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The Texas Energy-Only Resource Adequacy Mechanism

On Sept. 13, 2006, the Public Utility Commission of Texas put into effect a new Resource Adequacy and Market Power Rule which establishes an Energy-Only resource adequacy mechanism in the ERCOT electricity market, relaxes the $1,000 per MWh offer cap, and replaced existing market mitigation procedures with more market transparency and prompt information disclosure. The authors describe the motivation and rationale underlying the new rule, its development process, and its implementation details.

Eric S. Schubert, David Hurlbut, Parviz Adib and Shmuel Oren

I. Introduction

The energy market posts a real-time clearing price of $1,000 per MWh. Is it scarcity, or is it market power abuse? Does it matter? Market power abuses and scarcity pricing have been two ''hot topics'' in the ongoing evolution of electricity restructuring in the United States. Consumers worry about the lack of true competition and the potential for market power abuses; price mitigation is their defense against the transfer of undue amounts of wealth from consumers to power suppliers. In contrast, power suppliers complain that the cost recovery they can reasonably expect under current market designs is so small that it is unreasonable for them to increase their investments, which is why regulators cannot maintain resource adequacy in the face of increasing electricity demand.

Texas is aiming to reconcile consumer fears and supplier reticence with a two-pronged approach: crack down on suppliers that have and abuse market power, and then apply only light mitigation when scarcity pushes prices higher. While unique within the U.S., this so-called energy-only resource mechanism has been used successfully in other foreign markets, such as Australia, for five years or more.[1] It differs from integrated resource planning approaches such as Independent System Operator in New England's (ISO-NE) Forward Capacity Market (FCM) or PJM Interconnection's proposed Reliability Pricing Model (RPM).[2,3] This article discusses the Texas energy-only model – adopted and recently modified by the Public Utility Commission of Texas (PUCT) for the Electric Reliability Council of Texas (ERCOT) power region – in the context of how prices in a restructured wholesale electricity market affect resource adequacy.

II. Concerns Regarding the Operation of Competitive Electricity Market

Utility regulation has been based on a two-tier pricing mechanism that included payment for facilities used to provide goods or services (capacity charges), and payment for the goods or services actually produced and consumed (demand charges). Utilities were obligated to obtain adequate resources (both generation as well as purchased power) to meet current and future demand by their end-use customers. Most of risks associated with new capacity expansion involved having too much or too little for future demand, and customers bore the cost of these risks – subject to regulatory approval – at a level sufficient for the regulated monopolies to earn a reasonable rate of return on their investments. The tendency was to build more than what would actually be needed, resulting in large reserve margins that minimized the possibility of load shedding and made it easier to maintain system reliability.

Ensuring proper pricing signals is essential for true scarcity pricing in ISO-procured spot energy and ancillary service markets.

The move toward competition in the electricity industry introduced new factors and resulted in more uncertainties with regard to recovery of investment. The new competitive regime presumes that power plant developers bear the risks associated with new capacity expansion and that loads bear the risks associated with scarcity pricing. Price volatility and scarcity pricing, which reflect ever-changing supply and demand conditions, are essential elements of a truly competitive market. In competitive long-run market equilibrium, inframarginal profits and scarcity rents collected by generators will cover their amortized fixed costs and will assure that the total generation capacity and technology mix will be at the social optimum. The risks born by suppliers and consumers in an energy-only market framework can be reallocated through bilateral contracts and other risk management strategies.[4]

Ensuring proper pricing signals, therefore, is essential for true scarcity pricing in ISO-procured spot energy and ancillary service markets. Three conditions are necessary for proper pricing: mitigation or elimination of market power, liberal offer caps that permit volatility in spot market prices, and the ability of load to respond to prices (so customers can more effectively manage price risk). These conditions result in accurate price signals that reflect true scarcity and provide a realistic opportunity for investors to recover their investment costs and a reasonable return, avoiding the so called ''missing money problem.''[5]

Three key concerns need to be addressed when embarking on an energy-only path for resource adequacy: public response to high and volatile prices, inadequate load response, and the ''missing money'' problem that may impede timely investment in new resources.

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A. Public response to high and volatile prices

Under an energy-only resource adequacy mechanism, prices in ISO-operated markets may at times greatly exceed those experienced in other electricity markets in North America, which operate under a $1,000 offer cap. Market clearing prices in the range of $2,000 to $5,000 per MWh may cause significant consumers backlash, adverse media headlines, and political fallout. Therefore, it is essential to communicate to various political and regulatory authorities the full story about prices in a competitive environment: prices go up when demand goes up; the market is under close scrutiny to ensure that no one is controlling prices; and that customers have choices that can reduce the impact of high prices. If customers and the companies that serve them have the tools to manage the increased price risk, then customers will have confidence in the value of electricity deregulation. Regulators then can truly allow markets to meet resource adequacy needs. Because markets react more quickly, nimbly, and accurately to changing conditions and technologies, a wider range of services will be available more quickly at more affordable prices.

B. Inadequate load resource participation

Many loads currently cannot respond to spot market prices because they lack interval metering (e.g. five-min, hourly, or on-peak versus off-peak). Even if they had the ability, however, they would have no incentive to respond because they are not exposed to interval-by-interval prices. The remedy is advanced meters for customers deemed to be too small to use interval data recorders (IDRs). The benefit of accelerating this technological transformation might be greatest in large urban areas, where the opportunities to add generation or transmission capacity are limited and expensive. Retailers and traditional utilities could provide a variety of time-of-use or near real-time pricing options to those customers that would encourage peak-shaving and other demand-side responses to pricing signals in an energy-only market with the proper metering installed.

Many loads currently cannot respond to spot market prices because they lack interval metering.

Scarcity pricing can highlight to investors and consumers the true cost of serving summer peak load with generation resources that operate a limited number of hours each year. If the price of electric service rises to a certain level, some market participants may be willing to curtail their electric service voluntarily for a number of hours each year rather than paying for power during those high-priced hours. The centralized day-ahead market in all nodal market designs in the U.S. can work to promote improved demand response in times of scarcity pricing, especially in conjunction with load management or ''peak shaving'' programs, which focus on reducing electricity use during predictable peak usage, such as summer afternoons.[6]

C. Problem of missing money and lack of timely investment in additional resources

Scarcity rents in competitive markets represent the market mechanism needed to signal resource shortages and provide incentives for new investment in resources.[7] However, mitigated energy prices that suppress scarcity rents may cause resources not to earn enough return to cover their fixed costs, a problem that has been characterized as the ''missing money problem.'' Some economists believe that if a market design mitigates prices yet does not provide a capacity payment mechanism, it will fail to provide adequate incentives for construction of new generation resources or retention of existing resources.[8] Various ''out-of-market'' practices used by system operators to maintain reliability can further impede fixed-cost recovery if the true cost of using these tools is not properly

reflected in energy prices.[9] If the missing money problem is left unattended, the market may experience significant shortages of generation during summer peaks, leaving the market vulnerable to sustained high prices and involuntary load shedding.

There are various ways to address the missing money problem within the framework of an energy-only market, such as removing the price caps or at least raising cap to much higher levels than the $1,000 cap that is in place at most of the restructured U.S. wholesale electricity markets. Alternatively, capacity markets and capacity payments have been introduced in most U.S. markets and abroad that address the missing money problem. Capacity payment mechanisms distort energy price signals, however, and arguably fail to promote either effective load response or new investment in generation.[10]

III. Capacity Markets in the United States Have Been Stopgaps Rather than True Alternatives

Mitigating market power while permitting scarcity pricing is an important challenge facing newly restructured electricity markets. The difficulty of addressing this challenge is often cited as the primary obstacle to implementing energy-only markets. The need for capacity markets has been framed by some as a response to this obstacle by regulators, policymakers, and the public. However, a more fundamental problem that has led to a reliance on capacity markets, especially in the Eastern Interconnect of the U.S., has been the halting transformation of electricity deregulation itself.[11]

The goal of electricity deregulation is the transformation of an industry dominated by regulated monopolies into a competitive electricity market that looks like a commodities market and can deliver to customers the benefits of economic efficiency. A competitive commodities market is characterized by easy entry of new suppliers, good transportation networks, liquid spot and forward markets, and vibrant competition on both the wholesale and retail level.

Capacity payment mechanisms distort energy price signals, and arguably fail to promote effective load response or investment in generation.

A number of fundamentals are necessary for electricity markets to behave as a commodity market. *Easy interconnection of generation* and *socialized payment of transmission construction* allow for quick and smooth entry of new generation from multiple suppliers. *Aggressive investment in new transmission* allows easy delivery of energy to all loads, creating genuine competition among suppliers for all loads. *Retail competition* allows for a wider range of options in pricing the use of electricity by end-use customers through reliance on the dynamic creativity of the market to meet the preferences of end-use customers. *Price-responsive load* increases competition for generation at near-peak or peak demand, reducing the need for or scope of *ex ante* mitigation of potential system-wide market power abuse while allowing for scarcity pricing. *Bilateral forward contracting* can provide a myriad of energy risk-management features customized to the preferences and abilities of end-use customers.

This transformation is a daunting task.[12] The limited success in making that transformation has resulted in deficiencies in one or more of the elements described above. The logical policy alternative, bred by necessity, has been to rely on integrated resource planning approach in the form of capacity resource adequacy mechanisms such as ISO-NE's Forward Capacity Market or PJM's proposed Reliability Pricing Model. These approaches, in essence, are constrained optimization models that extend over a multi-year period, an effort to mimic the outcomes of forward bilateral contracting of resources needed for deployment in ISO-procured spot markets.[13]

Why has ERCOT been able to attempt a sustainable energy-only resource adequacy mechanism at this time? In 2005–06, the PUCT

was in a position to consider the implementation of a sustainable energy-only resource adequacy mechanism because the ERCOT electricity market had all fundamentals of a commodities market in place, largely because the ERCOT market had the regulatory co-ordination necessary to make this transformation.[14] Other energy-only markets, such as Alberta, Australia, and New Zealand, have a similar degree of regulatory coordination seen in Texas. In contrast, the fragmented regulatory oversight of the electricity markets in the Eastern Interconnect of the U.S. has slowed the pace of the transformation of electricity markets, making an energy-only approach infeasible at this time.[15]

IV. The Texas Approach: An Energy-Only Resource Adequacy Mechanism

The remaining challenge the PUCT faced in developing the recently adopted energy-only resource adequacy mechanism was the resolution of two longstanding issues debated from the early days of the deregulated Texas market: market power and resource adequacy. Market power and resource adequacy intersect on the vexing issue of scarcity pricing. Failure to address market power results in prices that are too generous for producers—the signals do not truly reflect demand and supply conditions, they undermine economic efficiency and they weaken public confidence in markets. Similarly, too much price mitigation results in prices that are too generous for consumers, blocking a signal reflecting actual demand and supply conditions. Both of these outcomes will result in lack of adequate investment in merchant plant development and can cause undesirable shortages in power supply.[16] Therefore, it is important for policy makers to address both issues, market power and resource adequacy, at the same time in order to ensure that the interdependencies between these issues are adequately addressed.

The remaining challenge the PUCT faced was the resolution of two longstanding issues: market power and resource adequacy.

A. Market power

In 2001, the PUCT approved an offer cap of $1,000 per MWh for the opening of the ERCOT wholesale electricity market as a single control area.[17] Retail choice began on Jan. 1, 2002, in areas that had been served previously by integrated investor-owned utilities. In May 2003, in the aftermath of the extreme wholesale prices that resulted from hockey stick bidding during a February ice storm, the PUCT issued an order in which it concluded that it was appropriate to protect the ERCOT market from the impact of such bidding practices. The PUCT ordered ERCOT to implement a mitigation procedure known as the Modified Competitive Solution Method (MCSM),[18] which limited the impact of hockey stick bidding when conditions in the ERCOT market suggested that physical or economical withholding might be present.[19] To provide a further deterrent to inappropriate bidding and other forms of gaming, the PUCT required ERCOT to adopt a ''sunshine policy,'' identifying any bidder who submitted a balancing energy bid in excess of $900 whenever the market-clearing price for energy (MCPE) exceeded $900. This complemented the policy already in the ERCOT Protocols requiring next-day identification of entities submitting up balancing energy offers priced higher than $300 per MWh or down balancing energy offers priced less than −$300 per MWh.[20]

In 2006, as part of the review of the interrelationship of its market power mitigation procedures and resource adequacy mechanism, the PUCT noted that while MCSM could reduce the impact of economic and physical withholding in the ERCOT real-time market, MCSM also resulted in unpredictable after-the-fact adjustments in market prices, which undermined the incentive value of high prices in the

balancing energy market.[21] In conjunction with the implementation of the energy-only resource adequacy mechanism, the PUCT terminated MCSM in October 2006 and altered its approach to market power mitigation and disclosure of resource-specific information, which is described in more detail below.

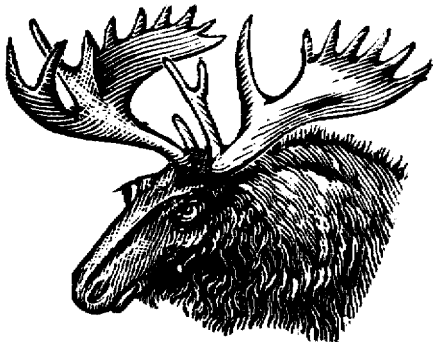
B. Resource adequacy

As part of its rulemaking on resource adequacy the PUCT noted that other ISOs in the U.S. had not reached a consensus approach to a capacity market design. PJM's Reliability Pricing Model and ISO-NE's Locational Installed Capacity (LICAP) market – which attempted to improve on existing capacity markets – seemed to represent additional regulation, rather than a market approach to providing incentives for new investment in generation and load resources.[22] During the rulemaking, the concern was expressed that capacity payments in the ERCOT market could become subsidies to existing generation, which once established, would be very hard to remove.[23]

The chief alternative to using capacity markets was to allow real-time energy prices to rise in times of scarcity in order to provide incentives for investment in peaking resources as well as baseload resources. The PUCT approved the resource adequacy rule in August 2006, with the mechanics of the energy-only resource adequacy based upon the Australian wholesale electricity market, adjusted to meet the specific circumstances of the ERCOT market.[24]

C. Key features of the energy-only resource adequacy mechanism in Texas

The PUCT stated that, as adopted, the new market power and resource adequacy rules were



necessary to meet the legislative policy of protecting the public interest during the transition to and in the establishment of a fully competitive electric power industry.[25] The key features of this market-friendly approach are as follows.

1. Higher offer caps and scarcity pricing

One of the PUCT's broad policy objectives in adopting an energy-only resource adequacy mechanism was to provide greater assurance that generation companies and developers will invest in the resources needed to supply the electricity needs of customers in ERCOT by allowing prices to rise in response to scarcity of resources in the market, in particular to encourage the development of such alternatives by providing incentives for the development of *new* peaking capacity.[26]

The PUCT reasoned that a $1,000 offer cap could provide sufficient incentives for market participants to build and to contract for new baseload, intermediate, and intermittent renewable generation, but evidence in other electricity markets suggests that a $1,000 per MWh offer cap might not provide incentives for sufficient new peaking generation to enter the ERCOT market. The protection of a stable bilateral contract will become more valuable to load-serving entities as price risk increases in the balancing energy market.[27] The PUCT also reviewed ERCOT credit standards in light of an energy-only resource adequacy mechanism but decided that any changes to ERCOT credit policies should take place through the ERCOT stakeholder process, which the PUCT would monitor over time.[28]

Another reason the PUCT chose an offer cap higher than the prevailing $1,000 per MWh was that under an energy-only resource adequacy mechanism, it believed that ERCOT could not rely on a daily ''must-offer'' requirement or capacity payments to ensure that sufficient resources are available in those situations. A higher offer cap could provide strong incentives for investment in quick-start generation and load response to meet demand in

unusual market situations. These incentives are critical in maintaining reliability in ERCOT, which is a small electrical interconnect when compared to the Eastern or Western Interconnections in the U.S. Additionally, the PUCT stated that a $1,000 per MWh offer cap would require market participants to lean too heavily on load resources and existing generation to meet peak demand.[29]

According to the approved rule, on Mar. 1, 2007, the offer cap will increase from $1,000 per MWh to $1,500 per MWh. Effective Mar. 1, 2008, the offer cap will increase to $2,250 per MWh. Finally, two months after the market begins operation under a nodal market design (sometime in early 2009), the offer cap will increase to $3,000 per MWh. The PUCT chose a significantly lower offer cap than its counterpart in Australia, in part because the ratio of all-time peak to average summer peak demand in ERCOT is not as high as it is in Australia.[30] The PUCT has decided to phase in the increase in the offer cap over a three-year period, rather than implement it immediately, consistent with the three-year timeframe in the rulemaking to gradually improve market transparency.

The PUCT also decided that to make the offer caps (which are lower than the caps in Australia) sustainable, ERCOT needed to increase the price responsiveness of load in ERCOT spot markets.[31] The PUCT stated that even under the proposed resource-adequacy mechanism, ERCOT might experience a boom-and-bust resource investment cycle. Demand-side response by load is intended to act as a shock absorber in any boom-and-bust investment cycles in ERCOT, where certain loads will curtail more often in years of shortages than years of plenty. The PUCT expected that prudent

load-serving entities would use their ability to arrange multiple-year contracts, which could protect them from high spot market prices in years with lean reserve margins. While these aspects of the ERCOT market do not eliminate a possible boom-and-bust cycle, the PUCT believed that they mitigate its impact allowing the offer cap of $3,000 to be sustainable.[32]

The PUCT stated that the price elasticity of demand is limited by the lack of interval metering for many loads and plans to address this shortcoming in other PUCT rulemaking projects. For instance, the PUCT will consider requiring advanced meters for residential and other small loads to provide customers and retailers with more discrete electricity usage information than monthly billings and average load profiles. In 2006, the PUCT required ERCOT to include provisions in the upcoming nodal market that would allow controllable loads to participate in portions of the ancillary service markets currently accessible only to generation resources.[33]

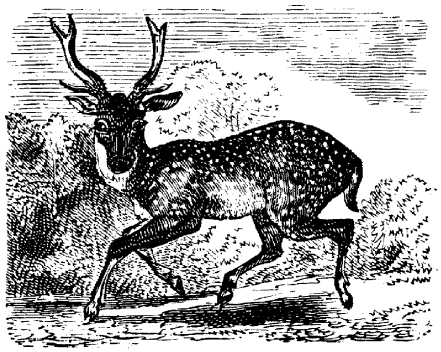
2. Publication of resource-specific offers into ERCOT-procured markets information

In adopting the rule, the PUCT stated that since the start of retail open access in ERCOT, the level of the offer cap and the appropriate amount of information to be disclosed have been interrelated. Because the PUCT has decided to increase the offer caps in order to encourage greater investment in generation and load resources in Texas, it concluded that such increases must be accompanied by increased disclosure of the information that affects the operation of the ERCOT market. The increased disclosure will help to ensure market transparency so that price changes are the result of a properly functioning competitive market and not the result of market power abuse or other market manipulation. The implementation schedule for disclosure is also being tied to the schedule for increases to the offer cap, thereby further emphasizing the PUCT's decision that these two issues are interrelated.[34]

The interrelationship the PUCT cites is consistent with disclosure policies in electricity markets in the U.S. and other foreign markets. In FERC jurisdictional markets, for instance, resource-specific information submitted into an ISO-procured market is released six months after the information was gathered, which is consistent with heavily mitigated individual resource offers and a low offer cap.[35] Quick disclosure of resource-specific information appears to provide limited benefit under these circumstances, because market participants are protected *ex ante* from potential price spikes, know the limited range in which the offers are made, and know the circumstances when price spikes will occur.

In contrast, an energy-only resource adequacy mechanism with lighter mitigation of resource-specific offers requires more rapid disclosure of resource-specific offers to provide market participants with the same range of information and protection found in FERC jurisdictional markets. This combination of lighter mitigation and quicker disclosure is seen in established electricity markets outside of the U.S.: the Australian electricity market discloses resource-specific offers with the names of the generators making the offers within 24 hours; the New Zealand electricity market discloses the same information within 14 days and may shorten the disclosure window in the near future; the Alberta electricity market displays the output of each generator, by name, on its Web site in real-time.

Effective Mar. 1, 2007, most of the required disaggregated information in the ERCOT market will be disclosed 90 days after the day for which the information was accumulated. This is one-half of the previous disclosure timeframe of 180 days. The rule will



shorten the disclosure period to 60 days, then to 30 days, on the dates when the offer cap is raised from the current $1,000 per MWh to $2,250 per MWh to $3,000 per MWh.[36]

One major exception to this disclosure schedule concerns offer curves for balancing energy and ancillary services. These two areas raise the greatest concerns about the possibility of market power abuse and other market manipulation. In order to provide greater transparency to the public and affected market participants in these areas, the PUCT stated that it is appropriate to require the disclosure of offer curves for these services on a more expedited basis. Balancing some market participants' concerns about disclosure against the greater need for public scrutiny, the PUCT concluded that, as a general rule, the offer curves should be disclosed 30 days after the day for which the information was accumulated.[37]

In addition, price setters will be identified after 48 hours. For each period that it runs a balancing energy auction or an ancillary capacity service auction, ERCOT will identify the name of the supplier with the highest-priced offer accepted, along with the price of the offer. This disclosure will be unremarkable and uninformative most of the time when prices are normal. When prices run high, however, the public will quickly know whose offer caused the price to clear where it did.[38] A supplier will still be able to price its offer however it wants (up to the prevailing offer cap), but an offer that is obviously priced significantly above marginal cost will draw public attention if it ends up setting the market clearing price. This targeted transparency should deter gaming without compromising a supplier's ability to offer energy or capacity at prices sufficient to cover a unit's marginal cost.

3. Scarcity pricing mechanism (SPM)

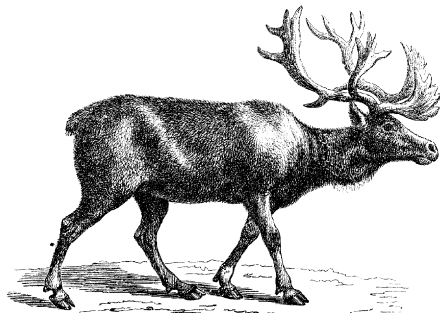
The SPM, based on the Australian model, is intended to raise offer caps to encourage resource adequacy while preventing excessive transfers of wealth from load to generation

during years when reserve margins are thin. Allowing excessive recovery would result in an unwarranted transfer of wealth to generators from load, a situation that the PUCT is attempting to avoid.

The SPM operates on an annual resource adequacy cycle.[39] In the annual resource adequacy cycle, the peaker net margin (PNM) is calculated as the sum of all positive differences between the clearing price in the ERCOT real-time energy market and the estimated marginal cost of operating a peaker with a heat rate per MWh of 10 million British thermal units (MMBTU). At the beginning of the annual resource adequacy cycle, the system-wide offer cap is set at the offer caps listed above, which is denoted as high cap (HCAP). If the PNM exceeds $175,000 per MW during an annual resource adequacy cycle, the system-wide offer cap will be reset at a lower level, denoted as low cap (LCAP), for the remainder of that annual resource adequacy cycle.[40] The offer cap would be restored to the highest level allowed in the rule at the beginning of the next annual resource adequacy cycle.

4. Exemption on system-wide market power based on installed generation capacity (small fish swim free)

Withholding production is illegal under Texas law only if the entity engaging in the behavior has market power. The new rule therefore gives small suppliers a safe harbor; if an entity controls less than 5 percent of the installed capacity in ERCOT, it is deemed not to have market power and therefore need not worry about prosecution if it decides not to offer any of its capacity into the market. On the other hand, exceeding the threshold doesn't necessarily mean the entity has market power. It does mean that if the supplier appears to



be withholding production, and prices are being affected, the first question investigators will ask is whether the entity has market power.

5. Voluntary mitigation plan

A supplier that is too big for the small supplier exemption may also obtain advance protection against prosecution for market power abuse. This safe harbor, however, is specific to the supplier's own circumstances and must be approved by the PUCT. The new rule allows generators to apply for a voluntary mitigation plan that, if followed, would constitute an absolute defense against a finding of market power abuse with respect to the behaviors addressed in the plan.[41] A large supplier may forego the voluntary mitigation plan altogether if it believes it has no need for it.

V. Conclusion

The framework adopted in August 2006 by the PUCT for market power and resource adequacy is unique in the U.S. It establishes an energy-only resource adequacy mechanism in the ERCOT market that raises the offer cap above the $1,000 per MWh that prevails in other North American electricity markets. The rule increases the role of market forces in determining wholesale electricity prices and enhances the information available to market participants by dramatically increasing market transparency through prompt information disclosure. The new rule also establishes bounds and backstop mechanisms for fixed-cost recovery while supporting mechanisms to promote adequate generation investment and market-based demand response.

Will all of this help Texas reach the promised land of competitive electricity deregulation? ERCOT will have tight reserve margins over the next few years, so the energy-only approach will be put through its paces right out of the gate.■

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Endnotes:

1. Australia, Alberta, and New Zealand all have used a variation of the energy-only approach recently implemented in ERCOT. The ERCOT mechanism is modeled after the Australian energy-only resource adequacy mechanism, adapted for unique circumstances in ERCOT. For more details, see Commonwealth of Australia (2002).

2. See Schubert (2005) for a discussion on the issues related to an energy-only

resource adequacy mechanism in ERCOT.

3. The ERCOT resource adequacy mechanism differs in some important details from the energy-only resource adequacy mechanism Hogan (2005, 2006) has proposed, in part because Hogan focused on markets under the jurisdiction of the Federal Energy Regulatory Commission (FERC) such as the California Independent System Operator (CAISO) and Midwest Independent System Operator (MISO) rather than ERCOT. Hogan (2005), page 7, footnote 11, acknowledged that lessons from overseas markets have value but ''the difference in context and details would take the discussion further afield from the U.S. setting.''

4. Some proposals attempt to facilitate such risk management practices and insure system reliability through hedging obligations imposed on load-serving entities that may also require physical cover of some sort. Such proposals are described by Vázquez, Rivier, and Pérez Arriaga (2002) and by Oren (Nov. 2005). A similar proposal for mandatory load hedging, but without physical cover, is advocated by Hogan (2005 and 2006).

5. The term ''missing money problem'' was popularized by Roy Shanker (2003).

6. In a centralized day-ahead market that is financially binding, market participants can place block (multiple-hour) offers for curtailing load on the following day.

7. For a more detailed discussion on the role of scarcity rents in resource adequacy, see Oren (June 2005).

8. See Joskow (2005).

9. For instance, any deployment of energy from reserves should be penalized with a scarcity adder, so that greater deployment from reserves will signal greater scarcity through the price of energy. Similarly, if a unit is turned on and operated at minimum load for reliability reasons, the available unloaded spinning capacity needs to be managed in a way that ensures a neutral effect on the clearing price of energy.

10. For a comprehensive review of capacity mechanisms see L.J. De Vries (2004).

11. In this analysis, the example of the California market in 2000–01 is not discussed, the failure of which was based on a deeply flawed model not implemented elsewhere in the U.S.

12. A successful wholesale market is extremely complex with many interrelationships that need to be considered. An overview can be found in Hogan (2006), at 3–12.

13. Using a multi-year constrained optimization, as part of a resource adequacy mechanism, is theoretically sound as the duality theory shows that outcomes of a constrained optimization and a set of centralized spot markets are equivalent. See Charles Rivers & Associates [Larry Ruff] (2004), at 5–6.

14. Because ERCOT is an electrical interconnection solely within Texas, federal agencies and courts have recognized that the oversight of the ERCOT wholesale market and transmission is within the state's jurisdiction. As a result, the PUCT has oversight of wholesale and retail markets as well as transmission service within the ERCOT power region, which is unique within the continental U.S.

15. The U.S. federal government is the regulator of the wholesale market and each individual U.S. state government is the regulator of the state's retail load. Jurisdiction of transmission planning and payment for new transmission is even more fragmented in FERC-jurisdictional markets.

16. Prices that are artificially high due to the exercise of market power might seem enticing to a new supplier, but they would be ephemeral unless the fundamentals of supply and demand indicate a true need for new capacity. The time required to bring a new plant on line would place the new entrant's capital at a significant risk. If the supplier with market power decided to let prices fall back to their normal non-scarcity levels, the new facility might fail to recover its costs at the lower prices when it came on line.

17. The ERCOT wholesale market began operating as a single control area on July 31, 2001.

18. Hurlbut, Rogas and Oren (2004).

19. Hockey stick bidding refers to a bidding practice where a market participant (or trader) offers an extremely high price for a small portion of its offer curve.

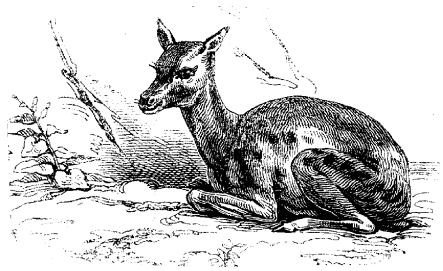
20. Public Utility Commission of Texas, Project No. 31972, *Order Adopting Amendment to Substantive Rule 25.502, New Substantive Rule 25.504, and New Substantive Rule 25.505*, at 3. Available at http://www.puc.state.tx.us/rules/rulemake/31972/31972adt.pdf.

21. *Id.*, at 6–7.

22. *Id.*, at 6.

23. Public Utility Commission of Texas, Project No. 24255, *Rulemaking Concerning Planning Reserve Margin Requirements*, Memo from Commissioner Barry T. Smitherman, July 15, 2005.

24. PUCT, Project No. 31972, *supra* note 20, at 129–147. The rule incorporated the concept of the *Statement of Opportunities* and the *Projected Assessment of System Adequacy* as a means to consolidate and gradually expand the amount and type of information that market



participants and the PUCT could use to review the adequacy of generation, load, and transmission resources to meet the projected demand in ERCOT.

25. *Id.*, at 6.

26. *Id.*, at 6 and 58.

27. *Id.*, at 59 and 67.

28. *Id.*, at 39.

29. *Id.*, at 67.

30. *Id.*, at 42 and 123. Note that the offer cap in Australia is $10,000 Australian dollars, which translates to about $7,500 in U.S. dollars.

31. *Id.*, at 54–56.

32. *Id.*, at 55–56. In the rule, the PUCT also recommended that ERCOT's Independent Market Monitor (IMM) should conduct an annual review of the effectiveness of the rule's scarcity pricing mechanism.

33. A controllable load is a load resource that has the performance characteristics of a generator and can respond to automatic generation control (AGC) signals.

34. PUCT, Project No. 31972, *supra* note 20, at 27–28.

35. Recently, a number of these ISOs have decided to implement scarcity-pricing mechanisms that prescribe specific situations when prices can rise to the offer cap.

36. In the final order associated with the rule, one commissioner dissented on the part of the rule that required 30-day disclosure of disaggregated information, but stated that 90 days, rather than 180 days, was a more appropriate timeframe for disclosure in ERCOT.

37. PUCT, Project No. 31972, *supra* note 20, at 29. The 30-day disclosure provisions have been appealed by Constellation Energy and by the City of Garland. Constellation Energy Commodities Group, Inc. v. Public Util. Comm'n., Cause No. 03-06-0552-CV, Court of Appeals for the Third District of Texas, and City of Garland v. Public Util. Comm'n., No. 03-06-00571-CV, Texas Court of Appeals, Third District.

38. We recognize that in a nodal market it is not always the case that the highest offer set the clearing prices and when the system is congested the nodal prices are affected by multiple offers of generators that are ''on the margin'' and not by just a single highest accepted offer.

39. Australian market uses a weekly threshold, which seems consistent with the summer weather patterns in the states of South Australia and Victoria. The annual approach used in the Texas rule was designed to be consistent with the long and hot summers in Texas.

40. The LCAP will be set at the higher of $500 per MWh or 50 times the price of natural gas sold in the Houston Ship Channel on the previous day.

41. PUCT, Project No. 31972, *supra* note 20, at 50.