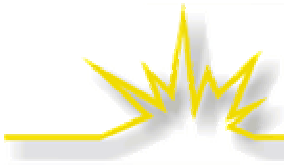

The Regulatory Assistance Project

Restructuring and the Environment

Regulatory Assistance Project
David Moskovitz, Wayne Shirley, Rick Weston
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Introduction

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

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

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

Discussion

There are five areas we discuss in more detail.

1) China's Goals Will Determine Whether Restructuring Leads to a More Sustainable Power Sector.

No one model of restructuring fits all countries. International experience shows that each country that has restructured its power sector has sought to achieve different goals and was facing a different set of problems and constraints. Thus, the most important step in any electric

utility restructuring is to identify and clearly articulate the country's goals and constraints. China's goals may include:

- Reducing electricity costs;
- Attracting private capital at reasonable cost;
- Assisting the economic development of western provinces;
- Maximizing public revenues from the sale of government owned assets; and
- Reducing the environmental impacts of the electricity sector.

Constraints are equally important to understand and may include the following:

- Prices should not increase as a result of restructuring;
- National security or economic conditions may force the use of local resources;
- Rapid reductions in the workforce may not be possible; and
- Current tax revenues and distribution among different jurisdictions must not change significantly.

A full and complete understanding of China's goals and constraints will help shape and determine the pace of industry restructuring. The lesson from other countries is clear. If electricity sector reform is to be done in a way that produces sustainable outcomes, the process must begin with high-level officials making it clear that environmental protection and sustainability are high-priority goals of restructuring.

The power sector reform process in China is in the 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.

2**) Environmental Regulations Should Be Reformed to Conform With New Industry Structures.**

Historically, China's approach taken to environmental regulation has been based on a government-owned or government-regulated system. As the power sector is reformed, it is important to simultaneously reform environmental regulations to assure that the regulatory approaches are compatible with a competitive generation market.

The US has made two expensive environmental mistakes that should not be repeated by China. First, older power plants have historically been allowed to produce more emissions than newer plants. Although setting lower standards for older plants has some logical appeal, it has had unintended consequences that become especially troubling in light of our rapid transition to competitive markets for generation. The right to emit more pollution than new plants provides a competitive advantage to the older plants. The older and more polluting plants were expected to be retired but the advantage of being allowed to emit more pollution than newer plants has provided a strong incentive to keep these plants running, and consequently polluting.

Second, the US has focused too much on one pollutant at a time. First, we regulated particulate matter and dust. Next our attention turned to SO2, and then to NOx. Next the focus will be on

fine particulates, mercury, and CO2. Dealing with one pollutant at a time has been inefficient and expensive; control options targeting one pollutant have inevitably resulted in higher emissions of those pollutants that are yet to be regulated. Minimizing the cost of pollution control and the environmental damage caused by electricity production requires consideration of all of the major pollutants at the same time.
There are many options for making environmental regulation compatible with a restructured generation market. The best options include emission fees, Generation Performance Standards, and cap and trade approaches.

Emission Fees

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 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. This will encourage investment in control equipment and cleaner sources of power. Third, revenues from the fees should be used to reduce pollution or promote the development of clean sources of power.

Generation Performance Standards

Power plant emissions in the US, and most other countries, have traditionally been regulated on the basis of pounds (or kilograms) of emissions per unit of fuel burned (e.g., lb or kg/mBtu). Historically, this input-based regulatory option was adopted because it could be applied to all industrial and commercial sectors being regulated, not just power plants. This method was also consistent with the U.S. practice of setting different standards for power plants depending on plant age and fuel use. However, using non-uniform, fuel input-based standards has led to unintended negative consequences. It encourages the construction and operation of plants with higher emissions and lower efficiency, encourages less efficient plants to continue operating, fails to provide incentives for pollution prevention, and is not compatible with competitive markets for generation.

To address these shortcomings, the US is turning its attention to output-based standards. 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. Ideally, the output standards would be uniform for all plants and trading would be used to reduce the cost of compliance. Output-based standards encourage greater thermal efficiency in the generation of electric power regardless of plant age or historic fuel use. Using uniform output-based emission standards is important for electricity markets in the process of evolving to competitive markets since they reward facilities that are efficient in production and promote the development of new and cleaner facilities.

Cap and Trade

Cap and trade approaches to minimizing pollution can be combined with output-based standards. A typical cap and trade approach sets an overall cap on the level of permitted pollution (set on a local, national, or even international geographical basis) and then encourages affected parties to trade among themselves to most efficiently achieve the required cap. The trades are accomplished through the creation of pollution credits, one credit for each permitted ton of pollution (e.g., SO_2), with auctions or other allocation methods used to distribute the credits initially. Businesses can choose to either cut their pollution output or purchase pollution credits, and will select the least-cost option. Some businesses will find that it is most economical to reduce pollution output below required levels and will then sell their unused pollution credits at an auction to the highest bidder. Our experience with cap and trade shows that stringent caps can protect health and the environment and trading can substantially reduce the cost of pollution reduction.

3) Create an Expert Regulatory Body.

The creation of a single, well-qualified and expert regulatory body is an integral part of power sector reform. This has become increasingly apparent in other parts of the world. Experience shows that flaws and weaknesses in power market rules are quickly identified by the market participants. Competitive businesses seek and find opportunities to profit in ways that were not originally anticipated. Some of these actions may be contrary to the public interest. A competent regulatory body must be created and delegated the authority to identify and detect behavior that is contrary to the public interest and take corrective action.

The creation of an expert regulatory body is essential to successful power sector reform. The agency should be established, staffed, and trained as soon as possible because one important role for the regulator is to design the new rules for the marketplace. International experience demonstrates the benefits of careful regulatory oversight of the restructuring process.

The regulatory commission must have very broad scope and authority over the utility and the market institutions. The regulatory commission must have sufficient staff to carry out its duties and mandates.

Experience in the US shows that the model of separate and independent federal and state regulators impedes the efficient development of wholesale generation markets. A better approach followed in many other countries would be to have a single central agency with regional branches that focus on regional market issues, as well as provincial branches that focus on service quality, consumer complaints, and distribution pricing issues. All of the regional and provincial branch offices would be under the direction of the central regulator at least with respect to the operation of wholesale generation markets.

4) New Regulatory Approaches Should Create the Right Incentives.

One of the first jobs of the regulators will be to establish the rules that control the prices and profits of the monopoly transmission and distribution companies. There are several alternative

approaches, each of which creates its own set of internal incentives. The question utility managers will ask is "How do we make money under the new set of rules and requirements?" Our experience shows that there are two basic options: price caps and revenue caps. Price caps set the price per kWh that the distribution utility may charge for the distribution services it provides. If sales increase up the utility will probably collect too much money from consumers. Revenue caps set the total amount of revenue (or sometimes the amount of revenue per customer) that the distribution utility may recover from customers. With revenue caps increases or decreases in sales have little, or no, effect on profits. Thus, price caps tend to reward increased sales and discourage energy efficiency; revenue caps encourage cost reductions without discouraging energy efficiency.

5) Market Structure and Design Should Consider the Environment.

Many market structure decisions and market design rules can have profound effects on the environment. A few examples are described below.

Market power

A fundamental prerequisite of a competitive wholesale generation market is the absence of vertical or horizontal market power. Structural separation of generation from transmission and distribution is vital. Control of generation must also be spread among enough owners to assure that concentration of ownership does not distort prices. The US markets have not done a good job in this area.

Some say that having four or five equal sized generating companies is adequate to ensure a competitive market. We believe that while this rule of thumb may make sense in markets for commodities such as wheat, rice, and oil, the electricity market is so different that more protection is needed. The need to instantaneously balance demand and supply and the inability to store electricity makes this market much more susceptible to market power manipulation than other markets. For this reason we believe that the number of generating entities competing to serve any given buyer or set of buyers should be substantially larger, preferably in the range of at least ten generating companies, roughly of equal size.

Separation of Generation from Transmission

Creating a competitive generation market in China will require the separation of generation from transmission. It will also require existing ownership of generation to be split into many smaller companies. How the generation is divided has significant environmental implications.

Our recommendation on the division of existing generating assets into as many companies as possible that are roughly equal in size is aimed at creating the most competitive market for generation possible and meeting other goals as well.

China's environmental goals and polluter pays policies suggest that needed environmental reforms include the adoption of market-based systems such as generation performance standards (which would impose uniform output-based emission limits for generating companies). It will be very difficult to impose these needed reforms on generating companies after the completion of

power sector reforms, since competing generators will have very different fuel sources and emissions. The ability to make needed environmental reforms would be substantially improved if the allocation or division of generating capacity took emissions into account. Thus, we suggest that the newly-created generation companies should each have roughly the same average air emission characteristics.

In addition, the separation process will give the new owner certain rights, obligations, and expectations. One expectation is that the new owners of competitive generation should not be able to pass pollution control costs onto consumers. This will make it more difficult to impose cleanup obligations on the new owner after separation is completed. Our advice is to review the environmental performance of existing generation and make cleanup requirements a part of the separation process. This way, the value of the generation assets, upon separation, can be made to reflect the cost of clean-up.

Market Design

Most power pools use supply-only bidding regimes. In the usual model of a competitive supply market, spot market prices are determined a day in advance by utilities, or in some regions by an independent system operator (ISO), power exchange, or a similar entity. A supply curve is determined using either marginal costs or bid prices to rank order the plants, beginning with the cheapest plants. The highest-cost resource called on in each hour sets the spot market price for all energy sold in that period. To the extent that there is any demand curve, it is an engineering construct based on factors such as yesterday's demand, the weather, and the day of the week. It is not based on the utility customer's willingness-to-pay or on actual production costs. Consequently, even though the merit order dispatch of a utility or pool may rank supply resources according to cost, the intersection of the supply and demand curves, while reflecting historic load patterns, expected weather, and related factors, is economically meaningless because the demand curve was not itself shaped in response to the supply curve.

In the U.S., the absence of a demand response combined with market power has produced prices that have been extraordinarily volatile and peak prices that have been so high as to place in question the political sustainability of the restructuring efforts. It is vitally important that energy efficiency, load management, and other demand responses be made an integral part of power pool design.

In addition, experience to date in some areas, California in particular, has been that virtually 100% of energy is traded on day-ahead markets or shorter-term markets. The absence of a significant forward market has accentuated the volatility of prices. The stability that is associated with forward markets enhances reliability from a planning point of view and may foster a more stable financial environment. China should consider requiring a significant part of the market to be procured through forward markets.

Intermittent Resources

Some of the cleanest generation options, such as wind and solar, are intermittent. The hour-by-hour output of any individual facility will not be as predictable as it is for most fossil generation.

As a result, renewables will be disadvantaged if the market rules require all generators to state their hourly levels of generation a day or more in advance and then impose penalties if the day ahead schedules are not met. Pools that have, or are considering, penalties of this type do so to address market power concerns. A far better solution to market power issues is to fully separate generation from transmission and to be sure that generation ownership is widely dispersed.

Capacity costs and reliability pricing

Pools differ with respect to their treatment of capacity costs. Some pools have no capacity requirements and no capacity markets, and other pools have both. Pools also differ in how they determine operating reserve requirements. The presence and design of a capacity market and the level of required operating reserves can influence how much and what kind of new generation gets built. China should consider rules that do not discourage renewables.

Some pools allocate the costs of ancillary services, such as spinning and non-spinning reserves, to load. Other pools allocate some of these costs to generation in proportion to the level of reserves caused by different generators. Allocating the cost of generation-related reserves to the generation that causes the cost to be incurred will influence the types and sizes of plants that are built.

Stranded costs

The most contentious issue in the US restructuring process has been stranded costs. Utilities with generating or other fixed assets that cost more than they would be able to recover in a competitive environment have labeled the difference as stranded costs. In some cases, utilities have also asked, and have generally been allowed, to recover other costs which amount to ongoing subsidies to existing plants that otherwise would not be competitive. This practice creates the risk that older and more polluting plants will remain in service. In other states, regulators have provided strong incentives to utilities to invest in pollution control equipment by allowing pollution control costs to be included in stranded cost charges.

Integrated Resource Planning (IRP) in single-buyer models

Single-buyer systems are generally based on long-term contracts. Consumers are obligated to pay for the contracts and have no ability to choose their own sources of supply. In a spot market it is clear that a 2-cent bid is better than a 4-cent bid. In the long-term market, comparing bids is not so easy. Specific plant operating conditions, the plant's location, the allocation of risk, long-term environmental performance, and non-generating alternatives to any plant are all factors that influence which bid wins. Integrated Resource Planning (IRP) is the best way to analyze these factors and deliver the least-cost energy services.

Transmission pricing

There is no single established system for pricing transmission services. Some pricing options will bias new construction against intermittent sources such as wind. For example, if transmission prices are based on the generating capacity connected to the grid, a 100 MW wind

farm with a 35% capacity factor (or perhaps 35% coincidence factor) would pay the same transmission fee as a 100 MW fossil generator with a 90% capacity factor. Pricing based on distance may also discourage renewables if the renewable resources are located in more remote areas. Also, the absence of congestion pricing can discourage investment in energy efficiency and load management. We believe the best approach is to use some system of congestion pricing and, to the extent that the revenues from these charges are inadequate to cover transmission costs, the remainder should be spread across all electricity sales on an energy basis.

Transmission regulation

The transmission entity (or entities) will be a monopoly and its prices and revenues will be regulated in some fashion. It is important that the transmission firm be regulated in a way that provides incentives for an efficient tradeoff between new investment in transmission and investment in transmission alternatives including energy efficiency, load management, and efficiently located new sources of generation.

Distributed resources

Distributed resources include several rapidly developing technologies including a new class of small (less than 100kW) clean micro-turbines and fuel cells. These new technologies can provide electricity and thermal energy on-site and in some applications they can substitute for expensive distribution system expansion. New pricing systems are being developed now under which distribution companies can send efficient signals telling customers and developers where these systems make the most economic sense.

By delivering electricity locally, fewer, in any, transmission and distribution lines will be needed. These new technologies offer to do to the electric industry what wireless cellular telephones are doing for the telephone industry. Restructuring the electric sector should not create or perpetuate barriers to the development of these technologies.

Conclusion

Restructuring the power sector is a complex but worthwhile process. The process must begin with agreement at the highest levels of government of the goals to be achieved. Designing and implementing the reforms will need the participation of industry, government officials from many disciplines, as well as environmental decision-makers. Important steps toward assuring a benign and sustainable restructuring could include the following:

- The creation of an ongoing power sector restructuring working group to oversee the restructuring plan and which includes environmental and public health officials. The group's charter or mandate should specifically include analysis and mitigation of environmental and public health impacts.
- To the extent practicable, market mechanisms should be employed to achieve reductions in emissions beyond those achieved by direct prohibition.

- Environmental and public health impacts that cannot be fully mitigated should be given weight in the choice among future power supply options.
- Particular attention should be paid to assuring that resource procurement and tariff methodologies reflect the value of energy efficiency, which can be understated in methodologies based entirely upon costs and prices as conventionally calculated.

The foregoing steps are necessary because restructuring based solely on privatization, on the creation of competitive markets, and on the reduction of prices will create strong pressures to run the least expensive power plants *even when those plants are least expensive because they do not meet prudent environmental standards.* A restructuring plan that ignores this fact is likely to create incentives to build and run the most environmentally harmful (but cheapest) plants even more than would be the case if restructuring had not taken place at all. Such restructuring also creates incentives to minimize the pollution control costs of new plants in order to be sure that they are the lowest cost competitors.

Creating restructuring programs through working groups that do not include environmental and public health officials may make a consensus seem easier to reach, but this is a false harmony, for the environmental and public health impacts will cause continuing friction between the energy sector and those concerned with its external costs and impacts. Eventually these concerns will have to be dealt with through retrofitted solutions, but the costs will be much higher than if they had been dealt with from the beginning. And, of course, the deaths and damages will also have been much greater than necessary.