investments so as to increase profits.

One critical aspect of the transmission company's role is to manage the system so as to reduce congestion and line losses.[59] Under certain circumstances, it is possible to design a revenue cap that accounts for congestion and rewards the transmission company for reducing in the least-cost manner.[60] However, policymakers should be extremely careful when considering such an approach (it may not, for example work well under market designs that independent system operators that do not own the transmission system nor make decisions about new investment). Suffice it to say here that the question of how to best manage congestion should be considered in the overall context of the industry's structure in a region or province.

### 4.5.7. Designing a Per-Customer Revenue Cap for Distribution Companies

Within the general framework of a revenue-capped PBR, there are many issues to address in order to provide clear incentives to the utility, prevent utility "gaming" of the system, protect customers in general, and prevent excessive cost-shifting between customers. The most critical issues that should be addressed in designing a fair PBR mechanism are summarized below.

> *Determining the Scope.* Revenue (and price) caps can be applied to customers as a whole, or to individual rate classes of customers. The number of caps to use presents a trade-off to regulators between the goals of protecting customers and giving the utility greater flexibility to respond to changes in the market. A single cap would allow a utility maximum flexibility to restructure prices and shift revenue burdens among customer classes. At the other extreme, a cap applied to every customer class would prevent cost-shifting between customer classes, and provide greater protection for smaller customers.
>
> *Inflation Rate.* The use of a general inflation index, such as the Consumer Price Index (CPI) or the Gross Domestic Product (GDP) implicit price deflator, has the advantage from a customer standpoint of being well understood and quite closely related to the customer's general cost of living. However, a general inflation index might not bear close relation to changes in a utility's costs. In principle, the inflation factor should be set at the rate at which costs are growing in the

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[59] Congestion occurs when there is a constraint in the grid that prevents power from being transmitted from one area to another and, instead, requires the dispatch of higher-cost generation within the constrained area to meet demand there. Congestion costs can be quantified as the difference between the cost of economic (unconstrained) dispatch to serve the load and the cost of the actual (constrained) dispatch required. For the PBR plan described here, the costs of congestion would be estimated for an entire year and included in the revenue cap.

[60] An example would be a revenue cap that is set at a level that includes the ordinary revenue requirement of the transmission company plus the estimated costs of congestion, including line losses. Under this approach, it would also be the responsibility of the transmission company to pay the costs of congestion and line losses. In this way, the cost of all transmission investment and alternatives would be "internalized" in the operations of the transmission company and it will have an incentive to address transmission constraints and their associated congestion costs in the most cost-effective manner.

utility industry as a whole.

*Productivity Factor.* The productivity factor will have important implications for utility cost recovery and the rate at which prices are allowed to increase. However, an appropriate level of improved productivity is not easy to define. In most cases, it is based upon historical or projected analyses of productivity gains by the utility and/or by the electric industry itself. It can also be used to set more ambitious goals for the utility. A productivity adjustment may not be necessary if the cap is instead tied directly to input costs incurred or output prices charged by a comparison group of utilities. As a practical matter, the main purpose of the X factor is to adjust the inflation factor (whatever it may be) so that the resulting multiplier, (I - X), produces a reasonable level of revenue growth or a reasonable level of anticipated cost growth.

*Z-factors.* This mechanism allows for recovery of specific costs that are not meant to be subject to the cap. Z-factors usually include costs over which the utility has no control, such as changes in taxes, that are not reflected in inflation in the short run. They can also include costs that are not meant to be subject to cost-cutting pressures, such as demand-side management (DSM) program costs. The costs that are chosen to be recovered through the Z-factor can have important planning implications. For example, the costs of complying with environmental regulations, even future regulations, should generally not be recovered through the Z-factor, in order to provide the utility with an incentive to minimize those costs now and in the future.

*Duration*. Time, or, more specifically, the length of the period between rate cases (often referred to as "regulatory lag"), is an important factor affecting the strength of the incentives. Having taken an action that improves profits, the question is how long the utility will be able to reap the reward. Under traditional regulation, cost savings that are achieved between rate cases generally go to the utility's bottom line. Consequently, the longer the period between rate cases, the stronger the incentive to take profit-increasing actions. PBRs are designed to take advantage of this fact: they typically run for three or more years, during which time the utility retains whatever profits (or losses) it earns, just as it would if it were operating in a competitive, unregulated market. At the end of the PBR's specified term, the utility's costs are reviewed (as they would be under traditional regulation), and a new PBR plan (with, possibly, revised I, P, and Z factors) can be put into effect.

*Targeted Incentives.* Regulators may wish to focus utility management on areas of performance that deserve particular attention but would not be addressed under the general price cap. Targeted incentives can be combined with a price cap to ensure that such areas are addressed. For example, quality of service (e.g., billing, frequency of outages, duration of outages) may deteriorate under a PBR, because, to save money, utilities may be inclined to cut corners or even eliminate certain services. To prevent this, targeted incentives are often applied by defining specific service quality performance standards and imposing penalties on the utility if the standards are not met. Targeted incentives and performance standards have also been applied to encourage superior performance of end-use energy-efficiency programs and to improve efficiency of power plant operations.

### 4.6. Metering Issues

Changes in pricing structures, or *rate design*, will, in many cases, require changes in metering technology. Currently, metering in China consists primarily of meters that measure only the number of kilowatt-hours that are consumed in a period, without regard to the actual hours in which the consumption takes place. This kind of metering is limited in its capability to support more dynamic rate designs. It reveals nothing about the customer's usage patterns and it is available for review only after manual meter reading, typically long after the fact of consumption. These shortcomings constrain providers to energy-based price structures that are not time-differentiated within billing periods, but they do allow for certain consumption-based structures (e.g., inclining and declining blocks). In addition, seasonal differentiation is possible, so long as the price changes correspond to the beginnings and ends of billing periods.

Price structures that vary by periods that are shorter than the billing period require a meter that can differentiate between consumption in the several (typically) daily periods. Given the higher costs of metering and administration for TOU price structures, these meters have been limited primarily to the higher usage consumers.

Multi-part pricing requires metering that can record both energy usage and peak customer demand during the billing period and, where applicable, time-of-use differentiations.

Interval meters, as their name suggests, record and store usage data for each interval, generally an hour, though often shorter periods are possible (even down to one minute). Most utilities in the United States collect hourly usage data from their larger commercial and industrial customers, although the data are typically retrieved only once a month. The infrequent collection inhibits the utility's ability to offer more dynamic pricing options.[61] Interval metering can support any of the price designs discussed in this paper; however, in the case of real-time pricing, additional equipment that communicates the hourly price of electricity to the consumer must also be installed.

The following table relates rate designs to the metering technologies necessary to support them.

[61] But it should be noted that dynamic pricing is not the sole or even primary justification for interval meters. The data provided by interval metering improve billing accuracy, support the more accurate assignment of costs to customers, give utilities better tools with which to manage their customers' loads, and support rate design generally, all of which provide significant value to companies and customers.

| Price Designs | Type of Meter System | System Features | Capabilities for Pricing Design |
|---|---|---|---|
| • Energy-only<br>• TOU<br>• Demand and energy<br>• Seasonally differentiated | Conventional Manual / Electronic Keypad | • Requires meter reader to cover a fixed route<br>• Meter values key-entered or electronically downloaded via port to hand-held recorder | • Typically limited to a single kWh usage value each billing cycle<br>• TOU meter for TOU prices<br>• Demand meter required for multi-part prices<br>• Cannot economically or logistically support the collection of time varying kW interval data<br>• Data only available once each billing cycle or with special read |
| • Energy-only<br>• TOU<br>• Demand<br>• Seasonally differentiated | Remote Meter Reading | • Requires meter reader to cover a fixed route<br>• Drive-by or hand-held systems that use low power radio to transmit meter reading over short distances | • Can support the collection of multiple kWh register values used in standard TOU prices<br>• Demand meter required for multi-part prices<br>• Communication methods cannot economically or logistically support the collection of time varying kW interval data<br>• Data only available once each billing cycle or with special read |
| • All of the above<br>• Real-time pricing | Automated Meter Reading | • Meters connected to a data repository by telephone, PCS, paging, satellite, fiber, or other communication technology<br>• Stored meter reading can be collected on a fixed schedule or on demand | • Preferred methodology for collecting interval data<br>• Full complement of interval and other meter data generally available on demand<br>• Accessibility varies by technology |

### 4.7. The Process of Auditing Utilities

Utility audits can take four different forms.[62] First, every utility should undergo an annual audit performed by an independent firm to verify that its financial condition is as the company's own books represent it to be. Second, regulators may need to audit some or all of the information provided by a utility in its annual or other reports to the regulatory commission. Third, a utility can be required to undergo periodic management audits to assure that its management is operating efficiently and following sound practices in all major aspects of its operations. Finally, a utility may need to undergo an operational audit of some particular part of its business if the regulatory commission has reason to believe that the company is not performing well.[63]

Each of these audit types has a different purpose and responds to different concerns. Each requires different capabilities, and each is likely to be paid for differently. Each is discussed in more detail below. However, all four have as a common fundamental purpose: the assuring of reliable information about corporate costs and operations to investors, regulators, and the general public. After the discussion of the different types of audits is a review of their potential application by SERC.

#### 4.7.1. Annual Corporate Audits

Annual audits are typically performed for all firms – not just utilities – that seek to obtain capital from investors through the sale of stock or the issuance of long-term debt. The purpose of the audit is to assure potential investors and lenders that the economic position of the firm is as described in the annual report. The certification of the auditor – together with any notes or statements of concern that the auditor feels are necessary – are included in the annual report to shareholders of the company, a public document. The auditor is typically a well-known accounting firm hired by the board of directors. Many investor-owned firms require stockholder approval of this decision.

The corporate audit is typically performed under the supervision of the audit committee of the board of directors. Such audits are invariably paid for by the firms being audited. A corporate audit for a U.S. company with annual revenues of a billion dollars or more can cost several million dollars. To assure that the audit is performed independently, many firms require that the audit committee be made up entirely of "outside" directors, i.e., directors who are not employees of the firm. The auditing firm should have access to all books, records, and personnel and is normally free to meet as needed with the audit committee without management being present.

The annual audit of an investor-owned utility is not normally regulated by the regulatory commission. This is because it is required by the securities laws.[64] Regulation of the audit process and of firms that

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[62] This paper does not cover energy audits, through which many utilities visit the homes of their customers to measure and review their energy usage. Such audits, a standard part of U.S. energy efficiency programs, normally lead to a set of written recommendations as to which energy savings measures would be most cost-effective for the customer.

[63] The line between management and operational audits varies from state to state in the U.S. The definitions used in this paper are those of the New York Public Service Commission. However, an audit that might be called an "operational audit" in New York might well be called a "management audit" elsewhere. The confusion can be compounded when the operation being audited in an operational audit is a limited aspect of management, as in the Arizona Corporation Commission's "Construction Management Audit" of the Palo Verde Nuclear Generating Station. The "Management Audit Manual" of the U.S. National Association of Regulatory Commissioners (NARUC) makes no distinction between management and operational audits, NARUC Manual, vol.1, pp., 6-9.

[64] However, the regulatory commission is likely to require an audit comparable to a corporate audit from entities that do not

do such audits is the responsibility of the entity charged with overseeing the securities markets. However, the existence of an annual audit is of importance to the regulators charged with licensing and tariffs because it increases the confidence that they may have in the company's annual report. Furthermore, investor confidence is itself of concern to utility regulators. Consequently, if the corporate audit process is not itself sufficient to provide adequate confidence and transparency, the utility regulators may order that it be strengthened for the firms under their jurisdiction.

Of particular concern is the potential for the corporate audit process to be undermined by conflicts of interest within the auditing firms. The U.S. experience, in which the firm doing Enron's annual audit – Arthur Andersen & Co. – also did millions of dollars in other types of consulting work for Enron, is just the latest of many examples of situations in which the need for an independent and honest audit has been compromised by the auditor's other lines of business. The U.S. Securities and Exchange Commission, which oversees the auditing function at the federal level in the U.S., has recently imposed additional standards to assure that auditing is not undermined by consulting or other relationships within audit firms.

### 4.7.2. Routine Regulatory Audits

A regulatory commission will sometimes need to verify the figures provided to it by regulated firms. This need can arise from a desire to go beyond merely accepting figures provided to the regulatory commission, or it can arise from specific concerns about the accuracy of the figures or of the purposes for which the money has been spent or of the categories to which expenditures have been allocated. Such an audit is almost always necessary when the utility is seeking to use its records to justify a tariff increase. Such audits are often also focused on a particular area that may be causing costs to increase. The figures supporting changes in automatic adjustment clauses, such as purchased power or fuel clauses or clauses designed to maintain a particular earnings level, would be examples of such costs.

Almost all U.S. regulatory commissions have the statutory authority to conduct audits of this type.[65] Most commissions have auditors on their staffs, and about half actually have a separate auditing division within the staff. The rest have their auditing capability within the finance or accounting divisions.

On occasion, for an audit too large for the commission staff to perform, outside auditors might be hired. Since the auditing function is within the commission's responsibilities, no additional authority would be necessary. Such outside auditors would be paid for out of money available to the commission for hiring consultants or else would be charged to the utility and recovered in prices paid by customers. If the audit were necessitated by mismanagement within the utility, the costs might not be recoverable from the customers and would therefore come out of money otherwise belonging to investors.

### 4.7.3. Management Audits

Management audits of all utilities above a certain size are required at periodic intervals in many U.S.

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sell common stock to the public, whether because they are owned by a closed group of private investors or a single individual or because they are owned by government.

[65] In addition to the authority to perform audits, they have the necessary supporting authority such as the authority to enter onto the utility premises, to examine all books and records, and to get any necessary information from employees of the utility.

states. These audits are quite different in scope and purpose from the audits described above. Their purpose is to ascertain whether the utility is being operated efficiently, and to make recommendations for improvement. Some jurisdictions require that utilities undergo periodic management audits but leave the choice of the auditor and the drafting of the scope of work entirely to the utility. Other states regard such audits as a part of the regulatory framework, and are involved in every step from the choice of the auditor to the review and acceptance of the final report.[66] Relatively few states in the U.S. have the capability to conduct such audits of large utilities without outside assistance. The more common pattern is for the regulatory commission to assign one or two individuals on its staff to work closely with the auditor. Although the utility pays for such audits, it has little say in how they are conducted.

Such audits normally seek to assess whether important parts of the utility business are being conducted in a manner consistent with prevailing industry standards. To this end, comparisons are often made to other companies in the utility business and sometimes to other businesses as well. In addition, input is often sought from the communities that deal regularly with the utility, such as its customers, its suppliers, and government officials at all levels.

Management auditing of U.S. utilities developed rapidly in the 1970s and 80s in response to public concern over rapidly rising energy prices[67] and allegations of mismanagement, especially in the electric sector. By late 1981, the U.S. National Regulatory Research Institute had published a detailed review of the management audit process.[68] This review noted that utilities at that time were often resistant to management audits, feeling that they were just another way for regulators to find fault with their operations and to embarrass them in public. With the passage of time and the evolution of more sophisticated auditing techniques, some of this criticism has diminished.

The most effective management audits are conducted with utility participation. In this way many areas of potential concern are remedied before the audit is complete and need not be the subject of

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[66] New York law, for example, provides "The commission shall have power to provide for management and operations audits of gas corporations and electric corporations. Such audits shall be performed at least once every five years for combination gas and electric companies, as well as for straight gas corporations having annual gross revenues in excess of two hundred million dollars. The audit shall include, but not be limited to, an investigation of the company's construction program planning in relation to the needs of its customers for reliable service and an evaluation of the efficiency of the company's operations. The commission shall have discretion to have such audits performed by its staff, or by independent auditors.

In every case in which the commission chooses to have the audit provided for in this subdivision performed by independent auditors, it shall have authority to select the auditors, and to require the company being audited to enter into a contract with the auditors providing for their payment by the company. Such contract shall provide further that the auditors shall work for and under the direction of the commission according to such terms as the commission may determine are necessary and reasonable. The commission shall have authority to direct the company to implement any recommendations resulting from such audits that it finds to be necessary and reasonable. Upon the application of a gas or electric corporation for a major change in rates as defined in subdivision twelve of this section, the commission shall review that corporation's compliance with the directions and recommendations made previously by the commission, as a result of the most recently completed management and operations audit. The commission shall incorporate the findings of such review in its opinion or order." [Chapter 48, Consolidated Laws of New York, Article 4, §66(19)].

[67] U.S. electricity prices tripled between the mid 1960s and the early 1980s, due to a combination of rising fuel costs, nuclear power plant construction cost overruns and the impact of inflation on capital costs.

[68] Raymond Krasniewski et al, "The Management Audit as a Regulatory Tool: Recent Developments and Prospects for the Future".

audit findings and recommendations. If resolution is not achieved in this manner, the shortcomings found by the auditor become part of the report to the commission. Normally, the utility is given an opportunity to indicate formally which recommendations it will implement and, as to the remainder, its basis for declining to implement them. The commission will then decide which recommendations the utility must implement and on what schedule.

Failure to implement a recommendation on the schedule required by the commission can be a basis for a penalty in a future rate proceeding. New York law requires that the Public Service Commission make specific findings as to each recommendation in the rate case following the completion of the management audit. In this way, compliance with the management audit process is tied into the process that determines the utility's profitability, assuring a high degree of attention both from utility management and from the utility commissioners.

Management audits are normally performed by firms with extensive management consulting expertise. Only a few of these firms confine their business to working for regulatory commissions. As to those that work for utilities as well, the potential for conflict of interest exists. New York prohibits a management auditor from working for a utility that it has audited in New York for several years before and after the audit. Many other states have similar prohibitions to assure that the auditors' reports are not biased by past or potential future relationships.

As with other types of audits, management audits should be done according to accepted accounting standards and need to be conducted according to a detailed work plan. In the U.S., most states either have their own audit manuals or use the Management Audit Manual prepared by the National Association of Regulatory Utility Commissioners.[69]

### 4.7.4. Operational Audits

The operational audit is likely to occur because some aspects of the utility's operations are of concern to the regulators. While operational audits are likely to focus on aspects of the utility that seem to have inordinate costs (such as its power purchases or its billing and collection), this is not always the case. The New York Public Service Commission has conducted audits of the manner in which a utility dealt with independent generators, the functioning of a utility's customer services operation, the effectiveness of utility programs implementing energy efficiency, whether a utility was discriminating against women or minority groups in its hiring practices, whether a utility was promoting the best qualified people to senior management positions, and the manner in which the utility board of directors made major decisions.

Because operational audits normally arise out of a concern that some aspect of a company's operation is not as it should be, the utility is less likely to be permitted to oversee these audits without commission involvement. If the utility is permitted any involvement in the decision as to the auditor, it is likely to be confined to choosing one from a short list reviewed by the commission. It may be permitted to comment on the draft report, but it is unlikely to be permitted to rewrite it. In most states the utility will be required to pay for the audit. However, because these audits are normally smaller in scope, the commission staff may perform them without outside assistance. When the subject matter is unusually specialized, the audit firm may be chosen more for its topical expertise than for its

[69] See note 68, above. This three-volume set includes "Fundamentals of Management Audits", "A Guide to Management Audit Plans", and "A Guide to Implementation Activities".

experience in performing audits.

The line between an investigation and an operational audit will also differ from one state to another. Indeed, investigations may include operational audits. However, investigations also include provisions for measures not found in an audit, such as the issuance of subpoenas, the taking of testimony, and the holding of hearings. Investigations also include the possibility of penalties, which do not normally follow from an operational audit alone.

Operational audits, like management audits, are often most effective if the utility is permitted to participate in aspects of the audit (though not in the selection of the auditor). In this way, the utility has an incentive to fix problems while the report is being prepared so that the problems can be described as “resolved” or “being remedied” rather than simply being embarrassed by having their shortcomings discussed in a public document. Recommendations that the utility refuses to accept can be ordered into effect by the commission, and failure to implement them can be a basis for future enforcement action or for penalties in a tariff proceeding.

#### 4.7.5. Implications for SERC

The essential purpose of each of the audit types discussed above is to remedy the imbalance in information that always exists between a company on the one hand and the public and the regulator on the other. This information imbalance is especially severe in countries like China, where there has been no tradition of public disclosure or of transparency or of independent regulation. Each of the audit types could help to improve this situation, which inevitably hinders efforts at reform of the utility sector.

Management and operational audits have a particular potential to be helpful in situations in which both the regulated entity and the commission lack detailed management expertise. Under these conditions, a well-run management audit process can be very helpful both to the regulated entity and to the regulator in introducing and implementing unfamiliar management concepts. For this process to work well, the management audit cannot be looked upon merely as a document to be completed and put on a shelf. It must include a process for extensive follow-up and for training.

The essential preconditions to an effective audit program are an adequate legal basis, adequate record-keeping within the utility, adequate financial resources, the existence of trained, capable, and independent auditing personnel, and a legal mandate to implement the recommendations of the audits. It will therefore be important to be sure that the pending electricity law gives SERC a clear power to review and audit all aspects of licensee activities as well as a clear power to require the necessary recordkeeping. SERC will also need the power to charge some types of audits to the licensee receiving the audit.

Finally, the existence of firms with the capability to do sophisticated and independent audits in China seems likely. However, training in audit practices and procedures is likely to be necessary if SERC is to manage these audits in an effective manner.

### 4.8. Licensing

A license is a permission to undertake an activity, but it can be much more. Licenses can be issued by government or by private firms. Governmental licenses are the only type covered in this paper.

The regulation of any business activity is likely to require a licensing regimen. The type of licensing to be done is determined by the extent of the regulation that government is imposing. Licensing can just be the way for the government to keep track of which firms are engaging in a particular activity and perhaps to impose certain minimum standards. It can also be the way that government supervise activities so potentially dangerous or so critical to the economic wellbeing of the nation that entry is tightly restricted and many activities are strictly controlled. A special category of licensing involves businesses which the state has decided should be operated as monopolies.

Even activities conducted by the government itself may require a license. In the U.S. for example, nuclear power plants owned by government utilities must have construction permits and operating licenses just like those of private utilities, and their operators must also have the same licenses certifying that they are capable of doing their jobs.

Any regime that issues licenses must decide the following questions:

1) What is the purpose of an electric utility license? Possibilities include one or more of the following:

- Keeping track of who is conducting the activity;
- Controlling entry into the licensed field, because monopoly (or a system of minimum rates) is thought to be preferable or in order to protect scarce resources;
- Protecting the health and safety of the public;
- Creating an instrument that functions as a comprehensive framework for regulating the activity;
- Establishing a contractual relationship between the government and the licensee though an instrument that can only be changed with the consent of both the government and the licensee; and
- Imposing certain specified duties and obligations on the licensee.

2) What types of activities require licenses?

3) Who should issue licenses, and by what process?

4) What provisions should licenses contain?

5) Who should enforce the license requirements, and by what methods?

6) Who should resolve disputes concerning licenses?

Before suggesting answers to these questions that might be useful in China's unique circumstances, we review experience in some other countries.

### 4.8.1. The United States

#### 4.8.1.1. Licenses to operate a utility with distribution responsibilities

U.S. utility regulation attaches less importance to licenses than do other regulatory systems. The licenses given to the investor-owned utilities are very old, in some cases more than 100 years. Almost all were given by state or by municipal governments, not by the national government. In many states they were the documents through which legislatures defined the service territories of the utilities. These documents – more often called "franchises" or "corporate charters" than "licenses" – contain conditions that differ widely from state to state. Some of them grant monopoly service territories. Some grant territories that are not monopolies. Some impose an obligation to serve all customers; others do not. Some require renewal after relatively short intervals; others continue without a specific time limit.

Importantly, the U.S. Supreme Court decided during the 18th century that corporate charters granted by state legislatures are contracts between the state and the private company and cannot be amended without the consent of the company unless the charter itself allows for such amendments. This is not true of an ordinary license, which is normally understood not to be a contract and to be given subject to the power of government to change laws and regulations affecting the licensee.

The contractual nature of the early U.S. charters gave significant reassurance to investors, who had a veto power over any changes. However, they prevented commissions from being able to adjust their regulatory framework to changes in the structure of the regulated industries. As one leading U.S. text on utility regulation observes:

> The franchise as actually used proved a defective instrument for detailed regulation. ...Changes in the prescribed rates or in the service standards were made with great difficulty. ... It was often impossible, consequently, for franchise or charter provisions to be changed "however ill considered or antiquated with respect to current need for regulation they might be. [citation omitted]"... Each of these methods was incapable of adapting to the development of an industrialized and highly complex society – a development requiring expertise, flexible regulation and continuity of policy.[70]

Important chapters in the history of government regulation of business in the U.S. are devoted to the evolution from regulation circumscribed by these charters to regulatory systems in which regulators could change their rules as long as two safeguards were observed. These were the right of the utilities and other interested parties to be heard before proposed rule changes were adopted and the right of utilities to recover the costs of changes whenever those costs were sufficient to cause their earnings to fall below a level that provided an opportunity to earn a fair return on their prudently invested capital.

As a result of this evolution, licenses now play a very minor in U.S. regulation of distribution utilities. All important regulatory and tariff proceedings are conducted without reference to the old franchise documents, which are rarely consulted.

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[70] Charles Phillips, The Regulation of Public Utilities, 3rd edition, (Public Utility Reports, Arlington, Va., 1993), 130-32.

#### 4.8.1.2. Licenses for new power plants

Because of the substantial capital requirements, the potential impact on prices and the potential impact on the environment, most U.S. states have for many years required regulated utilities to get permission to build new power plants.[71] Typically called "certificates of public convenience and necessity," these licenses were originally required before a private company could exercise any power to acquire the land of citizens unwilling to sell. As such, they consisted basically of approval to build a power plant with specified output and fuel-use characteristics in a specified location. To obtain such a license, utilities had to demonstrate a need for the project, a process which in many states required hearings exploring the feasibility of other alternatives that might be less costly or that might have a lower environmental impact.

With the coming of competitive wholesale power markets, the builders of the plants were often separate from the transmission and distribution companies. Consequently, they were not given the ability of a utility to acquire land from citizens unwilling to sell, and the market replaced the state as the primary determiner of what type of plant would get built. The licensing process for such generating stations has tended to become more a simplified process of authorization and less a determination of actual need for the facility. However, many states have maintained variations of these proceedings as a way of assuring that the distribution company buying the power has done a reasonable job of evaluating all possible alternatives. In some states, this process now requires certification not of individual power plants but of the process by which the distribution entity acquires power. As long as the distribution company has a process that allows competition from all suppliers[72] or that arranges for a well-balanced portfolio of power supplies and energy efficiency, the regulator will not review the need for individual power projects built pursuant to that process.

### 4.8.2. Licensing in Countries Other than the U.S.

#### 4.8.2.1. Distribution Systems

In countries in which restructuring has occurred recently – especially countries in which distribution systems have been privatized – licenses have a much more important role in establishing the framework for the regulatory process than they do in the U.S. Indeed, the terms of the privatization agreement sometimes become a license that virtually supercedes regulation in determining the fundamental conditions under which the new owner will operate, at least in the first few years. In some cases, the privatization has taken place before (or simultaneously with) the establishment of regulation, so the regulator has had little or no voice in the document that determines the tariffs, investment plan, and conditions of service in the early years of restructuring. In these cases, the license is likely to be little more than a reiteration of the privatization agreement. Some have argued that this is not necessarily bad, that investors would rather rely on a direct license and contractual

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[71] Only two types of power plants – nuclear stations and hydroelectric stations on navigable waterways – require federal licenses. These licenses are for special purposes – safety and balancing of water interests – but both are subject to a U.S. law requiring preparation of a statement comparing the costs of all reasonable ways of achieving the same ends as the proposed project, including substituting energy efficiency. Nuclear licensing includes not only licenses to construct and operate the power plants but a license to possess nuclear materials and licensing requirements for the important plant personnel, such as the operators and shift supervisors. Builders of nuclear power plant components important to safety must also be licensed.

[72] Sometimes the competition is restricted to a subcategory of suppliers, such as renewable energy or energy efficiency.

agreement with the government than on an untested and an inexperienced regulatory institution.[73]

However, it is generally recognized that initial agreements must evolve to meet changing conditions in the energy sector and that the process of supervision can best be overseen by a regulatory commission structured to be somewhat independent both from political pressure and from utility influence. Hence, one challenge that such commissions face is taking control over licenses that are likely to have been negotiated between a government ministry and an investor insensitive to the needs of the future regulator. A regulator presiding over a system that provides for automatic rate increases as well as disconnection policies and service quality standards that the regulator does not control is likely to lack credibility with customers who have been told that the regulator is there to protect them. Under these circumstances, it is especially important that the law establishing the regulatory commission be clear in stating the intended purposes of the licensing and in giving the regulator the powers necessary to safeguard and to enforce those purposes. The law should also articulate with clarity the standards for granting license applications and for rejecting them, as well as the rights of the applicant and of other interested parties to participate in licensing decisions.

A list of provisions likely to be found in licenses for companies offering distribution and transmission services would include the following:

A. A description of the licensee;

B. A description of the service territory and a statement of whether the license was exclusive in that territory;

C. A description of the service being licensed;

D. A description of the nature of the service obligation, i.e., for a distribution licensee all customers who pay for service or for whom the state arranges to pay;

E. A statement of the duration of the license;

F. Requirements as to the reporting of information by the licensee;

G. Provisions governing the means of making changes to the licenses conditions;

H. A requirement that the licensee comply with the laws and regulations of the nation;

I. Provision for renewal or termination of the license;

J. Provisions relating to the transferability of the license;

K. Provisions relating to license enforcement, suspension, and revocation;

L. A statement of the license fees;

M. Requirements for the maintaining of insurance;

N. Provisions for dispute resolution and or/arbitration; and

O. Transitional requirements from the previous operator to the newly licensed one.

A fundamental decision for a country to make regarding its licensing processes is what additional subjects are to be included in the license, what subjects are best covered in the privatization documents,

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[73] See, for example, *Regulation by Contract: A New Way to Privatize Electricity Distribution?*, Tonci Barkovic, Bernard Tenenbaum and Fiona Woolf, The World Bank Group, March 2003.

and what subjects are to be left to the processes of regulation, such as rules and orders by the regulator.

As noted above, most countries rely more heavily than does the U.S. on the license as an instrument for regulation. In Latin America, for example, regulation by contract has been prevalent in several countries for the last fifteen years, though with mixed results. In Europe, several countries – including Great Britain and the Netherlands – use license conditions extensively as regulatory tools. The same is true in most countries of Eastern Europe and the former Soviet Union.

Among the additional candidates for inclusion in the license if the country decides to use the license as the principle source of regulatory authority are the following:

A. The methodology that will be used to establish tariffs;

B. Standards of service quality;

C. Technical service requirements (grid code, system code, etc.) and compliance with such requirements;

D. Standards for customer service;

E. Expectations of performance in such areas as loss reduction, improvement in collections, and furtherance of energy efficiency;

F. Safety in operations and supply of service; and

G. Commitments as to new investments and the process by which investments and/or investment plans will be reviewed and approved.

Particular difficulties arise when the entities to be licensed and regulated remain owned by the government.[74] In these conditions, a number of the incentive and penalty arrangements that can be effective in dealing with private systems may not apply. Under such circumstances, the regulator might be given power to require that individuals in a few positions fundamental to the successful delivery of electric service be licensed in order to hold their positions, as is done with individuals in key positions of responsibility in nuclear stations. Regulators do not normally have the power to discipline individuals in private companies, but in the context of state-owned enterprises that are performing badly, such an approach may be among the few that will allow the regulators to achieve improvement.

#### 4.8.2.2. Licensing of generation in competitive markets

In theory, licensing of new competitive generation should be quite similar from one country to another. If a decision has been made to allow new generation to be built competitively, the fundamental licensing requirements require little more than a determination that valid procurement processes have been followed, that adequate financial capability is present, that all necessary permits have been obtained, and that the necessary fuel, power, and transmission arrangements are in place.

In fact, however, licensing of new generation in countries without established regulatory regimes may be more complex, because the licensee may regard the license as a fundamental part of its assurance of fair treatment. The need for such protection will be especially strong if the government continues to

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[74] The paper cited in the previous footnote (73) concludes that state-owned utilities do not respond well to tariff and other regulatory incentives and are therefore poor candidates for regulation by license contract.

own power plants, because a new private generator will be concerned that governmental power will be used and misused to favor the government's power plants. In such cases, the licensee may seek to incorporate payment and production terms and conditions into the license. Whether such provisions are sensible will depend on the overall condition of restructuring in the country in question.

An additional set of licensing issues will arise in countries that have – as China has – undertaken to introduce a competitive wholesale market. This will require attention to issues of market structure, particularly in assuring that at least five (preferably more) substantial owners of generation exist, with no one of them having the ability to determine the market price. It will also require that no one owner of generation also be in a position to control an essential facility, i.e., a monopoly transmission line, to the advantage of its generation units. To achieve these results, the licensing agency must have the power to reject or attach conditions to licenses when the fundamentals necessary to a successful competitive market would be would otherwise be adversely affected.

### 4.8.3. Conclusion

Earlier in this paper we suggested some questions that any nation's electric utility licensing regime would have to answer. We now offer some possible answers for China and particularly for SERC. Given that SERC does not presently have responsibility either for tariffs or for investment approval, the licenses that it can issue will be of limited usefulness as comprehensive regulatory tools. Nevertheless, they will begin to define the restructured electric sector, so they should be designed with care and should be capable of being broadened if SERC's responsibilities change in the future.

We have already outlined the general objectives of licensing. The remaining questions and our suggested responses to them are as follows:

*What types of activities require licenses?* For now, generation, transmission, distribution, transmission system operation and market operation should be licensed.[75]

*Who should issue licenses, and by what process?* Under China's approach to restructuring, licensing will be more important to shaping markets than it will be to tariff-setting or investment approval. Therefore, SERC is the logical licensing agency.

*What provisions should licenses contain?* Essentially the provisions set forth in items A-O on page 58.

*Who should enforce the license requirements, and by what methods?* SERC should enforce the licenses, using a full range of inspection and auditing capabilities. In addition, SERC should be able to impose fines and suspend or revoke licenses, although these powers are of limited usefulness in the case of state-owned utilities.

*Who should resolve disputes concerning licenses?* In the first instance, SERC is the logical entity to resolve such disputes. However, where private investors are involved, a credible process for resolving

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[75] Licenses should be carefully constructed so as not to inhibit the government from making later changes to industry structure (e.g., further unbundling of generation from transmission and distribution), as it deems appropriate. Licenses in Northern Ireland, for example, were written in ways that made the separation of system operations and market administration from the transmission and distribution business particularly difficult.

disputes over SERC decisions will also be necessary. Such appeals might be handled by a court with economic expertise, by a specially created panel, by arbitration, or by mediation. In the early years of China's restructuring, this decision may have to be made through negotiation with private firms in the course of the licensing process.

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A fundamental choice confronting all newly established regulatory commissions is whether to rely on the license (sometimes also called "franchise" or "concession") or on generic rules as the primary instrument of regulatory control. A license-based system establishes most of the conditions of operation in the individual license documents. A rule-based system promulgates most conditions in rules of general applicability, supplemented by decisions in specific "cases" (regulatory investigations).

In theory, a license-based system has attributes of a contract between the government and the utility, with the terms set forth clearly at the outset, while a rule-based system, offering the advantage of greater flexibility to meet changing conditions, depends for stability on societal concepts of due process of law. In fact, both flexibility and stability are essential attributes of all effective utility regulation, so each system must find mechanisms to assure the apparent advantages of the other. In so doing, they tend to converge – with each having to take on some of the disadvantages of the other in order to secure the advantages. Dispute resolution and the possibility of periodic competitive bidding for the license itself are two important sources of flexibility that can be built into a license-based system.

Regulation, like other changes in the status of China's power sector, is at an early stage. Consequently, utility licenses have not reached the status that they have attained in the U.S., where they define long-held actual and potential service territories but are rarely used as instruments for regulation. In China the granting or renewing of licenses is one of the first major tasks confronting SERC, making this an opportune time to ask whether innovation in the license process can promote efficiency better than approaches which rely on regulations and on detailed regulatory investigations.

Whatever approaches are chosen, experience elsewhere shows the need to avoid certain key mistakes such as vagueness in the law defining licensing responsibilities, vagueness in the key terms of the licenses themselves, and uncertainty about the process for changing license conditions or for allocating the cost effect of such changes.

## 4.9. Market Structure

### 4.9.1. Introduction

Extensive time and resources have already been expended in China to establish a framework for market development and evolution. A team from State Power Corporation worked with World Bank staff and consultants to contribute to World Bank Discussion Paper No. 416, *Fostering Competition in China's Power Markets*. This work began in 1998 and was reported in 2001. While some of the time tables were too ambitious, the fundamental approach of phasing in competitive markets through stages of development remains valid.

In addition to World Bank Discussion Paper No 416, which was developed within the context of China, there is also an excellent reference, Making Competition Work In Electricity, by Ms. Sally Hunt. This book is published by John Wiley & Sons in the U.S. has been translated into Chinese and is available in China.

This section describes some of the most critical near-term market structure issues facing SERC.

### 4.9.2. Principles for Market Design

Principles should be established to guide development and evolution of markets within China. By endorsing a set of principles, SERC will establish a framework within which alternative designs may be considered by regions and provinces. The following is an example of a set of market design principles:

- Participants should have choices and flexibility;
- The markets should be simple to understand;
- The markets should be simple to administer;
- The cost to participate in the market should be low;
- The rules and administration of the market should be transparent;
- There should be effective monitoring and enforcement of market rules;
- Operational rules should not be burdensome;
- Scheduling and dispatch should be economic, fair, and non-discriminatory;
- The transition from current market arrangements should be fair to consumers and other participants; and
- There should be flexibility to evolve to other market structures in the future.

### 4.9.3. Staging Market Implementation

There is no single solution for implementing markets in all of China. World Bank Discussion Paper No. 416 described three stages of industry structure reform and related markets. In China, the first stage of wholesale market implementation has been to establish single-buyer markets at the provincial level. The various regions, and the provinces and municipal power bureaus and districts within regions, may be at different points of the development of their electricity infrastructure and capacity to operate and administer markets. In addition, there are interegional transactions from projects such as Three Gorges. SERC should consider establishing region-by-region timetables for staging evolution of market designs.

#### 4.9.3.1. Economic Merit Order and Related Accounting processes

The most urgent issue to address in China is to improve the efficiency of power plant dispatch This will require sufficiently detailed accounting practices to permit owners of enterprises to be able to calculate their fixed and variable costs and reforming of existing generation contracts and prices.

Most markets for trading are based on the ability to stack competing generating units in an economic merit order. Two decisions are required. The first is to decide which units should be brought on line, the process which is referred to as "scheduling." This decision takes considers reliability requirements and the estimated cost to start and to operate each generating unit for some period of time. The second decision is to determine the level of load which should be supplied by each generating unit which has been brought on-line. This is the "dispatch" process. The economic comparisons required for both the scheduling and the dispatch processes are based on a knowledge of the cost to start each generating unit and the cost to load it at various levels.

From our experience in China, many entities do not appear to make these decisions based on the same economic basis as is used in developed markets, world wide. Under existing practices, contracts with power plants have a single, energy-based power price and this price is used by utilities to dispatch plants.

The use of the contract price for dispatch purposes is widely seen as a source of very significant inefficiencies. For example, consider two plants:

1. a hydro plant with a total cost (capacity and operating cost) of 40 fen/kWh and
2. a coal plant with a total cost of 35 fen/kWh.

For the hydro plant, the capital cost is essentially the full 40 fen and the operating cost is zero. For the coal plant, the capital cost is 20 fen/kWh and the operating cost is 15 fen/kWh.

Under existing practices, there are times that the coal plant would be dispatched and the hydro plant would sit idle. This result is very inefficient and costly. This is not the way these plants would be dispatched in competitive markets or under an efficient, variable cost-based dispatch. Dispatch decisions should be made on the basis of each plant's operating cost or its bid, not its total cost.

Such cost information and accounting processes are fundamental to development of commercially based trading among market participants. Therefore, SERC should encourage all business enterprises should establish systems of accounts and use the costs developed through such processes to make their commercial decisions

#### 4.9.3.2. Market development in East China

The first stage of regional market development in East China was to establish commercially based trading to complement, and to begin to replace, trading based on centrally determined allocations and administered prices. The East China market was designed to permit provinces, each of which had differing internal market designs, and which lacked uniform cost accounting systems, to buy and sell electricity regionally, with benefits to both the buying and selling parties. The East China regional market operator has acted primarily as a coordinator of these transactions, ensuring that reliability criteria have been met. ECG has established minimum guidelines for bilateral trading and competition among the provinces been stimulated.

The East China region has begun simulation of a monthly market. It is limited in scope in that it only attempts to test bidding processes on a monthly basis. It is a simulation and has been useful in helping market participants to understand some aspects of trading. SERC may wish, after development of day-ahead and real-time markets, to consider whether these should replace the monthly market simulation.

#### 4.9.3.3. Generation Contracts – the Key to Transition

A major issue to be addressed is the contractual arrangements under which existing generation is to be compensated as it is unbundled from vertically integrated utilities. Depending on how these arrangements are structured, they can facilitate or delay adoption of competitive markets. Properly structured markets and transitional contractual arrangements will be compatible with economic dispatch, encourage new investment, and ensure that those who have paid for existing generation will continue to receive the benefits to which they are entitled.

There are a number of contract structures that could be used to address the existing dispatch issues. Two examples are:

1. For regions without competitive generation markets, generation contracts should be restructured into two–part (energy and capacity) physical delivery contracts.
2. For regions with competitive generation markets, there are two options. Existing one-part contracts can be restructured into two-part physical delivery contracts or the contracts can be restructured as financial contracts (i.e., contracts for differences (CfD)).

For regions without generation markets, existing one-part contracts should be changed to two-part contracts.[76] Under a two-part contract, each plant would be paid a capacity price that reflected its own capacity cost, and an energy price that reflected the plant's energy, or variable, cost. Dispatch decisions would then be based on the energy portion of the new two-part contract. Payment for the capacity portion of the contract would not be based on dispatch.[77] This approach recognizes that capacity costs have to be paid whether the plant operates or not. Economic dispatch based on variable costs assures that total energy costs will be minimized, given the existing generation capacity. Notice that, with this approach, each plant will have a different capacity price and a different energy price.

For regions with competitive markets, existing contracts could also be replaced with competitive bidding for dispatch combined with financial contracts. This option (in some places referred to as a "gross pool" model) achieves the same result as the system of cost-based dispatch with two-part contracts.

With financial contracts, or CfDs, each plant is free to provide the amount of energy it is obligated to deliver either through its own generation or through the purchases from the pool. Assuming the market is competitive, each plant bids its energy cost into the pool. The pool will dispatch all plants

[76] The World Bank (among others) has made this suggestion a number of times.

[77] Capacity payments could be subject to contract terms relating to reliability, availability, and coordinated maintenance, etc.

based on the bid prices. The option fee associated with a CfD may be compared to the capacity charge of a two-part contract and the strike price is comparable to the energy charge.

With the CfD, the plant will generate power whenever its generating cost is less than the market price. If its generating (operating) cost is greater than the market price, the plant will not be dispatched and the contract will be met through the plant's purchases from the pool. The result of this approach is that each plant will bid its operating cost and be dispatched as if it had a two-part contract.

Note that, in this approach, every plant is essentially paid the same market price for its energy. The difference between the market price and each plant's CfD price can be thought of as a capacity price.

The CfD approach is administratively simpler for system operators as compared to physical contracts, which must be managed in an operational time-frame. However, as noted before, some entities will be reluctant to replace two-part physical delivery contracts with CfDs. The experience in Norway indicates that it is not necessary to force such a transition. It may occur over some period of time as market participants become more comfortable with the CfDs and understand that in fact they are closely related to more traditional instruments such as physical delivery contracts.

Reforming the existing contracts to separate the recovery of operational costs and from the recovery of fixed costs for existing units is vital. These transitional contractual arrangements have been referred to as "vesting" contracts in England and other countries.

Market designs and the generation contractual arrangements have to be closely coordinated and, preferably, regulated by the same entity. SERC should, as it facilitates movement toward competitive markets, understand the options for transitional contract arrangements. There is no one and only one way in which this may be done. Therefore, a major activity in meeting the objectives of the roadmap should be examination of alternative contractual arrangements and development of *pro forma* (standardized) vesting contracts.

International experience provides a few additional lessons:

- Averaging costs across classes of generating units instead of reflecting the disaggregated costs on a unit-by-unit basis makes it more difficult to create a competitive environment in which the relative costs of one unit may be compared to another. Also, aggregation, or portfolio treatment of systems of generators, increases the potential for gaming and the exercise of market power.

- Different provincial models can be incorporated into a single regional model. For example, in eastern China, Zhejiang has used one approach and Shanghai has used another.. Zhejiang Province has been operating a single-buyer market based on financial instruments in the form of contracts-for-differences (CfDs). The Shanghai Municipal Power Bureau prefers contracts that are based on physical delivery. The challenge of a regional market is how to coordinate or combine these two different approaches.

  Markets in the US and Scandinavia illustrate how both of these types of contracts may be integrated into a single design. Such an approach, which allows financial contracts and physical delivery contracts, is needed to meet the principle of providing market participants with choices or flexibility in how they may choose to participate in markets.

- In some cases, such as Hungary, long term PPAs have proven to be an obstacle to evolving from a single-buyer market to a more competitive spot market. In other cases, such as Panama, the single-buyer market and the PPAs were designed to permit transition to a competitive market within five years.

- In England and Wales, the initial vesting contracts, in the form of CfDs, were phased out over a period of three to five years. These were replaced by a wide variety of financial hedging contracts. Recent work has been completed for Cambodia that addressed the design of PPAs flexible enough to facilitate the transition to more competitive markets.

All of these experiences, and others, should be considered by SERC as it develops national and region-by-region guidelines for market design and for transitional contractual arrangements. There are a variety of solutions to these and related challenges. SERC will need to find its own solutions, ones that will suit the political, commercial, legal, and operational constraints in China.

### 4.9.4. Market Design

As SERC considers alternative market designs for provinces and regions and interregional trading, it should consider many issues and options. The following is a list of market components that warrant substantial investigation before final decisions are taken by SERC.

Markets (provincial, regional, interregional) may be unbundled or combined to address:

- Generation capacity
- Energy
- Combinations of generating capacity and energy
- Portfolio (system sales) trading (as compared to generating unit-by-unit trading)
- Ancillary services
- Losses
- Congestion management; and
- Market surveillance.

This is only a partial list to show the range of issues which must be addressed. Rules will have to be developed for each of these kinds of transactions and services. Even the discussions in World Bank Discussion Paper No. 416 and in Making Competition Work In Electricity, only introduce major topics for further investigation and development.

Internationally, processes in which stakeholders have been actively involved have required five years to develop all of the detailed rules and supporting software as required to implement electricity markets. In some instances such as development of the first electricity market in England, this process has been accelerated. But, in that instance, the government took a very strong role and exercised its authority over competing stakeholder interests.

### 4.9.5. Single-Buyer Markets

China already has experience with the operation of single-buyer markets at the provincial level, both in the more traditional form of PPAs and also in the form of CfDs (Zhejiang Province). SERC may wish to consider single-buyer structures for the development of regional markets. The single-buyer market design is relatively simple in comparison to the development and administration of a set of rules for a competitive spot market. However the entities that act as single buyers accept considerable financial risk as the counterparty to bilateral contracts for generation. Also, they may act to discourage competition. This issue was considered by the Government of Thailand when it decided to continue with a single-buyer design and not to form a competitive market. The national generation and transmission utility, EGAT, argued that it could be a stronger market player in the Greater Mekong Sub-region if it were a single buyer for all of Thailand.

Some single buyers, such as the one in Hungary, have been burdened with substantial stranded costs. As the market was opened and other, more competitive generation competed to serve load, some customers shifted away from the single buyer, which was nevertheless obligated to pay the costs of generation (contracts) which it no longer needed.

A determination of stranded costs and a method for recovery of them may be necessary as part of the phasing-in of competitive markets to complement and replace single-buyer markets. This has proven to be a very difficult issue in the US, where vertically integrated utilities have acted as single-buyers to serve load within defined service areas.

The challenge for SERC is to design single-buyer markets in such a way as to facilitate future migration to more competitive market forms either at the provincial or the regional level. Issues to be resolved include:

- What entity will be obligated to act as a regional single buyer?
- What risks will confront the single buyer and what protections will be provided to manage risks?
- What entity will supervise operation of the single buyer to ensure that:
    - Purchase of generation is transparent and fair, and
    - The right balance of generation is purchased according to economic and reliability standards and guidelines?
- What entity will develop pro forma contracts to serve as guidelines for PPAs between the single buyer and the generator?
- Will PPAs have provision for reassignment to another entity, such as a distribution company or a trader?

### 4.9.6. Expanding Competition

As the networks and institutional capabilities increase across China, it is expected that SERC will encourage expanded competition. This section and sub-sections discuss issues that SERC must address as this occurs.

Electricity markets may be decentralized, centralized, or a combination of the two. Centrally administered systems have been established as electricity markets have evolved from bilateral trading among vertically integrated utilities to unbundled market participants and wires businesses.

The historic industry structure in England and Wales, like that of Thailand, was characterized by a single state-owned enterprise that owned all generation and transmission. As the UK reformed that structure, it, like China, unbundled generation from transmission. The initial market called for financially binding, centrally administered, day-ahead transactions, cleared on an hourly basis. The cost of congestion, the difference between a constrained dispatch and an unconstrained dispatch, was allocated among market participants through an uplift charge and annual contracts for ancillary services. The market was based on a system of vesting contracts. Volatile pricing in the energy market was hedged through such contracts.

SERC will need to consider each of the following as it develops its plans for implementation of government policies to unbundle the electricity sector and to achieve economies through increased competition.

#### 4.9.6.1. Day-Ahead Market

SERC will wish to consider alternative designs for a day-ahead market. Will it be based on physical contracts? Will Day Ahead schedules be financially binding? How will settlement prices be determined: nodal clearing prices, zonal clearing prices, some combination of the two, pay-as-bid, or any of a number of different possible methods? (This question is discussed in greater detail in a section below.)

Numerous rules will have to be developed for the method that is adopted. Are market participants obligated to bid generation or to make offers to buy? This is the requirement for those US markets in which generating capacity is credited toward meeting a contracting obligation. Will scheduling and dispatch instructions be sent directly to each power plant or will they be communicated to the owner-operator of a system of generating units? What information will be made public with respect to bids, offers, clearing prices, etc?

#### 4.9.6.2. Real-Time Balancing Energy Market

Many of the same issues that must be addressed for the day-ahead market must also be addressed for real-time markets. What method will be used for dispatching and settling energy that is needed to meet the minute-to-minute balancing requirements? What will be the cut-off time for receipt of changes to bids and offers that were submitted for the day-ahead market? When, and under what rules, may the system operator/market administrator intervene in the market to mitigate prices in order to prevent abuse of market power? How will settlement prices be determined and what information will be made public?

#### 4.9.6.3. Hedging

Mechanisms should be included for hedging congestion and volatile pricing in the day-ahead and real-time markets. Hedging generally takes the form of a bilateral contract between two parties. The contract may be for physical delivery or it may be a financial instrument such as a CfD. Failure to permit such hedging contributed to the widely noted problems that occurred in California in 2000.

Hedges may take a number of forms. They may include long-term contracts for a number of years, annual contracts, and short-term contracts for periods of less than a year. Again, many issues will have to be addressed by SERC in approving market designs. What minimum requirements must be stated in each contract? What regulatory oversight will be required, if any? What role will the system operator/market administrator perform with respect to the contracts?

Related to hedging is secondary trading. SERC needs to understand and encourage secondary trading of short- and long-term contracts. This is already occurring in the East China region. Shanghai Municipal Power has entered into long-term contacts for generation capacity and energy. At times, it has excess power under long-term contract and has resold that energy through short-term transactions.

#### 4.9.6.4. Ancillary services

Ancillary services include the spinning and non-spinning reserves that are necessary to ensure continuity of supply when emergencies occur. These services also include regulating power and reactive supply to ensure second-to-second frequency and voltage stability. "Black start" capacity is also sometimes included as an ancillary service.

The obligations on market participants to supply these services must be clearly stated. How will the total obligation for ancillary services be determined for a province or for a region, and how will this obligation be allocated among market participants? Will market participants be permitted to provide their own ancillary services? What rules must be met in order to self-supply? Will ancillary services be contracted on an annual basis and then called upon day-to-day in accordance with the agreed prices and conditions determined through the annual process? Or, will each of these services be unbundled and competitively bid? Will the selection of suppliers be based on co-optimization of ancillary services with energy supply? How will the cost of these services be settled? It is possible for ancillary services, which generally account for a small percentage of the total cost of electricty generation, to become a major administrative burden? What reasonable compromises are necessary in order to simplify the process? What resources will be allowed to provide ancillary services? Will distributed generation, demand response, and end-use efficiency be permitted to participate in this market?

China has already provided an example to other countries of a method for giving incentives for the satisfactory technical performance of ancillary services. For several years, the East China region has imposed a penalty charge for failure to regulate frequency within a specified range. Frequency-regulating performance showed an improvement after this penalty was introduced.

#### 4.9.6.5. Congestion Management

Congestion will exist within and among provinces. Every system is congested due to insufficient delivery capability, and cannot meet reliability criteria under all conditions of generation availability, operating characteristics, and load patterns. This is referred to as reliability-related congestion.

A second form of congestion results from insufficient delivery capability to permit the most economic generation to reach load or to permit generation that is scheduled to serve a particular load to be delivered to that load. Outages of facilities may create congestion in real-time that did not exist at the time of determining day-ahead schedules.

Will congestion management be on a province-by-province or regional basis? If there will be two levels of congestion management, how will these be reconciled when there are conflicts between the actions needed to address one rather than the other? What methods will be used for managing these forms of congestion and how will the costs be allocated?

### 4.9.7. Generation Contracting or Capacity Obligation

A major issue to be addressed by SERC will be whether an obligation will be imposed to build, or purchase through contract, generating capacity and on which entities that obligation will be imposed. In the US, three of the markets include obligations to build, or contract for, generating capacity that is sufficient to meet the forecast demand plus a reserve margin. A number of the markets in Latin America include an obligation to contract for generation to cover 80% of the non-contestable load (i.e., that load that is not permitted to shop for alternative supply). In the original market in England and Wales, an element was included in the pool, price which reflected the the level of generating unit capacity scheduled as compared to load. This acted as an incentive to attract investment in generating capacity.

Most contract obligations are intended to provide incentives to install sufficient generation to meet the forecast load as well as provide a reserve margin such that system reliability can be maintained despite scheduled and unscheduled outages of generation. An additional objective could be to prevent market participants from relying fully upon the ***spot*** market to meet their long-term loads. Experience with traditional markets has indicated that, without any obligation, typically only about 80% of load has been met with long-term contracts. The power pool in Norway was an example of this.

If energy market prices are limited to low levels through some form of mitigation, buyers may decide to not enter into long-term contracts as a hedge against high spot market prices. This was illustrated in England when the regulator imposed limits on the total annual prices that the two dominant generators could charge until they sold 6,000 MW of their capacity to potential competitors. Some distribution utilities decided to not hedge their energy purchases during the period when these prices were capped.

Consideration should be given to whether and, if so, to what degree government regulators should intervene in markets by requiring certain percentages of total trading to be allocated among long-term, short-term, and spot transactions. Such interventions may discourage investment in generation.

If SERC determines to impose a generation-contracting obligation, it will need to address a number of questions, of which the following are only an illustrative few:

- Which entities will be required to contract for generation?
- How will the obligation be defined?
- What amount of load must be contracted for and how is that to be measured and enforced?
- Will there be a default supply for uncontracted load? If so, how will that be met?

There are many more issues that must also be addressed, in order to reach decisions that will be sustainable and not require substantial changes and adjustments that could create uncertainty for potential new investors. Imposing a generation contract obligation creates the need for a ***complete*** set of rules and definitions in addition to those that are required for the energy market.

#### 4.9.8. Roles of the Entities:

As single-buyer markets are replaced with expanded competition, the roles of the market participants will need to be addressed. Frequently the single buyer has been corporately bundled, though functionally unbundled, with an owner and operator of a transmission business. When the market evolves beyond a single buyer, an issue to be examined is whether the system operator/market administrator should be corporately bundled with the owner/operator of the transmission system. This will be a major industry structure issue that must be considered by SERC. The experiences in other countries in solving this challenge are informative.

In England, National Grid Company owns and operates the transmission system and also acts as market administrator and system operator. In Argentina, Australia, and in six markets in the US, the system operator/market administrator is separate from the transmission business. In both Australia and in the US, there are multiple owners of transmission. California created a power exchange as a market administrator for the day-ahead market. This was separate from the independent system operator. Numerous problems developed and, after the crisis in 2000, the Power Exchange was shut down.

Generally, transmission companies have wanted to retain the market administration and system operation functions. This can be of particular concern if the transmission company is permitted to own generation. Great care must be taken, if that is the case, to prevent the system operator/market administrator from using its generation resources to influence the market price.

In Hungary, as the single buyer was replaced with a competitive market, the system operator/market administrator was made independent of the transmission operator. But, the transmission operator continued to hold the PPAs that had formed the basis of the single-buyer market.

In the European Union, requirements as stated in the most recent directive are based on a Transmission System Operator (TSO) which is assigned responsibilities for operation of open access transmission and for administering markets. However, the question of whether this requires the TSO to *own* assets required to fill these functions is open to debate.

In some markets, brokers and traders have been created. Brokers add value by matching buyers with sellers. An energy broker arrangement was developed for East China but has not actually been put into operation. The Energy Broker may add value when there are many sellers and many buyers, and the broker can facilitate identifying potential trading partners. In contrast, a trader takes ownership of purchases and must then find buyers. A trader acts as a pool, taking risks and therefore earns profits to compensate for those risks. The trader may deal in either physical delivery contracts or financial arrangements. In the US, many trading businesses have suffered and incurred substantial losses.

Many brokers have been created over the years in Europe and in the US, but these frequently have proven to add relatively little value and have not been very profitable. Still, there may be roles for brokers and for traders in China. SERC needs to be aware of the alternatives and establish an appropriate regulatory framework as necessary to avoid abuses and protect the public interest.

### 4.9.9. Environmental Reforms

Reforming existing contracts as described above (and assuming that markets are competitive) will assure that dispatch is based on each power plant’s operating cost. However, neither of the contract reform options (two-part contracts or CfD contracts) will promote the environmental improvements that China is hoping to achieve though increased use of natural gas and FGD.

A major purpose of power sector reform and spot markets is to improve the dispatch of power plants. Exclusive reliance on spot markets to determine power plant dispatch can undermine China’s efforts to reduce air pollution. Electricity produced from natural gas is much cleaner but more expensive than coal. China is increasing its use of natural gas because of its environmental benefits, yet, with power plant operation determined by competitive bidding, these plants will not be dispatched very often. If this happens, the expected environmental gains will not be achieved. Coal plants with FGD face the same problem. Higher operational costs for these units will reduce their use and environmental benefits.

Two-part contracts for gas plants will have a high energy price and thus the plants will not be dispatched as often as dirtier, less expensive plants. Moreover, high CfD contract prices will not assure that the natural gas power plants operate.
Without appropriate environmental reforms, plants with low operating costs will run more and plants with high operating costs will run less. How the markets are designed and how environmental costs are considered in the market will determine the overall level of emissions from the sector.

Pilot markets in Zhejiang addressed this issue by doing a combination of two things: (1) dispatching plants with FGD on the basis of their operating costs (or bids) without the operating cost of the FGD and (2) by making extra-market adjustments to the prices paid to generators with FGD to reflect the added operating cost of the FGD units. These are the types of reforms that can be used to address the competitive disadvantage of clean power plants. The specific reforms adopted thus far however do not fully address the issue. The price differentials are too small, they do not cover all of the major pollutants, and they are too narrowly focused on coal plants.[78]

Power plants fueled by natural gas raise a similar but more extreme situation. Natural gas power plants have very high operating costs relative to coal plants. If China wishes to have these plants run for their environmental benefits, the markets or contracts will have to be adjusted. There are several options for doing so:

- Exempt natural gas power plants from bidding and require their operation to be controlled by contractual provisions or
- Fully incorporate environmental costs in the market (as discussed in a separate paper[79]).

Many natural gas power plants have been built in the in the US, UK, and other counties. In these countries natural gas power plants were generally built based on their economics without consideration of the plants' environmental benefits. For many years natural gas costs were low. Low gas prices and very high thermal efficiencies of natural gas combined-cycle power plants made these plants good investments without special consideration of their environmental benefits. In China, the price of natural gas is so high relative to coal that competitive markets may not lead to the construction and operation of natural gas-fired power plants.

[78] Power plant prices that distinguish between power plants with and without FGD were also recently set for plants in Beijing and the surrounding areas. Plants with FGD are paid a higher price than plants without FGD. While the intent is to compensate the cleaner plants for the added cost of FGD, the unintended result could be to cause the more expensive plants with FGD to be dispatched less due to the higher contract price.

[79] See Principles of Sustainability

### 4.10. Market Power and Monitoring

### 4.10.1. Introduction

Designing, and implementing, a competitive generation market is no easy task. Maintaining the competitiveness of the market is even more difficult. A critical function for SERC will be to monitor the markets for any sign of abuse and take corrective action quickly and efficiently.

Market power can be exercised in many ways. Not all abuses require a large market share or collusion between participants. In fact, we have observed a number of instances of apparent market abuse that were a consequence of failures in market administration, e.g., failures to operate the market according to the rules. Some actions by generators may not be illegal or directly violate a market rule, but they may nevertheless be unanticipated, undesirable, and undermine the competitiveness of the market. These abuses will need corrective action.

There are three separate, but related, issues to consider:

- Market structures and related rules that can moderate market power;
- Institutions and rules for market monitoring, and
- Rules and practices to correct market power problems and abuses, when they arise.

In general, it is impossible to avoid the possibility of market abuse. The market monitoring function is designed to detect abuses when they occur and to initiate corrective or enforcement action as may be appropriate.

### 4.10.2. Market Structures to Manage Market Power

Market structure is the first, most effective and most efficient way to address market power issues. In the absence of sound market structures like those listed here, market monitoring will have a very difficult task to control market abuses or ensure efficient outcomes. Market monitoring is not a substitute for sound market structure. The key elements of a sound market structure to address market power issues include:

- *An Adequate Number of Competing Generators*. Market power will exist in any market, submarket, or time period in which generators have the capability to raise prices or threaten system reliability by withholding generation.[80] The market power of generators is not likely to be eliminated solely by dividing up the generation sector into six or so competing companies. Many more are needed. For example, Argentina has nearly 40 competing generation companies, with the largest having no more than 15% of total capacity. The NORD POOL has more the 50, of which the largest accounts for less than 10% of the market. If ownership of generation is concentrated within a constrained area, the owner, even though it may have a relatively small part of the total generation in the region, may be able to exercise market power.

[80] There are now numerous studies on this point. For example, one study of the California price spikes found that the "actual prices in June, July, and August 2000 were higher than the benchmark prices by 90%, 56% and 36%, respectively. Joskow and Kahn, "Identifying the Exercise of Market Power: Refining the Estimates," (July 5, 2001) at p.2.

- *Resource Adequacy Rules and Energy Efficiency Policies to Improve Reserve Margins Generally*. In a rapidly-growing electric sector, market power will be a continual challenge as demand growth erodes capacity margins.[81] An adequate resource base of generation and demand-side resources is needed over time, along with forward-looking policies to promote their development.
- *Open Access to Transmission*. Rules for transmission and reliability must apply to all resource providers on an equal basis. Generators must not be able to use the transmission system to enhance their competitive positions.
- *Portfolio Management Practices by Power Providers*. Maintaining a large proportion of long-term bilateral contracts can reduce the potential for market power. The short-term spot market should be limited in size, so that short-term price volatility will affect only a small percentage of total sales.[82]
- *A Broad Array of Demand Response Opportunities*. The market power of generators can be countered and mitigated by customers who can reduce demand to meet economic or reliability goals. Customer responses include both longer-term energy efficiency improvements and shorter-duration load management opportunities.[83] Meaningful opportunities for customers and power providers to reduce demand at peak periods must be provided.
- *Easy Entry*. Clear rules that allow easy entry of all supply and demand-side participants can help limit market power.

### 4.10.3. Predicting and Measuring Market Power

Traditional economic tools to govern market power generally (e.g., the HHI index) are inadequate in power markets. To measure market power and determine which generators have exercised it, market monitors need to conduct different kinds of analyses including:

- Market-wide studies that test whether prices are competitive generally,
- Unit-by-unit analyses that assess the behavior of individual generators, and
- Field inspections to verify the condition of plants out of service

#### 4.10.3.1. Measuring Whether Market Power Has Been Exercised

There are a number of tools to determine whether generators are exercising market power in particular cases. A principal tool is called Competitive Benchmark Analysis. In this analysis, a computer model "bids" the marginal costs of each unit on the system for each time period, and "clears" that bid stack

[81] This is essentially what caused the California crisis. Rapid load growth in the states *around* California, and a drought that restricted hydro imports, left generators with market power and led to rapid price spikes.

[82] See, C. Harrington et al, "Portfolio Management: Protecting Consumers in an Electric Market That Isn't Working Very Well" (Regulatory Assistance Project July 2002) posted at www.raponline.org.

[83] For a review of demand side resources and the policies that could make them available to combat generator market power see, "Dimensions of Demand Response: Capturing Customer Based Resources in New England's Power Systems and Markets" (Report of the New England Demand Response Initiative, July 2003) posted at www.raponline.org.

against actual load conditions. The intersection of the supply and demand curves sets what would be the *competitive market* clearing price in each time period. "These prices are then compared with actual historical prices; if there are substantial discrepancies between the two that cannot be explained away, then there is a strong suspicion of the exercise of market power."[84]

#### 4.10.3.2. Determining Who Has Exercised Market Power

To determine whether *individual generators* have exercised market power, market monitors analyze the bidding and withholding behavior of individual generators. Has withholding been the result of:

- Forced outages due to maintenance, fuel, or related problems;
- Legitimate competitive decisions based upon low clearing prices or a justifiable desire to save output for anticipated higher-price periods; or
- Strategic withholding to raise market prices through the exercise of market power?

### 4.10.4. Responsibilities of the Market Monitor

The role of market monitoring is to ensure that markets are workably competitive, both in real-time and over the longer term. This involves identifying market abuses when they occur, including failures by the market administrator to follow the rules, so that particular corrective actions can be taken, and identifying weaknesses in market rules and structures, so that regulators can consider reforms to improve long-term efficiency. Market monitors are often responsible for:

- Monitoring market participants' compliance with the rules, standards, and procedures of the market;
- Looking for the exercise of improper market power, including physical withholding, economic withholding, misuse of must-run status, gaming of bidding rules, etc.;
- Proposing or imposing bid caps in one or more markets, and in load pockets;
- Advising regulators on the potential impacts of divestiture, merger, and acquisition proposals;
- Proposing or imposing "bid mitigation" decisions, revising bids that are outside of proper bidding behavior, or are the result of flawed market conditions (thus, they may restate received bids, in some cases after the market in question has cleared);
- Suggesting sanctions or penalties for physical withholding, under-scheduling load, failure to follow ISO instructions, inaccurate bid information, etc.;
- Making market information available to participants and regulators (in some cases, daily information is made public; but in most cases only aggregated data are made available so as to protect individual bids from public release); and
- Recommending changes to market structures, rules, and operations so as to improve the long-term effectiveness of the power system and markets.

[84] R. Rajaraman and F. Alvarado, "(Dis)Proving Market Power" (Christensen Associates, January 2002) at p.5

### 4.10.5. Market Monitoring Tools and Examples

#### 4.10.5.1. Addressing Market Power through Contracts

Market power is easier to exercise in spot markets than in long-term contract markets. Thus one way to reduce exposure to market power is to rely more heavily on long-term contracts. The failure to use long-term contracts is cited as one of the major reasons that costs rose so high in the California power crisis.[85]

The State of New York used contracts extensively as part of its transition to competition. There, market monitoring analysis revealed particular power plants and locations in which market power might be exercised (at least at some hours of the year). To avoid market power, contracts for each individual power plant included terms and conditions under which the power output of the plant could be "called" by the buying utility at less than the spot market price in that location.[86]

#### 4.10.5.2. Imposing Bid Caps, Price Caps, and Bid Limits in Wholesale Markets

A second common form of market power mitigation is the imposition of constraints on bidding. One type of constraint is the bid cap, usually set according to a policy openly developed and announced in advance so that generators can adjust their bidding behavior across the board. When a bid cap is imposed, the market operators will not accept a bid higher than the cap, or will record any higher bid as though it were at the cap.[87]

While an essential tool to moderate market power, bid caps are very controversial in the US. Some economists claim that occasional, high peak prices are essential to attract capital to build new generation. Others point out that financiers do not want to (and, in fact, won't) advance capital on such a speculative basis anyway. But most generators prefer the certainty of known bid caps to the uncertainty of "bid restatement" discussed below. In the Australia market, bids are capped at $10,000 per MWh. This has been sufficient to cover the cost of marginal plants that are needed at peak load times but which are operated for a relatively small number of hours in each year. By taking this approach, Australia has avoided the complexities associated with establishing a set of rules,

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[85] "The most important lesson is that any re-structuring process should begin with a large fraction of final demand covered by long-term forward contracts." Wolak testimony, supra, at p.13.

Another study of the California crisis found widespread strategic withholding, with one exception – a generator that had committed 90% of its output to long-term forward contracts. "…Duke's forced outage rates are far below what we observe for the other …generators on the high-price days. …It is well known in theory and clear from common sense that a generator that is fully contracted has no incentive to withdraw capacity. This shows that incentives matter." P. Joskow and E. Kahn, "Identifying the Exercise of Market Power: Refining the Estimates," (July 2001) at p. 28.

[86] Interview, James Gallagher, Director of Electricity, New York Public Service Commission.

[87] Bid caps have been imposed in many markets, with varying degrees of success. In December 2000, FERC imposed a "soft" price cap of $150 per MWH in California, but permitted generators to bid above the cap, provided they could provide some justification for doing so. Because FERC did not examine these justifications very closely, bids were often above the cap.

In other cases, the caps have been more strictly enforced, but usually at higher price levels. The New England ISO, for example, has imposed a bid cap of $1000 per MWH, which has limited the financial impact of the highest potential peak power prices on a few occasions when regional margins were thin. The New York ISO imposes a bid cap on all generators within New York City (which is a very large load pocket). Generators must bid no higher than their marginal operating costs, but they will be paid a locational marginal price (LMP) based on the bid of the highest-cost unit dispatched to serve the City.

monitoring, and enforcement mechanisms as are required by a contracting obligation.

#### 4.10.5.3. Long-Term Bidding

A different form of bid constraint has been employed successfully in Argentina. There, generators are required to post bids that remain effective not just for a single day (as in most spot markets) but for three months in advance. Bids do not have to be uniform across all hours, but the bid schedule must be posted well in advance of each day's market. This means that generators are unable to take advantage of short-term market conditions, and have much stronger incentives simply to bid their actual operating costs rather than to engage in complex day-ahead and day-of bid adjustments.

#### 4.10.5.4. Restating Bids That Appear To Demonstrate Market Power

Some corrective actions screen the offer prices from individual generators and alter bids if an offer price exceeds some bound around a "reference" price level.[88] The underlying rationale for this practice, called Automatic Mitigation Procedures (AMP), is that they apply corrective actions quickly. The longer it takes to accomplish corrective action, the more difficult it is to apply retroactive corrective measures to the entire market – which might well be necessary since clearing prices applying to all participants may well have been affected by the behavior in question. Commercial certainty for market participants is enhanced by a process that tells them quickly what prices must be paid (and received).

There is increasing support for enabling ISOs to apply corrective actions quickly. For example, ISO-NE states that the purpose of these procedures is "to mitigate the market effects of any conduct that would substantially distort competitive outcomes in the NEPOOL Market, while avoiding unnecessary interference with competitive price signals and normal market operations." AMP allows the ISO to monitor and adjust participant offers for very obvious instances of market power.

#### 4.10.5.5. Bidding Rules Changes and Other Corrective Actions

Frequently it is found that the rules are not adequate for fair and open competition. In some instances they have been found to be poorly defined and permit market administrators and system operators latitude to exercise judgment in ways that can have adverse commercial consequences.
Market monitors look for ways generators have abused market rules and suggest modifications to end the practices. For example, the California electricity crisis revealed a wide range of misleading and anti-competitive bidding strategies that were performed by major market participants.

Another example in PJM involves the manner in which imports into the PJM market region were treated by the PJM market. Because PJM settles its markets using locational marginal prices, imports that can be delivered to some locations will be more valuable than imports delivered to other locations.

In the summer of 2002, the PJM Market Monitor noticed large discrepancies between the amount of power scheduled to be delivered in its Southern and Western interfaces (importation points) and the amount actually delivered there. Because power was more valuable at the Southern interface, generators selling into PJM were "scheduling" delivery there, and were being paid on that basis, even though the physical characteristics of the system would not support such delivery. Due to grid conditions, the power would actually be taken at the Western interface. This situation had adverse effects on the transmission system; scheduled and actual flows varied substantially, sometimes by as

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[88] Bushnell (2003) and Lesuitre and Goldman (2003)

much as 3000 MW, increasing transmission congestion and affecting system reliability.

As a result of the Market Monitor's investigations, PJM market rules were modified. The new rule treats all imports as though they are delivered to the lower-cost Western delivery point, thus eliminating the incentive to marketers to schedule delivery at a higher-priced location where transmission was not really available.

### 4.10.6. Institutional Issues for Market Monitoring Units

The job of the market monitor is demanding, both technically and in a political sense. It is crucial that market monitors have a clear mandate, adequate resources and information, and the administrative independence to do their jobs. As noted before, there is need for independence from the market administrator, although the market monitor will necessarily depend upon the market administrator as a source of information. Reports should be filed directly with the regulator as well as with the governing body, provided that care is taken to preserve the confidentiality of commercially sensitive information.

#### 4.10.6.1. Information Needs and Capabilities

The minimum information available to a monitor includes those data required to clear a market: generator availability, capacity and offer data (energy, reserves, voltage regulation), scheduled flow for bilateral transactions, detailed network capability and conditions (capacity limits and likely contingencies for security-constrained optimal dispatch), and load requirements (bids); and information gained from the cleared markets including prices, dispatches, and network congestion. Additional data and descriptive information may also be available. For example, generator cost and operating information can be valuable when analyzing offers that lead to unusual prices.

Market monitors must be able to evaluate this information rapidly, and will need the software and modeling ability to track patterns of trades to look for improper bidding behavior and inefficient outcomes that may result from particular market rules.

#### 4.10.6.2. Institutional Home of the Market Monitor

The market monitoring needs to track and assess system conditions and market operations on a close, daily basis. This suggests physically placing the function *within* the operations or trading center for the regional power system. In the US the function is delegated to an independent entity within the market operator or the ISO.[89] There is reason, however, to be concerned that a market monitor located structurally within the system operator may not be sufficiently independent to identify abuses, enforce sanctions against them, and recommend changes in the market to prevent future abuses. In China, it

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[89] PJM has a Market Monitoring Unit (MMU) within the PJM organization (which runs the power market and operates the system dispatch for the multi-state region). These employees are accountable directly to the President and Board of the RTO. There is no outside independent market monitoring entity.

In New York (NYISO), and in New England (ISO New England) the MMU is staffed by ISO employees, accountable to their ISO organizations. Each of these pools also has an independent Market Advisor, reporting directly to the Board of the ISO.

The California ISO established a Market Surveillance Unit within the ISO, and an outside Market Surveillance Committee (MSC), made up of 3 or more independent experts, not on the ISO staff. The MSC was intended to advise the ISO staff and CEO, as well as the ISO Board directly.

may make more sense to make it a regulatory function, as was established in Panama.

#### 4.10.6.3. Adequate Resources

Market monitoring requires adequate access to data, and the professional skill and judgment to interpret the data to reveal patterns of market behavior. This requires an adequate budget and a highly-skilled staff.

The four RTOs operating Market Monitoring Units in the US have staffs of between 11 and 31 people, but importantly, they all have the ability and funding to hire outside experts as well.

### 4.10.7. Conclusion

Practice in the area of market monitoring is still evolving in the US as it is elsewhere. The important lessons from many markets are:

1. Electricity markets create many opportunities for non-competitive behavior, and inefficient allocation of resources;
2. Active market monitoring is needed to discipline participant behavior and to develop advanced, factually-based market structure reforms;
3. While there are many lessons to be learned from market successes and abuses across the world, the problems that arise will be highly fact-specific, and thus the market monitoring function must be based on each market's characteristics, and must be permitted to evolve to meet new and changing needs in each market; and
4. Market monitors must have the resources and authority to conduct these tasks on a continuing basis as an integral part of the market system.

### 4.11. Implications of Retail Access

#### 4.11.1. Introduction

Initially China's reformed power sector will be a single buyer model. All consumers will be served by a single seller and all suppliers will sell to a single buyer. This is expected to evolve quickly to a multiple buyer wholesale market. Distribution companies will be separated from the main transmission grid. Multiple distribution companies will be buying from multiple sellers but each distribution company will provide retail service on a monopoly basis to their consumers.

The final step would be to allow retail consumers to buy power directly from generation or competitive retail suppliers. In retail competition[90], individual end-use customers are given the opportunity (or in some cases, may be required) to choose a power supplier from among competing power generators or other competitive retail sellers, such as retailers, aggregators, and ESCOs.

In both wholesale and retail competition models, transmission and distribution functions and most reliability services are provided by regulated, monopoly utilities.

In the State Council Decree No.5, the State Council's Reform Plan for the power sector, and in the rules governing operation of the newly-created East China and Northeast China power markets, policymakers in China have acknowledged both the potential benefits and the potential drawbacks of retail power access, and have endorsed the idea of direct access on a pilot basis only for the largest customers.

This paper examines the issue of retail competition, with four main conclusions:

1. In China, most of the benefits of competitive power markets occur at the wholesale level; retail competition is likely to add little in the way of benefits to consumers or to the economy. For countries with financially weak distribution companies, such as India, retail competition may offer more significant benefits;

2. Experience with retail access in the power sector has been mixed at best. While retail competition has been fully implemented in some places, the net benefits are not clear;

3. Retail competition introduces complex challenges for regulators and power companies, and can undermine progress on environmental and efficiency goals; and

4. If retail access is desired, it can be phased in for the largest power customers, but even here, some important limitations and protections are required.

#### 4.11.2. Pros and Cons of Retail Access

International experience shows retail competition can be implemented. However, well respected economists and market designers disagree on whether the benefits of retail competition outweigh the

[90] When retail customers can choose among multiple power suppliers, we say they have "retail access" to the market. When different power suppliers must compete to sell their services to retail customers, we say they are engaging in "retail competition." Thus, the terms "retail access" and "retail competition" refer to the same business situation, viewed from both sides of the market. In this paper we use both terms.

costs.[91] For China, the benefits of wholesale competition outweigh the costs. The case for retail competition is not clear. Support of retail access seems to be based more on philosophy and ideology than economics.

#### 4.11.2.1. The case for retail competition

The proponents of retail competition say that the benefits include:

1. Price – With retail choice, customers could "shop around" for the best price, and would not be required to purchase from suppliers who were inefficient or made bad resource decisions. The pressure from these customers would force utilities to become more efficient, lowering the cost of power for individual customers and for the economy as a whole.

2. Service quality – In a "choice" environment, retail customers would not be captive customers of monopoly utilities, but could insist on high-quality customer service, avoiding suppliers with unreliable power sources, improper billing practices, etc. However, it is difficult to provide a different level of service quality to one customer than to another when both are connected to the same distribution system.

3. Innovation – Retail competition would inspire the creation of new types of services (such as "green" power, combinations of on-site generation and purchased power, advanced controls and meters, and new pricing options). Just as competition in telecommunications has given rise to many new types of service options, retail electric competition could give rise to new types of electric service. Thus far there has not been much innovation in electric services in most places.

4. Improved wholesale competition – retail access allows a better matching of buyers and sellers. Generation with particular attributes could find buyers with the same characteristics. Adding more buyers also reduces the opportunities of distribution companies to exercise monopsony power. Finally, in counties such as India, where distribution are insolvent or financially weak, retail buyers with the ability to pay can improve the ability of power plant investors to obtain financing.

#### 4.11.2.2. Problems with retail competition

There are significant reasons to be cautious about moving to a retail choice system in electricity. While there are some benefits to retail choice, there are also some significant problems, most of which occur even if retail access is limited to the largest users:

1. **Difficulty of performing planning** – To maximize the value of service at lowest reasonable cost, utilities, or suppliers, need to perform forward-looking Integrated Resource Planning, or to engage in strategic Portfolio Management. These functions are very difficult in an environment where the utility does not know who its customers will be at definite terms into the future.

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[91] See, Paul L. Joskow, "Electricity Sector Restructuring And Competition: Lessons Learned", August 2003; Paul L. Joskow, "Why do we need electricity retailers? Or, can you get it cheaper wholesale?" Center for Energy and Environmental Policy Research, Massachusetts, Institute of Technology, revised discussion draft (January 13) 2000; Price C Watts. "Heresy? The Case Against Deregulation of Electricity Generation", The Electricity Journal (May): 19-24 2001; and Stephen C Littlechild, Competition in Retail Electricity Supply, Journal des Economistes et des Etudes Humaines, September 2002.

2. **Difficulty in ensuring adequate generation** – Forward-looking rules to ensure resource adequacy (adequate reserve margins) are much easier to apply to a system of retail franchises than to a host of independent retail customers. In China, we expect most power plants will have long-term contracts with grid or distribution companies. Retail consumers generally do not enter into such long-term power supply contracts. Even if retail consumers were willing to enter into such contracts, it is not clear that they could support investments in forward-looking reserves. Only the largest, most financially secure companies would provide the credit support needed to finance new power plants in advance of immediate need.

3. **Pressure to under-invest in energy efficiency and environmental protection** – One of the hopes for retail competition has been that innovative service offerings, including "green power" options and options combining power supply and DSM services would emerge. These options could lead to a less-polluting and more efficient power sector. For the most part, this has not occurred. The market barriers to energy efficiency that lead to wasteful energy decisions by builders, factory managers, office tenants, and residential customers are not resolved by retail competition. With respect to the environment, retail choice has led to new "green power" options in some jurisdictions, but a relatively small number of customers choose them. In most jurisdictions, most retail access customers pursue the lowest per-kwh retail rate, and increase the political pressure on governments and utilities to keep rates low, even at the cost of higher pollution levels and higher electric bills for customers generally.

4. **Non-choosing customers must be protected** – Because electric service is so essential to modern life and modern businesses, governments find it necessary to provide electric service on some basis even to customers who do not choose a retail provider. This "default" service becomes a new public utility franchise, which must then be regulated so that it operates in the public good. A key consequence is that even when retail access is permitted, it must exist side-by-side with default service, which adds complexity and some powerful tensions between the two systems.

5. **Effects on costs** – When power suppliers' sales are not protected by a utility franchise, they are exposed to greater financial risks, and need to return their capital costs more quickly. This can lead to higher capital costs and shorter investment horizons by power sector investors. Transaction costs both in the market design and in suppliers marketing for customers are also substantial. In the US, retail marketing costs added so much to the cost of doing business that retailers found it very difficult to market to small customers profitably.[92]

[92] The costs of "customer acquisition" for smaller customers often exceeded the profits expected from sales to those customers over the first two years of service. Unless customers sign long-term contracts with competitive suppliers, this is a significant business risk.

#### 4.11.3. Experience With Retail Access

##### 4.11.3.1. Most Customers Do Not Choose

One of the chief benefits of electric market reform was thought to be consumers' ability to choose an electricity provider. In most power systems, however, most customers choose to stay with their traditional utility provider, or with a default service provider selected by the government.

This is especially true for smaller customers. In the United States, for example, 17 states enacted retail competition plans. But in no state that deregulated retail sales of electricity is there currently an active, competitive market for residential consumers. In most restructured states, less than 5 percent of consumers have switched electricity providers, and in recent months, these numbers are dropping.

Large customers are much more likely to take advantage of retail access.[93] For example, in the state of Texas, most of the largest customers chose direct access, for two main reasons. First, new gas-fired generation in Texas created a very competitive supply market. And second, under Texas regulations, customers with loads greater than 1MW were denied the protection of a "price to beat" that was available to smaller customers. Because they did not have a traditional, regulated utility price to rely on, and because new competitive generators were offering low prices, large customers chose new retail arrangements.

##### 4.11.3.2. Default Service and Standard Offer Plans Dominate

All US states that have established retail competition have also established a regulated standard offer service – available to consumers who do not choose a competitive electricity supplier – with limitations on the rates utilities may charge consumers. These rate limitations had two purposes: 1) to protect consumers who "refuse to choose" during the transition to competitive retail service, and in many cases, 2) to mandate lower prices by regulation, and thus deliver consumers an immediate benefit from restructuring prior to the anticipated benefits that would result from competition.

##### 4.11.3.3. Utilities Seek Stranded Cost Recovery, Exit Restrictions and Re-entry Charges

In response to the potential threat of competition, utilities in many places have demanded financial compensation, and have sought to erect additional barriers to customers leaving the system. In the United States, "stranded cost" recovery awards have totaled many billion of dollars. In addition, many utilities have requested rate structures with higher fixed and lower variable charges, combined with customer charges for the privilege of leaving the utility system, called "exit fees."

##### 4.11.3.4. Large Customers Promote Retail Access But Also Seek Stable, Regulated Rates

As noted above, small commercial and residential customers are not often interested in pursuing retail competition, but larger customers, particularly the largest industrial customers, often do want to choose their power suppliers. While the percentage of *customers* seeking retail access has been small, in some jurisdictions the percentage of *total sales or total demand* seeking retail access has been much larger.

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[93] But, as noted below, they still will seek protection from market forces, volatile prices, producer insolvency, and other consequences of market exposure.

Even though large customers have often led the political fight for retail competition, this does not mean that those customers will willingly accept all of the financial consequences of retail choice. In some jurisdictions, large customers have happily moved away from regulated rates when they were higher than short-term market rates – but when market prices rose to level higher than the more stable regulated rates, they asked the utility to take them back as customers. In Pennsylvania, for example, a large number of "choice" customers, including some very large industrial customers, sought service from regulated default service providers when market prices rose above the regulated rate.

Another issue for many larger customers has been rate design. Under franchise regulation, many larger customers were required to install real-time or other advanced metering and were required to be on time-of-use prices. These prices reflected the cost of producing and delivering power at different times and different places. With restructuring and retail access, these customers were free to choose among competing suppliers. Customers were no longer required to be on any particular price structure. Many of these customers preferred the certainty of fixed prices to the more efficient time-of-use prices they were previously required to take. Thus, although the expectation of many was that restructuring would lead to innovative pricing, retail competition helped many customers avoid the price volatility of generation markets through less-efficient, simpler pricing.

In China, the motivations of industrial customers may be different from those in other countries. In most jurisdictions, large customers have sought retail access because it increases their opportunity to bargain for lower rates, without any impairment of reliability. In China, some customers may wish to secure retail access in order to bargain for greater reliability, even if it requires paying higher rates. On the other hand, policymakers may want to encourage retail access as a way of moving large energy-intensive industries off of subsidized rates. Finally, many large customers in China are exposed to mandatory TOU rates and operating orders that greatly affect production schedules. Some may seek retail access as a way of avoiding those requirements.

#### 4.11.3.5. "Green Power" Products Emerge, But Are a Small Component of the Market

An important feature of the emerging marketplace for electricity services is evidence that some consumers prefer cleaner energy sources, termed "green power". Market research often reveals that many customers would prefer to purchase "green" power, and even more customers believe that environmentally responsible power should be a shared obligation of all customers. Green power can be provided to consumers with or without retail competition. Indeed, Shanghai and Beijing will be offering green power options to consumers in the near future.

In the US, 80 monopoly utility in 28 states offer green power. In retail competitive electricity markets, access to green power has been the leading reason why small customers switched suppliers (Swezey & Bird, 2000). Typically, 1 to 2 percent of existing utility customers switched to green rates when the choice was offered.[94] In the early stages of the California market, "virtually all" of the 160,000 residential customers who switched providers took green power offerings (Swezey & Bird, 2000, p. 9). Also, a handful of prominent California business and institutional customers widely publicized their

[94] Voluntary purchases of green power through retail competition are a weak substitute for comprehensive policies to promote sustainable resources generally. Even in very favorable circumstances, "green power" options will provide only 1% to 5% of the total portfolio that utilities provide.

green power purchasing as a badge of environmental citizenship.

#### 4.11.3.6. Investment in energy efficiency, renewable energy, and other public purpose programs declines

One of the most serious effects of retail access programs has been the resulting underinvestment in public-purpose programs aimed at the long-term benefit of the power sector and of society in general. Pressures to cut costs in anticipation of competition have led to significant cut-backs in funding for energy efficiency, renewable energy, universal service, and public-benefit research and development.

For this reason, it has been necessary to create competitively-neutral, non-bypassable mechanisms to support these public goals. Even with those new mechanisms in place, retail access has led to a decline in spending for these purposes.

### 4.11.4. Phasing in Retail Access for Large Customers

Consistent with State Council decrees, SERC's power market policies plan to create opportunities for some large companies to contract directly with power suppliers[95]. This policy would enable Chinese enterprises, power companies, and regulators to test the benefits and risks of direct access. SERC will need to address the following issues if these pilots are to be successful:

#### 4.11.4.1. Power Shortages and Direct Access

China is considering allowing large industrial customers to purchase power directly from generators as one way of addressing the power shortage. In most countries, the move to direct retail access for large industrial customers is driven by their desire to lower their own prices. In China, one near-term motivation relates to the willingness of industrial customers to pay higher electricity prices in return for exemptions from electricity curtailments caused by power shortages. Direct retail access is also seen as one solution to economic distortions caused by electricity and coal pricing.

The proposal to allow industry to buy power from generation assumes that industrial customers would pay higher prices in return for being exempt from curtailments required by the current power shortage. It is also assumed that retail access customers would be served by competitive suppliers instead of by Big Five generators with access to the negotiated coal price.  Under these circumstances, the question remains whether retail choice (even if accompanied by higher coal prices, and higher electricity prices) could do much to address the power shortage. Policymakers will have to think carefully about whether retail access would actually cause more generation to be built and operated, and/or more demand management and energy efficiency resources to be deployed.

#### 4.11.4.2. Equal Access to Distribution Systems

Wholesale competition requires equal access to the transmission system. Retail competition for all but the largest customers also requires equal access to the distribution system." Equal access" in this context means: (a) the price of transmission and distribution has to be the same for service to the

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[95] At present, three very large customers have been given this opportunity, but because they are very energy-intensive industries, and power shortages exist in many areas, they have not yet entered into retail access contracts.

customer, whether the power is being supplied by the traditional power supplier, or a competitor; (b) the right to use the transmission and distribution system[96] has to be equal, based on rules that do not favor one company's customers over another's; (c) the rules for service interruptions, voltage reductions, and disconnections in case of shortages or grid stability problems have to be the same for all similarly-situated customers.

#### 4.11.4.3. Reliability

Plans to permit limited retail access will need to take into account a number of issues related to reliability.

- Existing transmission and distribution systems were established to serve particular, known power flows. New contractual arrangements with different power providers can create new congestion and new contingencies on the grid, as suppliers attempt to dispatch different plants to serve those loads.

- Rules will also be needed to ensure that the new supplier has the capability to serve its retail choice customers without impairing service to existing customers. If retail access does not lead to more power actually being generated, direct access by industrial customers might merely be shifting the burden of curtailments from industrial consumers to other consumers.
- Reliability services -- For both reliability and commerce, bulk-power systems require certain services beyond the basics of energy, generating capacity, and power delivery. Some of these ancillary services (such as regulation and reactive power) are required during normal operations to maintain the necessary balance between generation and load in real time and maintain voltages within the required ranges. Other ancillary services (such as contingency reserves) provide insurance to prevent minor problems from becoming major catastrophes. Finally, some services (such as system blackstart) are required to restore the bulk-power system to normal operations after a major outage occurs.

  The costs to produce and manage these services amount to about 10% of the cost of service on many utility systems, and they have historically been included in the bundled electricity prices that retail customers pay. When individual customers leave the utility tariff, they must still be required to contribute to these services, which benefit all interconnected users. SERC and NDRC will need to establish rules under which large "choice" customers (or their power suppliers) support both current reliability services, and to systems that are intended to promote long-term generation capacity adequacy.

#### 4.11.4.4. Terms Governing Customer Exits and Re-entries

One of the most difficult problems with retail access for large customers is the exit-entry problem. There are three stages to this problem which must be dealt with:

- **Customer exits:** Historic utilities, with an obligation to serve all customers who want service, have planned to serve these large customers. When they leave the utility, the utility may have

[96] i.e., the allocation of transmission capacity cannot be used to discriminate against competitive power customers.

"stranded investment" in facilities that are no longer needed. If this is a problem, cost-based exit fees, perhaps collected from the exiting customer over time, may be required to protect other customers from costs being shifted onto them.

- **Customer returns:** When problems arise with competitive suppliers, or when market prices rise, large customers often seek to return to their traditional power supplier, invoking the "obligation to serve" rules of that utility. Since important industries and large employers are involved, it is very hard to say "no" to those requests, even if the return will create new costs and/or harm service to other customers. Thus, it is critical that this possibility be worked out before the customer leaves the traditional system, and is built into an enforceable contract or regulatory approval order at the time the customer seeks permission for retail access service. Those arrangements can provide for adequate, cost-based payments to the utility for the right to return, which may mean that the returning customer will pay a higher rate than other customers.
- **Impact on utility plans:** As noted above, generation utilities must engage in forward-looking planning processes to make sure they have a strong, reliable resource mix to meet current and future conditions. If utilities cannot predict whether their biggest customers will still require service in the future, it is more difficult to plan, and it is more difficult to make long-term investments for the future. For this reason, SERC and utilities should consider rules that would require advance notice of a customer's intent to leave service for a competitor, and would suitable advance notice of any intention to seek service again in the future.

#### 4.11.4.5. Public Purpose Programs

Utility systems support renewable energy, energy efficiency, universal service, and similar public purposes through their ratemaking policies, performance standards, the collection of special funds, and other regulatory means. Because these services and resources are critical to the public good, it would be inequitable to allow some customers to avoid their share of support for them when they choose a different power supplier. Thus, regulators must ensure that adequate support for these purposes is built into the rules for retail access. Competitively-neutral, non-bypassable rules are needed to ensure equal contributions for important public purpose programs.

### 4.12. Principles of Sustainability

#### 4.12.1. Introduction

Sustainability should be the cornerstone of China's long-range electric sector policy. Electricity is a central factor in economic development and in environmental impact. Failure to employ sustainability principles to the electric sector will lead to a number of serious adverse consequences in the future. Because China is undertaking major electric structure restructuring, now is the time to establish and adhere to long-term sustainability goals.

##### 4.12.1.1. What Is "Sustainability?"

Although varied definitions have been offered for a variety of applications, sustainability usually means ensuring that development meets the needs of present generations without compromising the ability of future generations, who are essentially unable to represent their own interests, to meet their own needs. [97]

Sustainability requires the conservation and enhancement of the resources base upon which economic well-being is founded. This requires unification of economics and environmental policy in decision-making at all levels.[98]

#### 4.12.2. Sustainability for the Electric Sector

##### 4.12.2.1. The Connection Between Electricity And Sustainable Development

Three facts about electricity explain the important connection between the electric industry and sustainable development.

- *Electricity is an input to a productive economy, not an output.* 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 producing and selling more electricity than needed to make cellular phones and all of China's other goods and services would be inefficient and polluting.
- *The environmental impact of the industry is very large both in absolute terms and in relation to the industry's position in the economy*. 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.
  While many governments wish to create abundant low-cost electricity for their citizens and

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[97] Kamal Hossain. "Evolving Principles of Sustainable Development and Good Governance." In: K. Ginther, E. Denters and Paul J.I.M. de Waart, eds Sustainable Development and Good Governance, Norwell, Ma.: Kluwer Academic Publishers, 1995,

[98] Prime Minister H. Gro Brundtland. "Sir Peter Scott Lecture," Bristol, 8 October, 1986.

economy, to do so by ignoring its environmental consequences only creates 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 afterwards when the environmental harm has occurred and large vested financial interests resist change.

- *There are many specific power sector restructuring decisions that have very large environmental implications*. Restructuring will affect what power plants run, what power plants are built, the level of power plant investment in pollution control, the level of utility investment in DSM and energy efficiency, and the ability of demand-side participation in competitive markets.

All of these issues and more will affect the sustainability of China's power sector reform. Adopting sustainability reforms at the time of restructuring is important. Once restructuring is complete, new generating companies will be competitive businesses. These companies will make every effort to increase profits. Companies will strongly resist more stringent emission requirements. It will be much easier and fairer to impose more stringent requirements before restructuring is complete. The basic elements of sustainable power sector reform are shown below.

#### 4.12.2.1.1. Restructuring Will Use Competition to Determine Power Plant Dispatch and Polluting Power Plants Could Have a Competitive Advantage

Restructuring will change the order in which power plants are run. Currently, dispatch decisions are based on existing contracts and one-part contract prices. With power sector reform, we expect power plant dispatch will be determined by competitive bids. Assuming the market is competitive, these bids will be based on each power plant's operating cost. Without appropriate environmental reforms, plants with low operating costs will run more and plants with high operating costs will run less. For example, in the new markets coal plants without FGD will run more and plants with FGD will run less. Furthermore, natural gas-fueled plants have higher operating costs and as a result these plants will run less. How the markets are designed and how environmental costs are considered in the market will determine the overall level of emissions from the sector.

Pilot markets in Zhejiang addressed this issue by making extra-market adjustments to the prices paid to generators with FGD to reflect the added operating cost of the FGD units. Power plant prices that distinguish between power plants with and without FGD were also recently set for plants in Beijing and the surrounding areas. These are the types of reforms that can be used to address the competitive disadvantage of clean power plants. The specific reforms adopted thus far however do not fully address the issue. The price differentials are too small, they do not cover all of the major pollutants, and they are too narrowly focused on coal plants.

#### 4.12.2.1.2. Restructuring Will Affect Power Plant Investment

China's reformed power sector will include new spot markets but most electricity will be sold under long-term contracts. The rules and process that determine which plants receive contracts will greatly influence what kinds of plants are built. Will the rules favor coal, gas, or wind? Will the rules consider the environment? The electric industry is growing rapidly. Plants built today will be creating emissions for 30 years or more.

#### 4.12.2.1.3. Restructuring Will Affect Power Plant Lifespan

International experience shows that restructuring may cause generators to extend the life of the oldest and most polluting plants. This is because older plants without FGD have low operating costs and capital costs that have been mostly, if not fully, paid off. How will environmental laws and rules be reformed to address this issue? Will licenses issued by SERC be for a specific period of time requiring relicensing for life extension of existing plants?

#### 4.12.2.1.4. Restructuring Will Affect Investment In End-Use Energy Efficiency

The cleanest and lowest cost way to meet customer energy needs is to invest in more efficient motors, appliances, and other energy consuming equipment. How restructuring is implemented will determine whether the market and regulation will provide incentives for investment in energy efficiency. For the grid companies, the tariff-setting process and policies relating to cost recovery will greatly influence utility investment in DSM. The design of market rules will determine how utilities, customers, ESCOs, and others will be able to enter demand-side options into direct competition against power plants.[99]

#### 4.12.2.1.5. Restructuring Will Lead To Price Reforms

China's power sector reform has already led to pricing reforms at the generation and consumer levels. The design and level of these prices will greatly influence consumer electricity demand and consumer investment in energy efficiency.

#### 4.12.2.2. SERC's Role In Sustainability

#### 4.12.2.2.1. Sustainability As A Governing Policy

SERC should clearly establish that sustainability will be a governing policy for its decision making. SERC should weigh the impact on China's ability to achieve and maintain electric sector sustainability when making decisions about:

- Market design and market rules
- Licensing
- System planning and expansion;
- Funding and implementation of energy efficiency, load management and other demand-side management programs; and
- Suggesting tariff methods, levels, and design.

Consideration of environmental impacts should be reflected in the rules and regulations adopted by SERC governing the electric sector.

#### 4.12.2.3. Regulatory Tools and Resources For Sustainability

#### 4.12.2.3.1. Environmental Costs

As the electric industry is reformed and relies increasingly on markets and competition, sustainability may be best achieved by including the full cost of pollution in the cost of electricity. There are many

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[99] See forthcoming World Bank DSM paper

ways to accomplish this and China's "polluter pays" policy provides an excellent starting point. If sustainability is to be achieved, the "polluter pays" policy must have three essential characteristics. First, the fees must apply to all major pollutants. Second the fees must be high enough to reflect the full damage cost imposed by pollution. Third, revenues from the fees may be used to redress or prevent pollution, but they cannot be returned to the polluter in direct proportion to the fees it (the polluter) pays.

Until the "polluter pays" policy fully meets these three requirements, other steps must be taken. Experience in the US and elsewhere provides other options. Chinese researchers have identified several options.[100]

The approach taken to environmental regulation will influence the environmental performance of the power sector as well as the cost of meeting environmental goals. As the power sector is reformed to include more and more competition it is important to simultaneously reform environmental regulation to match the more competitive model. Experience in the US points to three policy options to consider.

#### 4.12.2.3.2. Energy Efficiency

Energy efficiency is usually the most cost-effective mechanism for improving sustainability. Because of its inherent characteristics and its relative costs, it produces greater improvements in net environmental impact and in net economic impact than any other resource.

At the same, energy efficiency is usually the most under-utilized resource. A variety of factors, ranging from consumer education to profit incentives of electric suppliers, combine to make it difficult to achieve the levels of energy efficiency that are known and can be easily verified.

Specific recommendations appear in separate documents.

#### 4.12.2.3.3. Renewable Electricity Generation

Renewables, especially wind, have operating characteristics that are very different than those of most power plants. Market rules written for a system consisting mostly of coal plants may impose unneeded costs and other requirements on renewables. Special attention to market rules, transmission access, and transmission pricing will be needed if renewable generation is to fairly participate in the sector.
Fully reflecting environmental costs as described in the following section can also increase the use of renewables. Also, there are a number of mechanisms that have been successful in improving the use of renewable energy. These include:

- Mandatory purchase requirements at avoided cost (e.g., PURPA in the U.S. and "feed-in" laws in Germany and elsewhere);
- Support for renewable energy research and development through research consortia (e.g., the Electric Power Research Institute and several state-level programs);
- Creation of a renewable energy fund to support new renewable energy production in response to public bid offerings;

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[100] See, "Environmentally Friendly Pricing Solution For Coal-Fired Power Plants", Chinese Academy For Environmental Planning and Chinese Research Academy Of Environmental Sciences, 2003

- Establishment of a renewable energy portfolio standard (RPS) applicable to all generators or retail electric sellers in a competitive electric market.
- Public expenditures through government agencies, universities, and grants to utilities and equipment manufacturers.

#### 4.12.2.3.4. Environmental Regulation

Environmental regulation also needs to be reformed to reflect the new power sector industry. Power plant emissions have traditionally been regulated on the basis of the emissions associated with the fuel-input used to produce electricity (e.g., lb./mBtu). However, this approach fails to provide incentives for pollution prevention, and is not compatible with competitive markets for generation.

Output-based standards overcome these shortcomings. Instead of specifying the amount of pollution per unit of fuel or heat input, output-based standards specify a given amount of emissions per kWh produced. Output-based standards encourage greater thermal efficiency in the generation of electric power regardless of plant age or historic fuel use.

China has been researching and testing output based standards.[101] Chinese researchers have found that output-based performance standards can help prevent utility restructuring from resulting in a degradation of air quality by providing a mechanism to ensure that disparities in environmental regulation do not create a competitive advantage for more polluting resources. This approach improves economic efficiency by allowing generators to optimize the choice between fuel source and control technology. Setting the standard low enough can improve air quality and reduce the adverse impacts of electricity generation on public health and the environment.

### 4.12.3. Conclusions

The electricity industry is key to the sustainability of China's economic and environmental development. Increased availability of electricity energy services at reasonable prices and with less pollution is possible if the right policy options are selected. The reform of China's electricity industry is still in the very early stages and making sustainability a goal of the reforms is the first and most important step.

The reform process in China is in the very early stages. Now is the time for policymakers at the highest levels to make it clear that the reform of the industry should be a driver and a model of sustainability.

[101] See http://www.chinaenvironment.net/sino/sino12.pdf