Power Shortages:
SERC's Regulatory Challenges

Regulatory Assistance Project

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Introduction

China has been in a long and steady process of power sector reform. Many of the reforms have been aimed at separating the business functions of the power sector from the government function of regulating and overseeing the sector. The most recent step in this direction was the creation of SERC.

SERC's performance in its first year is being tested by a very tight power supply situation in about 15 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.

SERC and NDRC have been focusing on the power shortage. The State Council has adjusted the 10th FYP for the power sector covering 2003-05. In addition to the previously planned 60-80 GW, an additional 30 GW of new power plants will be added bringing the 10th FYP up to 110 GW. Power plant construction has been accelerated, but demand growth is very rapid and periodic shortages are likely. Efforts are also being made to increase and make better use of the transmission grid, and examination of tariff reforms has started.

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.[1] 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:

a. 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.

b. 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

[1] 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.

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.

c. 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.

d. Preventing the problem from reoccurring requires a commitment to frequent reviews of long-term plans.

Key issues

Key issues are discussed below:

A. 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 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.[2] 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.[3] 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.[4]

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

Regulators need to take four steps:

i. collect needed information,

ii. learn from international experience,

iii. take action to address the current problem, and

iv. 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.

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[2] 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."

[3] 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

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

Step 1 – Collect information

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

2. 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?[5]

3. 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.[6] 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.

4. 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.

5. 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.

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[5] 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

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

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 by nearly 85 percent over the next 17 years.[7] Adoption of the standard 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}.

6. 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.

Step 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.

1. 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.[8] 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

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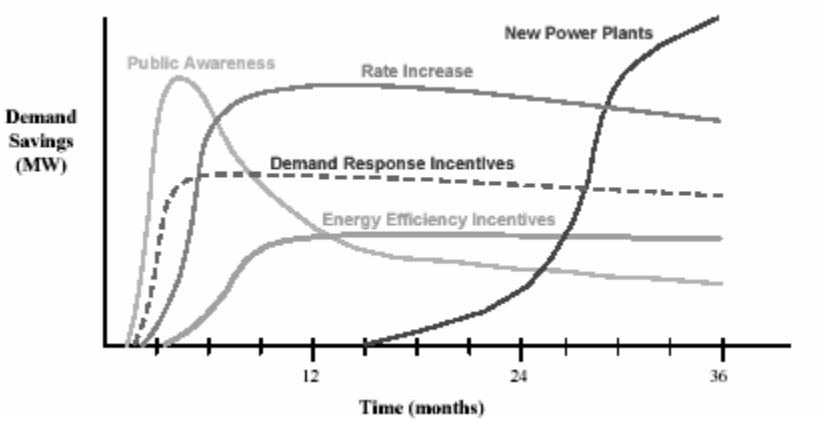
[7] See "Prediction of Energy Conservation Potential for China Major Energy-using Products Through Standards and Labels" June 2003 http://www.efchina.org/documents/FnlRpt-EngO!EcaC.pdf for the English version.

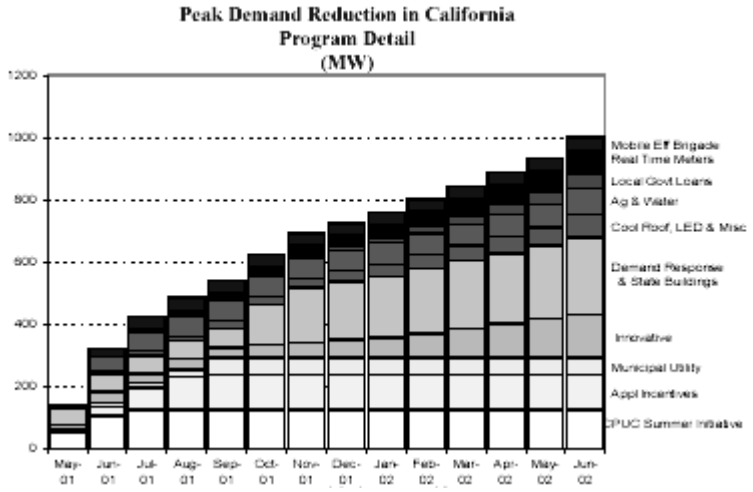
[8] See http://www.aceee.org/conf/prsntatn.htm for the detailed presentations delivered at a conference that review the responses to power shortages in California, the Pacific Northwest, and New York.

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."

longer time period. The following graph from the California Energy Commission shows the mix of actions and response times:



2. 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:



3. 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.

4. 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.

5. 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.[9] 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.

6. 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.

7. In the U.S., the emphasis on energy efficiency, customer load response, and in some states renewables is important for three reasons. First, energy efficiency was the most successful and cost-effective option to address the crisis. Second, renewables were an attractive option because they did not depend on expensive and volatile fossil fuels. Renewables were also clean and modular, so siting and construction were simple and fast. Third, regulators focused on energy efficiency and renewables because these options were fast, low cost, and most likely to be overlooked by utility planners.

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[9] 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.

A detailed U.S. study of the energy efficiency and DSM response to the California crisis and similar situations elsewhere in the US 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.*[10]

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.[11]

[10] 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

11 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. "

Estimated 2001 Costs and Impacts from Energy Efficiency and Conservation Related Programs[12]		
	Program spending ($million)	**Estimated Savings (MW)**
California	971	3,668
Northwest	150	390
New York	72	263

8. 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 blamed for failing to develop and implement effective emergency plans.[13]

   Chilean regulators were blamed for slow and ineffective action.[14] Regulators in both Brazil and Chile were also criticized for taking actions based on short-term political considerations.[15] Chilean regulators failed to implement

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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 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

14 Id.

15 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

effective demand-side options and Brazil's demand-side action was rationing combined with taxes and fines.[16]

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.

9. 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.[17]

10. 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

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[16] Id

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

entered into expensive long-term power contracts that have lasting economic and political problems.

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

12. 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 well above the market price.[18]

Step 3 – Take action.

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

1. 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,[19] 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

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[18] 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

[19] Raising on-peak electricity prices and devoting the extra revenue to funding targeted energy efficiency improvements at energy intensive industries is a step that may be especially effective in China. See also RAP's August 2003 paper prepared for SERC entitled "*Discussion of Electricity Price Reforms and Other Regulatory Options To Effect Efficient Consumption"*

all available options are being considered and that least-cost options are being implemented.

2. 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:

    a. Remove regulatory barriers and obstacles to utility investment in energy efficiency and distributed resources.

    b. 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.

    c. SERC needs to establish rules describing how future power sector reform will apply to new plants.

3. 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.

    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.

Step 4 – Reduce chances of future problems

1. 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."[20]

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.

2. 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."[21]

3. 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.[22]

   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

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[20] 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

[21] 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

22 See http://www.cpuc.ca.gov/PUBLISHED/REPORT/26305.htm

prudent reserves, are achieved and provided through policies, strategies, and actions that are cost-effective and environmentally sound for California's consumers and taxpayers." [23]

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.

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23 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.*