



THE REGULATORY ASSISTANCE PROJECT

Electricity Markets: The Roles of Integrated Resource Planning and Competition in Meeting China's Power Needs

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I. INTRODUCTION

What does it mean to have a competitive electricity market? What kind of competitive electricity market makes sense for China? There are no simple answers. Competitive electricity markets come in many forms.

Well-functioning, organized markets are not natural things like plants and animals. If one plants a flower seed in good soil and gives it sun and water, it will grow into a predictable and complete thing. Markets, in contrast, are like machines: one must thoughtfully design and build them to do a desired job. And then they need to be carefully maintained and constantly overseen and, when necessary, modified and improved, because sometimes even well-built machines fail to do what one expects. One need look no further than the current financial crisis gripping Wall Street and Washington to find proof of these characteristics of markets. The lesson applies generally to all sectors of an economy, but even more so with respect to essential infrastructure and energy services: *China needs to design and build its electric market to achieve specified objectives, and then it should be prepared to watch it closely, manage it carefully, and, when necessary, fix it.*

International experience can help identify the best option for China. The United States provides many useful examples because it has so many types of competitive electricity markets. In the U.S., the particular form of a competitive market is decided partly by the Federal Energy Regulatory Commission (FERC) and partly by the states. This division of responsibility may be cumbersome, but it provides China with some very useful models.

A good example is New England, the six-state region in the northeastern part of the U.S., where there is a single regional wholesale market regulated by FERC, managed by an independent system operator called ISO New England (ISO-NE). Five of the six participating states have restructured their retail electric market, though each in a way that differs in important respects from others'. The sixth state, Vermont, has retained the vertically integrated monopoly structure. There are now six different types of electricity markets in New England, and they all operate within a single, regional wholesale market.

MARKETS AND REGULATION

Markets are tools. We use them to produce and deliver goods and services in the most efficient ways possible, to spur innovation, and to put our scarce resources to their most highly valued uses. But we also know that markets are, at best, imperfect tools, that they are not in all cases the best means for achieving an end, that without vigilant oversight and management they can be destructive of the greater public good.

The financial crisis which started in 2008 in the United States is a case in point, and it offers important lessons for China as it considers how best to reform its electric sector. The evidence is quite clear that the crisis was the result of a lack of regulatory oversight. Key failures were:

- The Federal Reserve's unwillingness to enforce a 1994 law that required it to prevent banks and other creditors from engaging in unfair, deceptive, and predatory lending; this led directly to the practice of sub-prime mortgage lending and the overvalued housing market, whose collapse is a central cause of the crisis;
- The passage, in 1995, of a law that restricted the ability of investors to sue companies, securities firms and accounting firms for misstatements and misleading financial projections; it insulated management from the consequences of their actions and encouraged excessive risk-taking, and the massive bankruptcies of Enron, WorldCom, Global Crossing, and Tyco followed;
- The repeal, in 1999, of crucial features the Glass-Steagall Act, passed in 1933 to separate commercial and investment banking; by allowing commercial banks to invest directly in the wide range of securities, it greatly increased bank depositors' vulnerability to collapses of the stock market; and
- The enactment of the 2000 law that explicitly excluded derivatives, including credit default swaps, from regulation under the Commodity Exchange Act of 1936.

The causes of the financial crisis demonstrate unequivocally the need for strong, fair, and decisive regulation. The lesson is especially important because creating and overseeing an electricity market is much more difficult and risky than a financial market.

Implicit in these different approaches to industry structure are different goals, priorities, objectives, and choices about reliance on planning and markets. If the overall public policy objective is to minimize the long-term economic and environmental costs of meeting demand for electric service, then we find that those states that have been most pragmatic, that have recognized that neither planning nor markets can alone achieve the best outcomes, have been most successful in meeting their goals. Those states have found an effective balance between planning and markets that allows them to reap the benefits of wholesale markets—economic efficiency, innovation, and choice—while reducing their attendant risks—price volatility and uncertainty of supply. They have done this by limiting their exposure to short-term market fluctuations and avoiding heavy reliance on particular energy sources and fuels: market strategies that, in fact, have been greatly advanced by other government policies relating to end-use energy efficiency, renewables, and environmental protection.

Vermont provides an especially useful example. The five other New England states have required their utilities to divest generation and open their markets to retail competition to one degree or another. Vermont, by contrast, has retained a vertically integrated utility structure. Vermont utilities are legally responsible for meeting the need for present and future demand for service.

Unlike the distribution-only utilities in the other states, Vermont's electric companies manage their own resource portfolios using a variety of market mechanisms, such as:

1. A mix of their own generation units that were built using competitive construction practices;
2. Long-, medium-, and short-term power purchases from inside or outside the region, using competitive procurement practices;
3. Demand-side resources, using a wide range of market-based practices; and
4. Full participation in the ISO-NE regional wholesale regional market as both buyers and sellers is one means by which the utilities meet their obligation to serve.

In essence, the Vermont model relies on traditional planning tools and processes to determine what resources (demand and supply-side) will minimize Vermont consumer costs and risks, and then uses the market to deliver the desired resources in the most efficient manner possible.

This paper explains how the state's utilities make complementary use of markets and the integrated resource planning (IRP) process to meet their needs, and describes the benefits of both. In summary, IRP provides utilities the framework within which to consider the broadest range of resources to meet energy service needs; and the regional competitive wholesale market (through bilateral contracts and short-term energy trading) expands the pool of resource choices and ensures that the portfolio of resources assembled by an IRP is as inexpensive and diverse as possible.

II. COMPETITIVE WHOLESALE MARKETS

In most of the United States, wholesale sales of electricity are considered transactions in interstate commerce and are regulated by the federal government, under exclusive authority granted to it by the US Constitution.¹ The Congress

¹ Article 1, Section 8, Clause 3 states that "The Congress shall have power . . . To regulate commerce . . . among the several states, . . ." Even wholesale sales of electricity within a state are regulated by FERC, because, given the multi-state nature of the grid, they are effectively indistinguishable from, and can have direct impacts on, interstate commerce. The only exception to this is Texas, whose network is not interconnected with those other states.

delegated that power to FERC under the Federal Power Act. Individual state utility commissions regulate utilities within their own state and decide many issues relating to the relationship of the utilities to the wholesale market.

The degree of wholesale competition in the United States varies from region to region. Commodity markets have not been developed in all regions, and those that have been created differ somewhat in the ways they are operated and in the electricity products they trade.

A. The New England Wholesale Market

In the northeastern United States, there is a competitive market for wholesale electricity. ISO-NE serves a six-state region consisting of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

ISO-NE currently operates under a service agreement with the New England Power Pool (NEPOOL), the voluntary organization whose over 200 members are engaged in the electric power business.² The two organizations work together to develop the market rules and operating procedures and the transmission tariffs for New England's wholesale market. NEPOOL members make up virtually all of the participants in the market.

The New England wholesale market is really three markets, one each for energy,³ capacity,⁴ and ancillary services.⁵ ISO-NE serves as the market "clearinghouse." Like any commodity market, these markets establish prices by matching supply and demand. The "clearing price" (i.e., the price at which the commodity is sold) is derived by matching suppliers' bids (ranked in ascending order by quantity and price to yield a "supply curve") with buyers' offers to purchase (ranked in descending order by quantity and price, to produce a "demand curve"). The point where supply equals demand determines the market-clearing price for a given period.

² Members include not only utilities, but also independent generators, competitive retail suppliers, providers of end-use energy efficiency and short-term demand response, end-users, and transmission owners. NEPOOL was created in 1971, as a means of addressing the regional reliability challenges that were exposed by the October 1965 blackout in the eastern US.

³ "Energy" is the generation or use of electric power over a period, typically expressed in kilowatt-hours or megawatt-hours.

⁴ "Capacity" is the instantaneous measure of a generating unit's maximum output or of a transmission line's maximum ability to deliver power (usually expressed in kilowatts or megawatts).

⁵ "Ancillary services" support the reliable operation of the transmission system as it moves electricity from generating sources to retail customers. The ancillary services market is the least-developed on the three New England markets.

The energy, or “spot,” market operates in the short-term, from the day before to real time. In the day-ahead market, suppliers offer energy in defined quantities and prices, in specified hours. At the same time, buyers, primarily local distribution utilities and other load-serving entities, but also large industrial customers, may bid to purchase these products, also in defined amounts and prices in specified hours. These bids to supply and purchase are matched until the market clears. The clearing price is paid to all suppliers whose bids are less than or equal to that price, and it is paid by all purchasers whose bid are greater than or equal to it. This price provides the basis for further trading and competition among participants in the wholesale market: the commitments that the participants make in the “day-ahead” market are binding – the seller must supply and the buyer must purchase – but these commitments can be resold in secondary trading up until the time of the transaction the next day. The market works generally as expected. Supply and demand fluctuate in response to changing prices. When supplies are tight, prices increase, making it economical for the more costly generation and more valuable alternative resources, such as demand response, to operate. Where there are retail pricing mechanisms that reveal these changes in wholesale prices directly to end-users, consumers often respond by decreasing their usage. And the converse is true. When supplies are plentiful, prices decrease, production falls, and consumption increases.⁶

The New England capacity market works in a similar fashion, except that it is not intended to provide capacity in the short term, but instead to assure that the system has sufficient resources to assure reliability over the long term. It is called the Forward Capacity Market (FCM). The ISO forecasts the system’s peak demand for power three years ahead. Suppliers of capacity – which includes not only generation but end-use energy efficiency, short-term demand response, and customer-sited generation – bid the price at which they are willing to provide capacity three years later. The bids are accepted in ascending order of price, and the marginal bid (i.e., the final bid that brings the aggregate amount of capacity to the level projected) determines the clearing price, which all cleared bidders will be paid *if, and only if, their capacity is on line and operable three years later*, and for as long thereafter as it continues to serve capacity needs. All buyers in the market will be charged for the capacity, in proportion to their total demands for capacity at times of system peak.

⁶ But, again, only to the extent that customers see the changes in prices and that the change is sufficient to render increased consumption valuable to them. This is called “price elasticity” and it describes customers’ willingness to purchase more or less as price falls or rises. Short-run price elasticities for electricity are typically quite low, which is to say that a price change must be fairly significant to induce a change in consumption. Longer-run elasticities are slightly higher, because customers can make investments that increase the efficiency of their end-uses. But even then there remain very substantial market barriers to customer investment in end-use efficiency that justify alternative, administratively overseen means for providing those resources.

Most electricity in the region is traded through bilateral contracts, typically direct transactions between wholesale buyers and sellers for market products over specified time periods and at set prices. Bilateral transactions can provide price certainty because the risks of spot-market volatility are reduced or mitigated in the negotiation of contract terms. However, the “price” for this reduced risk is the longer-term commitment that the parties make to each other, which typically will not allow either of them to effect unilateral changes to the terms of the contract in response to changing market conditions.

Short-term trading in the day-ahead and real-time markets allows participants to balance their loads and generation resources. Electricity supply and demand can be unpredictable, owing to diverse factors such as weather and the unexpected failures (forced outages) of generators. Generators and consumers can buy and sell in the spot market to manage risk and to account for any differences between their bilateral and day-ahead entitlements, on the one hand, and their real-time needs on the other. Nevertheless, the spot market poses the most risk for participants because prices can change dramatically in very little time. As a consequence, new, short-term financial agreements have been developed to hedge against price volatility in the real-time spot market.

III. THE RETAIL MARKET IN VERMONT

Increasing competition in US wholesale electric markets during the early 1990s was accompanied – indeed, partly the cause of calls for the opening of retail markets to competition as well. By mid-decade, Vermont and many other states were considering restructuring their electric industries to allow for retail choice. Since then some seventeen states have opened their markets to some form of retail choice. Vermont, after in-depth regulatory and legislative investigation, decided not to restructure but rather to keep its electric companies vertically-integrated and to continue to regulate all aspects of their monopoly operations.

But this does not mean that Vermont cannot participate in the greater regional market. To the contrary: its utilities participate actively in the market as both buyers and sellers and, as a consequence, the state has a wider range of resource options from which to choose – constrained only by the types of generation available and the transmission paths over which electricity may be delivered. New England’s energy supply is comprised of resources fueled by natural gas, oil, nuclear, coal, hydro, pumped storage, and other renewables.⁷ Vermont is also interconnected with and receives power from Canada (Hydro-Quebec). Furthermore, the state has indigenous renewable resources, one of the nation’s most aggressive energy efficiency programs, and modest development in

⁷ ISO-NE, *2006 Regional System Plan*, October 26, 2006, at 53.

distributed generation and short-term demand response. Retail customers do not have direct access to competitive generation; instead, resource decisions are made through a planning process that fully reflects the state's goals and policies.

A. Integrated Resource Planning

Vermont's utilities are responsible for acquiring power and delivering it reliably to their customers. This requires utilities to participate in, among other things, the regulatory process known as integrated resource planning (IRP).⁸ Under Vermont law, each regulated electric or gas company is required to prepare and implement a "least-cost integrated plan" for provision of energy services to its Vermont customers.⁹ Orders of the Public Service Board (the state's regulatory agency) have further defined the requirements that a utility's IRP should meet in order to be approved and implemented.

The objective of the IRP process is to ensure that utility customers are provided with safe, adequate, and reliable service while reasonably balancing the costs and benefits of providing this service. The cost factors to be considered are both direct dollar costs and those indirect costs that are hard to quantify in dollar terms, such as environmental and societal impacts, which are referred to as "externalities." After its IRP is approved, a utility is responsible for administering approved projects, evaluating and reporting on progress, and updating its IRP as required. Projects should be carried out in accordance with deadlines specified in a utility's implementation plan.

IV. IRP AND THE WHOLESALE MARKET

⁸ Vermont is one of at least 23 states in the United States that currently require formal IRP; there are at least eight others that require a partial form of IRP.

⁹ 30 V.S.A. § 218c. Least cost integrated planning:

(a)(1) A "least cost integrated plan" for a regulated electric or gas utility is a plan for meeting the public's need for energy services, after safety concerns are addressed, at the lowest present value life cycle cost, including environmental and economic costs, through a strategy combining investments and expenditures on energy supply, transmission and distribution capacity, transmission and distribution efficiency, and comprehensive energy efficiency programs. (2) "Comprehensive energy efficiency programs" shall mean a coordinated set of investments or program expenditures made by a regulated electric or gas utility or other entity as approved by the board pursuant to subsection 209(d) of this title to meet the public's need for energy services through efficiency, conservation or load management in all customer classes and areas of opportunity which is designed to acquire the full amount of cost effective savings from such investments or programs.

(b) Each regulated electric or gas company shall prepare and implement a least cost integrated plan for the provision of energy services to its Vermont customers. Proposed plans shall be submitted to the DPS and the PSB. The PSB, after notice and opportunity for hearing, may approve a company's least cost integrated plan if it determines that the company's plan complies with the requirements of subdivision (a)(1) of this section.

As explained above, the central principle of IRP is to identify, analyze, and acquire the least-cost, long-term portfolio of resources sufficient to meet demand for energy services. However, this is not a matter of simply comparing prices and choosing the lowest one. While prices show what a resource costs, prices do not show what it is worth.

Consider, for example, a photovoltaic (PV) system that produces power at the cost of 8¢ per kWh and a coal-fired plant that produces power for 4¢ per kWh. Which is the preferred resource? Despite the disparity in prices, the answer is requires knowing the operating characteristics of the two resources and the nature of the demands that the resource will service. It may in fact be the case that the 8¢ per kWh PV is more valuable to the utility than the 4¢ per kWh coal plant. This could occur if the PV's output were largely on-peak or if installation of the PV reduced transmission and distribution costs. IRP is the analytical tool by which we can determine whether the advantages of the PV facility are sufficient to overcome its 4¢ price premium over the competing resource. In this way, planning and markets are reconciled.

In sum:

- **Competition reveals what a resource costs.¹⁰**
- **IRP identifies what a resource is worth given the resource's operating characteristics and how it integrates with the existing power system, and**
- **Ultimately, IRP reveals whether any particular resource is worth more to the system than it costs. Resources should be acquired (built or bought) whenever they cost less than they are worth.**

The benefit of IRP is that it allows very different resources – e.g., lighting retrofits, photovoltaic units, a utility-owned and operated gas-fired turbine, a non-utility biomass facility – to be compared in order to determine which is the most cost-effective for a given utility at a given time. Because the available resources may be very different, as illustrated above, an analysis must include all related costs for each potential alternative. When conducted in this manner, an IRP analysis identifies the resources that offer the greatest value, net of costs, to a utility and its customers.

The evaluation of competing resources is at the heart of the IRP process. IRP is a very effective tool, even in the absence of broader market competition, but it will

¹⁰ Competition may take the form of competitive bidding for construction of power plants, competitive bidding for long- or medium-term demand or supply resources, and bid-based short-term markets.

be improved by access to a competitive wholesale market, which can greatly expand the pool of resource choices. In this way, competition is entirely compatible with planning. It enables the utility to test whether the marketplace—through competitive bidding, negotiation, or some combination of the two – can provide resources at a lower cost than the utility itself can. If the answer is yes, then total costs will be lower than otherwise, and consumers will benefit.

V. THE ROLE OF THE STATE REGULATOR IN REGIONAL MARKET TRANSACTIONS

The electric sector in Vermont remains vertically-integrated, and the therefore utilities retain the obligation to meet demand for service at the lowest total societal cost over the long run. As such, resources choices are in the hand of the electric companies, with review and oversight by the regulators. Prior to acquiring most resources, whether through construction or purchase (including some on the spot market), a utility company must receive regulatory approval. When determining whether to grant approval, the regulator reviews environmental effects, system reliability, and economics. The regulator must also find that the proposal is “consistent with the principles for resource selection expressed in that company's approved least cost integrated plan.”

VI. CONCLUSION

Discussion of competitive markets often focuses on the distinction between wholesale and retail competition. This may oversimplify the issues and options. Vermont is just one example of states that have made important restructuring decisions to combine the best of markets and planning. China’s emphasis on energy efficiency, environmental improvement, and renewables suggests that lessons from states like Vermont, Minnesota, and California can be especially useful.

These states have found that IRP gives utilities the framework within which to consider the broadest range of resource alternatives to meet energy service needs. The competitive wholesale market for electricity products increases the number and types of resources from which to choose and ensures that the various options reviewed in an IRP are as inexpensive and diverse as possible. This can yield benefits such as lower utility and consumer costs, greater system reliability, reduced consumer risk, and less environmental damage.