

Power Sector Policy in China: Next Steps

2nd DRAFT

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I. Introduction and Summary

Over the past thirty years, China has implemented a series of reforms that have greatly improved the efficiency, reliability, and environmental performance of its power sector. Other nations too have reformed their power sectors, in some cases creating competitive wholesale and retail electricity markets, but none has increased the efficiency (in terms of energy intensity or Btus per unit of gross domestic product) of its sector to the degree that China has.

But there are still daunting challenges facing the country and, to respond to them, China has set aggressive, high-priority goals for itself, in particular with respect to energy efficiency and environmental protection.

Recent international experience shows that competitive generation markets, by themselves, are unlikely to yield the optimal amount or mix of resources that are needed to meet a country's economic and environmental goals. For this reason, the power sector development plans that China announced ten years ago should be reevaluated and updated to ensure that the sector can contribute fully to meeting the nation's broader economic and environmental goals for the next decade. In light of current conditions in China, we suggest these additional actions:

1. Develop improved planning methods to identify the least-cost mix of supply and demand-side options. This is aimed at identifying the *optimal* mix of supply and demand-side options that meet China's energy needs and environmental goals at lowest total cost over the long run.
2. Create an industry structure and competitive bidding processes to acquire the identified supply and demand-side resources in the least-cost manner. In this way, markets are used to acquire the resources China needs, but they are not relied on to manage generation dispatch or provide retail service (where, without very strict controls, they can be too easily subjected to market power abuses).
3. Adopt generation pricing and other practices to allow improved implementation of China's new power plant dispatch rules.
4. Redefine the role of transmission providers (i.e., the grid companies) to specifically address long-term system planning (including demand-side management), investment, dispatch, and renewables integration issues. This will ensure that an integrated least-cost approach to system design and operations will be adopted. Regulatory policy should be reformed as well, to ensure that the companies will be most profitable when they succeed in providing least-cost service.
5. Redefine the role of distribution companies to explicitly include investment in energy efficiency. Indeed, this has already begun. In November 2010, NDRC issued a rule, "Demand-Side Management Implementation Measures" (the DSM Rule) that requires grid companies to meet 0.3% of their loads with end-use energy efficiency. Integrated least-cost planning will reveal the optimal level of efficiency investment. After experience with energy efficiency is gained by the

grid companies, this mandate can be revised to require that they “acquire all cost-effective end-use energy efficiency resources in their service territories.”

II. Background

China began a step-by-step restructuring of the power sector more than ten years ago. In February 2002, the State Council issued its notice on the “Program for Electricity System Reform” (国发【2002】5号), setting forth the basic elements of the plan which remains in effect today. The early significant reforms of this period included the separation of generation assets from the grid companies, the dismantling of state-owned assets into diverse generation companies, and the establishment of an independent regulatory authority in the State Electricity Regulatory Commission. Since these initial reforms, however, the process has slowed, in part due to the uncertainty inspired by the power sector crises in California and elsewhere. The slowing of the pace of reform has provided China with an opportunity to pause and reflect, and to adjust its plans for the industry.

A. Driving Forces Here and There, Then and Now

The reasons for the power sector reforms elsewhere in the world that served as the models for China’s planned reforms were very different than those that China faced and is still facing today. The reform movement (sometimes referred to as “restructuring”) that began in Chile in the 1980s expanded to the UK and Norway by the end of the decade, and from there it quickly spread to parts of the US and other parts of the EU. The reforms were driven mostly by (1) technology changes, which suggested that competition in generation might flourish, (2) the desire to reduce electricity prices generally, and (3) a growing ideological shift toward markets and reduced government oversight and away from planning and regulation. In those places where, under regulation, there had been very significant problems with utility mismanagement and failed investments in new generating resources (e.g., huge cost over-runs with nuclear facilities), the defenders of markets argued that competition would effect a better allocation of risk and reward between investors and consumers.

In contrast, the driving forces for power sector reform in developing countries were the inability to finance or build generation and chronic capacity shortages. Restructuring was also seen as a means of addressing serious price distortions. These have not been issues in China where power plant financing is not a significant problem and electricity prices do not depart significantly from marginal cost.

International experience with market reforms has been mixed. It is clear that some of the goals have not been met. Sometimes one goal (e.g., supporting the construction of more generation) has been met at the expense of another (e.g., lower prices and volatility). Other general observations about the experience with reforms include the following:

- Analysts are divided on the question of whether reforms have led to higher or lower electricity prices. It is clear however that electricity costs, as distinguished from electricity prices, are higher because reforms have not incorporated mechanisms to steer investment to lower-cost, higher-reliability demand-side resources (such as end-use energy efficiency).
- Electricity market prices have been very volatile. Policymakers have adopted price caps and other mechanisms to limit price spikes.

- Regions that rely on energy markets have had problems supporting needed investment in new generation and grid capacity. As a result, longer-term contractual requirements and other mechanisms have had to be added to markets to assure that adequate capacity is built.
- The innovative services that retail competition was expected to create have so far failed to materialize.
- Markets have failed, by themselves, to stimulate the acquisition of clean, environmentally sustainable resources. This is because the benefits of such resources—improved public health, environmental protection, etc.—are not costs that markets recognize and trade in.

Looking ahead, it's clear that the goals and priorities for the world's power sector need to shift toward reducing greenhouse gas emissions, very large investment in renewable energy and energy efficiency, and grid expansions to accommodate the new mix of clean resources. And it is also clear that the reforms of the 1990s will not meet the challenges of the future.

The UK provides one of the best and most recent examples of the international trend. The UK was a pioneer when it moved to liberalized electricity markets in 1990. Energy efficiency was part of the original reforms, but its oversight and promotion was not seen as a major responsibility of the regulator. In recent years that responsibility has increased dramatically and it will likely increase even more in the near future. The UK government has announced that meeting its climate goals requires a major new commitment to energy efficiency and low-carbon energy supply. The government has begun a thorough re-examination of the roles of government, grid companies, and grid company regulators and of the market's design, all aimed at meeting the UK's climate goals. The review is expected to be completed soon but the certain key conclusions have already been set out in a draft report¹:

- “The power sector needs to lead the decarbonisation of our economy, but the current market has a bias towards fossil fuels.”
- “Without reform, the existing market will not deliver the scale of long-term investment, at the pace we need, in particular in renewables, new nuclear and CCS [carbon capture and storage], nor will it give consumers the best deal. However, if we are to meet our long-term carbon targets, we need to reform the market now, to make low-carbon investment more attractive.”²

In light of these findings, the draft report identifies four reforms that are needed to cure the market of its bias against clean resources:

- **“Carbon price support:** Greater long-term certainty around the additional cost of running polluting plant. . . . By strengthening the carbon price for electricity generators, it will increase the cost of fossil fuel generation, making lower-carbon power more attractive;
- **“Feed-in tariffs:** Long-term contracts would provide more certainty on the revenues for low-carbon generation and make clean energy investment more attractive still. . . .
- **“Capacity payments:** targeted payments to encourage security of supply through the construction of flexible reserve plants or demand reduction measures (so-called negawatts) to

¹ *Electricity Market Reform*, Consultation Document, presented to Parliament by the Secretary of State for Energy and Climate Change by Command of Her Majesty, December 2010, pages 4-5.

² *Electricity Market Reform*, pages 4-5.

ensure the lights stay on. Capacity payments will ensure there remains an adequate safety cushion of capacity as the amount of intermittent and inflexible low-carbon generation increases; and

- **“Emissions Performance Standard:** A back-stop to limit how much carbon the most carbon intensive power stations - coal - can emit. An emissions performance standard will reinforce the existing requirement that no new coal is built without demonstrating carbon capture and storage technology.”³

In contrast to the UK, power sector reform in the United States took place at the regional and state levels rather than at the national level and so the character of reform differed from place to place. Likewise, the re-thinking of reform is also taking place at the regional and state levels. From these different ways to implement reform some common themes emerge: first, markets by themselves cannot solve all problems but, second, market mechanisms can be carefully targeted to specified ends. In particular:

- Competition drives choice to resources with the lowest financial costs, not necessarily to those that are cleanest. Consequently, ten states in the Northeast interested in reducing the power sector’s CO₂ emissions joined together to create a cap-and-trade regime called the Regional Greenhouse Gas Initiative (RGGI). California adopted its own climate change legislation, AB32, which, among other things, creates a multi-sector carbon cap-and-trade program. California is also working with 12 other states in the West to develop a region-wide climate change action plan.
- Thirty states have mandated minimum purchase requirements for renewable resources. These are called Renewable Portfolio Standards (RPS), and most allow for the trading of renewable power’s attributes among the entities that must comply with the RPS law. This competition for the attributes (certificates) increases flexibility and reduces compliance costs.
- Saving energy is the least-cost resource, but commodity electricity markets were not designed to trade in avoided energy. As with renewables, many states imposed energy-savings requirements on their distribution companies to address, at least in part, this shortcoming of markets.
- Policymakers and system planners have realized that commodity energy markets also don’t do a good job of ensuring that sufficient capacity will be available at all times or that new capacity will come on line as needed over the long term. Consequently, market rules have to be revised to reward resource availability (i.e., available to be dispatched when needed in real time). For example, markets for future capacity have been created in the Northeast and Mid-Atlantic states, to reduce the risk of future capacity shortages. A key breakthrough with these markets (referred to generally as “forward capacity markets”) is that end-use efficiency and demand response are allowed to participate on an equal basis with supply resources.⁴

³ *Electricity Market Reform*, pages 5-6.

⁴ The designs of such mechanisms matter greatly. As noted above, the UK is re-thinking its market structure, but it is unlikely to follow the examples in the eastern United States, where there is some concern that the markets are paying too much for capacity. Drawing on lessons from other countries, the UK is considering approaches that rely on long-term contracting rather than simple capacity auctions. See, for example, Moreno, R., et al., *Auction approaches of long-term contracts to ensure generation investment in electricity markets: Lessons from the Brazilian and Chilean experiences*, Energy Policy (2010), doi:10.1016/j.enpol.2010.05.026.

B. China's Conditions

The power sector will play a major role in China's economic and social development. Rapidly growing demand and price pressures will continue to confront the country, but the dominant long-term challenges will be energy efficiency, environmental protection, and climate change. These were not significant considerations when other countries restructured their power sectors or when China first considered how to restructure its power sector. As noted above, many jurisdictions are now thinking of ways to either redesign their earlier power sector reforms or superimpose new mechanisms on them to meet their climate challenges. China has the advantage of building the needed reforms into its power sector at the outset.

China has aggressive goals for renewable and other clean energy resources, including hydro-electric, nuclear, advanced coal, and, most recently, high efficiency natural gas. Liberalized electricity markets of the types adopted in the UK and US will not, if left to themselves, deliver significant investment in clean power generation technologies. So long as coal-fired facilities have the lowest financial costs, explicit policies will need to be adopted to ensure that investment in cleaner technologies will be made.

Furthermore, China's power sector continues to confront two longstanding challenges: (1) the need to increase interprovincial and inter-regional trading and (2) the need to improve power plant dispatch. Both provide opportunities to lower costs and reduce emissions. Again, the typical competitive generation market will not resolve these issues, but, fortunately, there are fixes that are effective, simpler, and much less risky.

So, the question for China is what policies and what mix of markets and competition will deliver the desired outcomes at the lowest cost?

C. Unique Features of the Chinese Electric Sector and the Risks of Unintended Consequences

The experiences of other countries can be useful in guiding Chinese restructuring efforts, but China's electric sector is marked by several important and unique characteristics that limit the direct applicability of those experiences to it:

- First, unlike those of the US and Europe, China's grid system is fairly unified, with most assets controlled by only two major state-owned grid companies.
- Second, generation is fairly concentrated and generally wholly or partly owned by government.
- Third, China explicitly emphasizes integration of environmental and power sector policy, and has a history of impressive measures, including environmental dispatch, differential pricing, strong support for renewables, and various energy efficiency programs. Power sector reform should retain and enhance these significant policies.
- Fourth, China has a track record of mobilizing huge amounts of investment, despite the absence of explicit market or contracting mechanisms. Most developing countries' power sector reform efforts have been driven by the need to attract capital. The challenge in China is directing investment in ways that better meet long-term efficiency and environmental goals.

D. China Has Adopted Key Reform Policies

China has already adopted many new innovative and powerful power sector-related policies. Taken together these policies demonstrate China's serious and ongoing commitment to energy efficiency and

emissions reduction. The problem is that these policies are not fully reflected in power sector development plans. In some cases, the policies will be difficult to sustain if the original reform plans go forward. In other cases, the expected benefits of the policies will be more difficult and costly to achieve. Key issues that need to be addressed in the next steps of power sector reform include:

1. *Energy Intensity and Efficiency.* China's 20% energy efficiency goal for the 11th Five Year Plan (FYP) has been met. The energy efficiency goal for the next five-year period is 16%. Though less than the 11th Five-Year Plan's target, it is nonetheless very aggressive, given the significant growth and improved efficiency of the overall economy. Clearly China considers its energy efficiency goals to be the equivalent of firm commitments. It is equally clear that integrating energy efficiency in the next steps of power sector reform could help meet future goals more effectively.
2. *The Objectives of the 12th Five Year Plan.* The goals for China's 12th FYP have not yet been broken down for each sector in each province, but it is clear that the goals will be consistent with China's commitment to reduce carbon intensity by 40-45 % by 2020. The Plan also specifies aggressive goals for renewable energy, nuclear generation, and gas-fed generation.
3. *Multi-Pollutant Emissions Control Strategies.* China has had success in meeting in the total emission control targets of its 11th Five-Year Planning period, a 10% reduction in SO₂ emissions below 2005 levels by 2010, primarily through the installation of flue gas desulfurization equipment on coal-fired power plants and a price premium to encourage operation of the equipment. Environmental goals for the 12th FYP call for an additional reduction in SO₂ emissions of 8% and, for the first time, include a reduction target for NO_x emissions (10% nationally), which will have operational and economic impacts on power generation. Additionally, pilot projects for mercury control have already been advanced around the country, setting the stage for broader multi-pollutant regulation of China's coal-fired power stations
4. *The DSM Rule.* On 4 November 2010, the State Council issued the DSM Rule. It fills a gap in China's efforts to improve energy efficiency. The rule imposes an obligation on the grid companies to invest in end-use energy efficiency to achieve a level of saving equal to at least 0.3% of the company's annual sales and peak demand. The rule broadens the grid company's role to include delivery of electricity *and* energy efficiency.
5. *Climate-Friendly Regional Air Quality.* On 11 May 2010 the State Council issued rules relating to improving regional air quality, including a requirement for denitrification equipment on all new and existing coal-fired power plants by 2015. While not directly related to power sector reform the rule makes it clear that increased reliance on clean generation and energy efficiency are considered major options to achieve better air quality.
6. *Integrating Renewable Energy Resources into the Grid.* China's renewable energy law and related regulations are very aggressive. These rules will be major drivers of power sector investment and operation. Purchasing and interconnection obligations imposed on the grid companies, as well as the renewable energy quotas and mandatory market share requirements, make it clear that connecting and integrating wind and other renewable generation will be a major responsibility of the grid companies.
7. *Environmental Dispatch.* China has adopted new and very innovative rules governing power plant dispatch. These rules are aimed at one of China's longstanding problems. The

environmental dispatch rules can deliver significant system efficiency and environmental benefits.

8. *Energy Efficiency and Load Management.* China has adopted world-class pricing and related policies aimed at encouraging large users to invest in energy efficiency and load control, including new load management requirements in the DSM Rule, which specify 70% of peak load to be outfitted with load monitoring equipment and 10% of peak load to be outfitted with load control equipment. The benefits that these policy tools provide can be put at risk by poorly designed reforms.

Together China's achievements create a very powerful framework for progress on energy efficiency and emissions reductions. But the basic policies and China's energy efficiency and emission reduction goals need to be reflected in the next steps of power sector reform. International experience shows that the types of generation markets China envisioned a decade ago will not deliver the amount or mix of generation China desires. Bid-based generation markets (which rely on variable fuel costs to determine the loading order) will not achieve all the benefits of China's dispatch policies. Likewise, reforms that call for direct retail access will undermine many of China's current and proposed innovative pricing policies, because those pricing policies are aimed at public objectives that competitive markets, by themselves, rarely value. Further reforms will need to better reflect the country's energy efficiency, renewables, and clean energy goals.

III. Reforms to Consider

We suggest that China consider a comprehensive set of reforms that suit the country's conditions and goals. Our suggestions combine the best of improved planning with competitive mechanisms. We have avoided reforms that have been adopted in other countries but that would be risky here, given China's current conditions, and which would be dependent on institutions that do not yet exist in China or that have consequences that are inconsistent with China's goals. The following sections describe these suggested reforms.

A. Improved planning methods

China could benefit from a combination of better planning and better markets. International experience demonstrates that generation markets that rely on spot market prices to guide new investment are unlikely to yield the optimal amount or mix of resources. This is especially true in China where the optimal mix of resources will be determined not only by cost, but also by factors such as climate and environment policy, resource diversity, and supply security. Relying on better planning to decide what resources should be added is a much simpler, less risky, and more direct approach than designing and redesigning generation markets in an attempt force them to produce the outcomes that the planning process would have identified in the first place.

China already uses planning efforts to determine its future investment in energy efficiency, renewable energy, nuclear, coal, and natural gas generation. Our recommendation is that China should use improved power sector planning tools to identify the mix of supply- and demand-side resources that best meet its goals. The planning tools should also have the capability to evaluate grid expansion and operations, as they relate not only to conventional generating resources, but also to intermittent renewable generation and the integration of clean energy resources into the system generally. These methods aim to better

integrate evaluation of demand- and supply-side options (including transmission and distribution), to identify the optimum mix of resources to meet economic, energy efficiency, climate, and environmental goals.⁵

B. Generation-related reforms

On the generation side, power sector reform should be aimed at structural and regulatory measures to:

1. Use competitive markets to acquire resources in the most cost-effective manner and to acquire resources in a way that helps address the persistent barriers to interprovincial trading, and
2. Operate, or dispatch, new and existing generation in the most energy- and environmentally-efficient manner possible.

1. Implement competitive acquisition for new generation

We suggest using competitive acquisition for new generation for four reasons. First, it is a well-tested, low-risk approach that can deliver new generation in a very cost-effective manner. Second, it provides an effective means to encourage new entrants. New entrants can improve competitive conditions and spur innovation and investment in new technologies. Third, it can help address barriers to interprovincial trade. And, finally, it avoids most of the market power issues that would be present if markets were driven by spot prices.

There are very few structural requirements to support competitive acquisition of power under long-term contracts.⁶ Competitive generation using long-term contracts has worked well in both single-buyer markets, where a generator has only one entity to which to sell its output (the grid company), and in multiple-buyer markets, where a generator can reach many buyers within a regional market.⁷

We recommend that buyers be the distribution companies rather than end-users. Retail competition, given the current state of China's system, provides few or no benefits but raises a number of complications.⁸ Therefore, if China chooses to adopt a multiple-buyer model, the multiple buyers should be the distribution companies. Each distribution company would be given the obligation to acquire the optimal mix of supply- and demand-side resources to meet its customers demand. It would invest in end-use efficiency and buy power (and energy efficiency, too) in a regional or national market.

For the most part, the basic elements of a potential multi-buyer system in China already exist. They are:

⁵ Hu Zhaoguang et al., "Integrated Resource Strategic Planning in China," *Energy Policy*, Volume 38, Issue 8, August 2010, pp. 4635-4642; Hu Zhaoguang et al., "Integrated Resource Strategic Planning: Case study of energy efficiency in the Chinese power sector," *Energy Policy*, Volume 38, Issue 11, November 2010, pp. 6391-6397.

⁶ Competitive acquisition of generation through long-term contracting has proven to be an effective way to reduce long-term costs, diversify resources, stabilize prices, encourage entry and innovation, and avoid volatile short-term energy prices. In fact, China already has successfully used long-term contracting to encourage cost reductions, entry, and innovation by renewables.

⁷ The multiple buyers in this case are distribution companies. For reasons beyond our scope here, this model is not very suited to a multiple-buyer market that includes large end-users as buyers too.

⁸ The justification for this statement is beyond the scope of this paper. Briefly, though, it has to do with the failure of competitive markets to value broader societal objectives and of retail electricity markets, in particular, to provide the system benefits (among them, price risk mitigation, energy efficiency, and environmental protection) that monopoly regulation can.

- The presence of a regional market within which any seller can contract with any distribution company;
- Credit-worthy distribution companies that can enter into long-term contracts (the distribution companies should not be in the generation business); and
- Clear technical and financial requirements that generators must satisfy.

There are a few additional steps needed to resolve current generation pricing issues and barriers to entry:

1. Government approval (or licensing) of new generation investment should be conditioned on certain findings:
 - That the proposed power plant is consistent with national or regional energy and environmental plans;
 - That the builders and operators of the proposed power plant meet reasonable technical and financial qualifications;
 - That the proposed plant has been reviewed by the transmission company and the plant has been informed of any transmission costs it will be responsible for; and
 - That the proposed power plant has an approved long-term contract with a distribution company.
2. Contract terms and conditions, including prices, should be determined through competitive bidding. The contract should be approved if the bidding and bid evaluation process meets reasonable government standards.
3. The contract satisfies appropriate least-cost (optimal resource mix) planning principles and any other reasonable resource obligations placed on the distribution company. The structure of any contract should be consistent with efficient dispatch rules. This means that contracts should:
 - Reflect the underlying two-part, fixed (capital)/variable (energy) cost structure of the power plant. This will assure that economically efficient dispatch decisions can be made without harming the generators' ability to cover their capital costs. This will overcome the problems China has experienced implementing the environmental dispatch rule and integrating renewable resources into system operations.
 - Describe incentives for meeting availability requirements (and penalties for failing to do so). The current generation pricing practice provides internal incentives to maintain high availability. The two-part (capacity/energy) pricing structure described in the first bullet retains that incentive if the capacity payments are conditioned on power plant availability.
 - Explicitly address which party bears the risk of future costs relating to environmental risks, such as the need to install and operate pollution control equipment or pay environmental fees or taxes. The more of these risks that are borne by the generator, the greater the incentive will be to build the cleanest power plant possible.

2. Adopt structural and regulatory measures to improve the dispatch of existing generation

China should continue to implement its innovative environmental dispatch policy.⁹ There have been some difficulties doing so—they relate primarily to the availability of reliable coal-use data and the need for a reasonable compensation mechanism (i.e., to ensure that generators whose dispatch is reduced under the new policy are not financially harmed, and that those who operate more do not receive undue financial windfalls)—but they are resolvable.

Accurate data on power plant efficiency and emissions are needed to implement the dispatch rule. This information is also needed by power plant operators for safe and efficient operation. A good approach for China is to require power plant operators to install continuous CO₂ monitors and to provide the data to the regulatory bodies and system operators. This has been a requirement in the US for many years. The CO₂ monitors are used both to measure power plant efficiency and to verify the accuracy of SO₂ monitors.

The question of providing compensation for power plants that will operate for fewer hours under the environmental dispatch rule than they do under current operating rules is unique to China. China has attempted to solve this problem with a policy called “generation rights trading.” It allows power plants that want to operate for more than their allotted hours to “buy” the rights to the incremental generation from other, presumably less efficient, power plants. This is an innovative scheme that, under ideal conditions, could solve the problem. In practice, it seems to fall short of the intended result.¹⁰

A simpler solution would be to convert the current, one-part pricing structures to two-part pricing, in exactly the same form as we recommend for new generation contracts. This will both solve the compensation problem and facilitate efficient system operation under the environmental dispatch rule. Converting one-part generation prices to two-part prices is a straightforward calculation. The generator’s variable costs are collected in per-megawatt-hour energy prices; its capacity costs are typically covered by per-kilowatt-month prices (conditioned on the plant’s availability to be dispatched when needed). This will provide reasonable compensation to inefficient power plants that are expected to operate less under environmental dispatch and will avoid excessive compensation to power plants that are expected to operate more.

C. Grid-related reforms

For the grid companies, most of the discussions in China focus on the separation of transmission from distribution and whether the separation should be (1) limited to accounting separation, (2) full separation into separate legal entities, or (3) somewhere in between accounting and full separation.

⁹ This innovative practice will not only correct the current, economically inefficient practice of dispatching plants on the basis of their total costs (i.e., contract prices) rather than according to their variable (fuel) costs, but it will also adjust dispatch for plants’ environmental (specifically, emissions) characteristics.

¹⁰ Under ideal conditions, the incremental net revenue (revenue minus incremental variable costs) of the purchasing generator would be greater than the net revenue loss (revenue loss minus the variable cost savings) of the selling generator, there would be perfect information, and there would be no transaction costs. In reality, variable costs may not be well known, information may be lacking, and transaction costs are significant.

Our recommendations begin with rethinking the role of the grid company and its transmission and distribution functions, and considering how these functions relate to China’s energy efficiency, emission reduction, and long-term climate goals.¹¹

1. Transmission

In our view China’s transmission companies should have the following functions:

- To plan the transmission system and invest in transmission and non-transmission alternatives to maintain and improve reliability;¹²
- To plan and invest to support China’s renewable energy law and other government measures to diversify the mix of fuels and technologies that produce electricity;
- To facilitate interprovincial and interregional trading of power;
- To facilitate improved generation dispatch practices, including balancing intermittent renewable energy generation and managing ancillary services; and
- To promote competition among power plants by giving more plants access to more markets.

To meet these responsibilities, a transmission company should:

- Connect new generation in a timely manner;
- Minimize line losses through design, maintenance, investment in technology, and information management;
- Minimize congestion through careful planning, investment, pricing, and operation;
- Have large geographic scope to facilitate interprovincial trading and renewable energy integration;
- Not build or own generation;¹³
- Manage contracts/markets for ancillary services; and
- Be subject to a set of rewards and penalties (PBR; see footnote 11) that are consistent with its newly-defined role and government oversight.

Put another way, this is the transmission company that invests in and operates the “strong grid/smart grid.” With such a grid, the company can directly address the major challenges of integrating large new

¹¹ Performance-based regulation (PBR) is a set of policies and practices that, taken together, give regulated companies financial incentives to act in specified ways. Every regulatory or pricing measure creates incentives; the question is whether those incentives are desirable. Often, policies aimed at one problem create others, by giving incentives for behavior that yields unwanted outcomes. Like those of other nations, China’s regulatory regime gives firms a set of incentives; however, these incentives are not consistent with and, in some ways, flatly contradict the government’s policy goals. For example, today revenues (and, ultimately, profits) are determined by sales volumes; this effectively discourages Chinese grid companies from investing in energy efficiency—but increased energy efficiency is a stated policy objective of the national government. Revenue-cap regulation (referred to often as “decoupling”), can resolve this inconsistency. See, e.g., *Revenue Decoupling: Standards and Criteria*, RAP, June 2008, http://www.raponline.org/docs/RAP_Shirley_DecouplingRevenueRpt_2008_06_30.pdf.

¹² Demand response (load management) is an example of a non-transmission alternative that meets transmission system needs.

¹³ The transmission company could be a purchaser of generation to serve specific, narrowly defined purposes, such as spreading reliability costs broadly or facilitating interprovincial trading. For example, given the transmission company’s responsibility for maintaining reliability, it might be reasonable for it to contract for peaking capacity, which is seldom used and therefore is not typically the sort of resource that competitive generation companies are interested in providing (markets for ancillary services will help resolve this problem).

sources of renewable energy into the system, making cost-effective use of smart-grid technology, and developing market mechanisms that incorporate both supply- and demand-side options—all of which are essential if China is to meet its aggressive energy and environmental goals.

2. Distribution

Compared to transmission, defining the role of the distribution company is more complex – and more important. Our main concerns relate to energy efficiency and portfolio management.¹⁴

To support China’s national energy efficiency and emissions reduction goals, distribution companies should be given four functions:

1. Distribution companies should see their role as that of energy service companies that deliver electricity, and energy efficiency, and other customer services. With the release of the DSM Rule, China has recently imposed an energy efficiency obligation on the distribution companies, which, in effect, acknowledges this broader, resource- and customer-focused role for them.¹⁵
2. Each distribution company should be required to act as a sophisticated buyer of electricity– or “portfolio manager” – for its geographic region. The firm will plan for and acquire a portfolio of resources – including both supply-side (generation) and demand-side (energy efficiency) resources – to meet the energy needs of end-use customers. The firm’s purchases will be guided by targets set at the national level (for example, renewable energy and emissions goals)¹⁶.
3. Distribution firms should be responsible for network maintenance and investment. In particular, investment in appropriate smart-grid technology will help the company meet its energy efficiency goals, by allowing it to be more active and intelligent about helping consumers use electricity as efficiently as possible.
4. Distribution firms should purchase generation resources through competitive bidding for long-term contracts.¹⁷

Overall, these four functions will serve to focus distribution company efforts on China's key power sector goals: improved energy efficiency, emissions reductions, renewable energy investment, energy diversity, price stability, and reliability.

3. Incentive structure

The current lack of incentives for grid companies to invest in energy efficiency is well known. SERC’s 2009 report on energy efficiency and emission reduction states:

¹⁴ See http://www.raonline.org/docs/RAP_Harrington_PortfolioManagement-OrdinaryCustomerInterestInElectricMkt_2002_07.pdf for a detailed discussion of portfolio management.

¹⁵ In addition, making energy efficiency a distribution company obligation is especially important as China moves to develop the “smart grid.” Smart grids have potential to greatly increase a distribution company’s ability to deliver and measure energy efficiency. But the exact nature and capability of the smart grid will be shaped by the nature of the distribution company’s regulatory obligations. If energy efficiency is not one of the distribution company’s designated roles, the smart grid will likely develop to focus on issues other than efficiency.

¹⁶ With increased focus on smart grids and distributed generation it may make sense to allow the distribution company to invest in generation below a certain size or generation with specific characteristics.

¹⁷ The portfolio could also include medium- and short-term contracts. We emphasize long-term contracts because of the important role they play in supporting new entrants and reducing costs.

*Demand-side management violates the operation objective of power grid enterprises. For example, a power grid company has saved energy consumption by green action and demand-side management. However, the profit is lower as a result. The energy conservation result of green action is opposite to profit evaluation, which affected the motivation of power grid enterprises in demand side management.*¹⁸

It is critical that China decide what functions the transmission and distribution entities will perform (regardless of whether they are fully separated from each other). This is the time to make energy efficiency a grid company obligation *and* to adopt regulatory practices that provide the corresponding incentives for the company to achieve its goals.

The incentive, or PBR, scheme for the distribution companies should specifically be designed to encourage investment in energy efficiency.¹⁹ Targeted incentives should reward distribution companies for portfolio management and competitive bidding for long-term contracting. This will help deliver stable retail prices and meet China's environmental and efficiency goals.

International experience provides many good examples of PBRs designed to reward energy efficiency and other desirable distribution company behavior. California, Maryland, Vermont, and Massachusetts are several of the many states that have adopted innovative and effective PBR schemes. Testing this approach in one or more provinces would be a useful next step.

IV. Conclusion

China has made extraordinary strides in the past thirty years and, more recently, has adopted some of the world's more innovative power sector reforms. Nevertheless, it still faces huge challenges. This short paper is intended to spur further discussion and analysis, as China considers the next steps it will take to secure an economically and environmentally sustainable energy future.

¹⁸ State Electricity Regulatory Commission, *2008 Report on Energy Conservation & Emissions Reductions in the Power Sector*, October 2009, page 43. The National Development and Reform Commission, the National Energy Administration, and the Ministry of Environmental Protection assisted in the production of the report.

¹⁹ See footnote 11.