

## The Efficiency of Wholesale vs. Retail Competition in Electricity

*If markets are sufficiently competitive, the retail model of restructuring is likely to produce a greater array of products and services and lower electricity prices, but the wholesale model may yield lower transaction costs and better encourage transmission investment. Which model is best? We don't know yet.*

Douglas R. Bohi and Karen L. Palmer

**Douglas Bohi** is director of the Energy and Natural Resource Division at Resources for the Future, a nonprofit research institution based in Washington, D.C. During 1987-88, Dr. Bohi served as chief economist and director of the Office of Economic Policy at the Federal Energy Regulatory Commission.

**Karen Palmer** is a Fellow in the Quality of the Environment Division of Resources for the Future, and is co-author of *A Shock to the System: Restructuring America's Electricity Industry*, published by Resources for the Future. Dr. Palmer received her Ph.D. in economics from Boston College in 1990.

This paper is based on a longer report prepared for the National Renewable Energy Laboratory under subcontract number AAH-5-15202-01 with Resources for the Future. For their comments on the earlier version, the authors wish to thank (without implicating) Dallas Burtraw, Paul Galen, Bill Hogan, Val Jensen, Peter Fox-Penner, and Charles Stalon.

A central issue in the debate over restructuring the electric power industry is the extent to which the market should be opened to competition. One aspect of this debate is whether competition ought to be restricted to the wholesale power market or extended all the way to retail customers. Some state regulators have recommended retail competition, while others, including the U.S. Department of Energy, prefer to limit competition to the wholesale level, at least until experience warrants taking the additional step.

The purpose of this paper is to describe some of the potential dif-

ferences in economic efficiency that could arise between the wholesale and retail competition models. The comparison is limited to the qualitative properties of two hypothetical market structures that are intended to reflect the essential differences between wholesale and retail competition. We are not concerned with problems of getting from today's market structure to either end state.

To make the comparison as straightforward as possible, we assume that both models of competition contain identical generation and independent system operator (ISO) sectors, and differ only with respect to the distribution func-



tion (see **Figure 1**). To avoid market power problems, the number of generation units controlled by the same firm may be limited. To avoid discrimination in the use of transmission, the ISO is responsible for coordinating the operation of the transmission grid, including dispatch of generating units, maintenance of system reliability and other system control functions.

As noted, the two models differ at the distribution stage. The wholesale competition model is characterized by a set of distribution companies that provide a bundled service (power plus

wires) to customers. The retail competition model is characterized by unbundled wire and power service, where customers may purchase their power either directly from the spot market run by the ISO or from one of several competing power marketing companies, and all wire services are supplied by a separate regulated company.

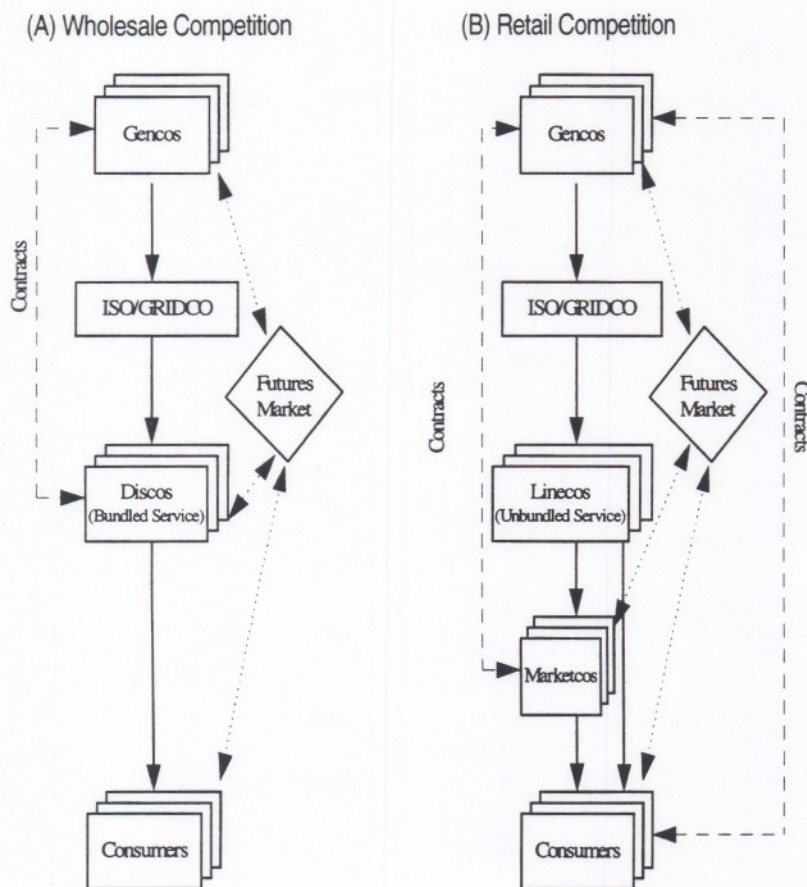
The distribution companies in the wholesale model are essentially the remains of that portion of today's integrated utilities. It is assumed that they will continue to be regulated at the state level, though the form of regulation

may be incentive-based (e.g., price caps) rather than cost-based. The marketing companies in the retail model are assumed to be unregulated as long as several such firms compete in the service territory formerly served by the regulated distribution company. Whether the number will be large enough to achieve competition is an issue discussed further below.

One could choose to compare many different variations of these market structures, but our choice is motivated by four considerations. First, competition at any level must break the linkage that gives integrated utilities the incentive to favor their own generation and to limit encroachment on their retail customers. An ISO achieves this objective. Second, a workable model of competition requires that network externalities associated with the loop flows and transmission expansion be taken into account.<sup>1</sup> Again, an ISO achieves this objective. Third, making the distinction between the two models at the distribution stage allows for a natural progression from wholesale to retail competition: wholesale competition may evolve into retail competition simply by altering the structure of the distribution function. Finally, the sharp distinction between the two market models makes it clear where the differences in efficiency benefits may arise.

### I. The Spot and Contract Markets for Power

In either model, physical power transactions would take place



**Figure 1:** Industry structures with wholesale and retail competition



through a spot market and financial transactions would be arranged through a contract market, in a manner similar to that in practice in Britain and proposed in California. For our purposes, the spot market is assumed to be run by the ISO, as in a Poolco approach, although we do not wish to exclude the possibility of other arrangements. Generating companies would offer to supply amounts of electricity to the spot market at given times and prices. Distribution companies in the wholesale model, or marketing companies and customers in the retail model, would make bids to buy power at given times and prices. The array of offer and bid prices and volumes would be used to determine the market-clearing price for each time period. The ISO would then dispatch generators according to the bids in a manner that balances demand and supply in real time.

**T**he price of power may vary at different nodes on the transmission grid because of congestion. In effect, higher-cost generation may be required to balance supply and demand at some nodes. Because of transmission constraints, it is possible that some nodes may be relatively isolated from the rest of the grid, so that seller or buyer market power may exist at these nodes. In either model, regulatory oversight is required to guard against the exercise of market power, and may lead to a reduction in firm size or the expansion of transmission capacity to reduce constraints.

The market-clearing prices in the spot market may be expected to vary considerably over the course of the day and year as the demand for electricity rises and falls, or as fuel input prices change. Reliance on spot market prices alone may impose unacceptable risks on both buyers and sellers of power. Sellers would face uncertainty about their profit margins while the buyers would be uncertain about what they will pay for electricity as an in-

---

*The sharp distinction between the two market models makes it clear where the differences in efficiency benefits may arise.*

---

put in production or in final consumption.

In order to mitigate some of the price risk, buyers and sellers could enter into contracts with each other that fix the price of power, or they could take hedging positions in the futures market. We will focus on contracts because futures trading rarely takes place for more than a year into the future. Because longer term positions can be taken through contracts, the contract market provides signals for investment in generation as well as a mechanism for hedging against price fluctuations.

Payments under the contract would depend on the relationship between the spot price and the contract price (i.e., a contract for differences). Recognizing that all electricity transactions take place at the market-clearing spot price, the contract would require the power seller to pay the buyer the difference between the spot price and the contract price whenever the spot price is higher, and require the buyer to pay the seller the difference whenever the spot price is lower. The contract could also allow for a multitude of prices that vary with time of day or season of the year.

Final consumers are unlikely to engage in contracting with generators except in the retail competition model, where they also purchase directly from the spot market. When final consumers find it more advantageous to buy from an intermediary—the distribution company or the marketing company—they would also find it advantageous to shift price risk to the intermediary. The intermediary, in turn, would hedge its risk position by entering into contracts with generators.

The contract market would serve to reduce the risk to new investment in generation by establishing in advance the price of power that would be received. When contracts can be arranged that allow adequate recovery of fixed costs with a reasonable degree of certainty, the investment would proceed. Thus, generating companies do not have to rely entirely on the vagaries of the spot



market in determining whether or not to invest.

Based on this set-up, the following sections discuss five factors that could lead to a difference in economic efficiency in the two models for distributing electricity.

## II. The Effect of Contracting on Market Efficiency

Economic efficiency is achieved when consumers pay prices that are equal to the marginal cost of production, since consumers would purchase up to that volume of electricity where the price just covers the cost of production. The spot market, which operates the same way in both competition models, may be assumed to generate prices that approximate marginal costs in real time. The contract price, in contrast, results from desire on the part of both buyers and sellers to smooth over fluctuations in the spot price. The contract price may be fixed for all times and volumes, or it may vary somewhat as the parties share the risk of spot price fluctuations.

The incentive to enter into contracts, and the relationship between the spot price and the contract price, will depend on whether buyers or sellers are more averse to price fluctuations. For example, if both parties were unconcerned about spot price variability, they would be indifferent between buying at the variable spot price or at a fixed contract price that equaled the mean value of spot prices. Risk-averse buyers, on the other hand, would be willing to pay more than the average spot price for a contract

that smoothed the acquisition cost of electricity, while risk-averse sellers would be willing to take a fixed contract price at less than the average spot price.

Importantly, the contract price is the actual transaction price, regardless of the spot price, and it may exhibit relatively little real time variation. While contract prices may behave much differently than spot market prices, the difference does not imply a loss of

---

*Generators do not have to rely on the vagaries of the spot market in determining whether or not to invest.*

---

market efficiency. The reason is that risk is as much a cost of doing business as generation costs. Contracts contribute to economic efficiency by shifting price risk to that party that is best able to absorb and manage it.

The question at hand is whether the contract market may be expected to work any more efficiently in the wholesale or retail competition model. An efficient contract is one that encourages generators to minimize costs, encourages consumers to use power efficiently, and achieves an optimum trade-off between risk-bearing and the cost of shifting risk to

another party. Several considerations come into play in this regard.

### A. The Diversity of Customers and Risk Effects

The trade-off between risk and price will vary across customers and generators, so that the market model that best represents the diverse interests of customers will likely achieve the highest level of efficiency. This condition is most likely to be achieved in the retail model, especially when final customers enter into contracts directly with generators, because their interests will be better represented than if they use an intermediary such as a regulated distribution company or an unregulated marketing company. The pressures of competition will force marketing companies to represent the interests of their customers, simply because those companies that appeal to the diverse preferences among customers will be able to take customers away from firms that are less enterprising. In contrast, distribution companies will not feel the same competitive pressure, and will not be as responsive to variations in consumer interests.

In addition, marketing companies will be more careful than distribution companies in negotiating contract terms with generating companies. Marketing companies that are the most successful in negotiating terms that lower their power acquisition costs will be the most successful in attracting and retaining customers. Firms that fail to obtain the best terms will lose customers to the



more enterprising competitors. Again, the lack of competition among distribution companies, in contrast to the marketing companies, will reduce the pressure to negotiate the best possible terms on behalf of their customers. Thus, with retail competition consumers will pay lower prices for electricity than they would under wholesale competition.

In the wholesale model, the pressure of regulation replaces the pressure of the market as the mechanism for encouraging efficiency on the part of distribution companies. The implications for efficiency will therefore vary with the effectiveness of regulation. For example, price-cap regulation will encourage distribution companies to bargain for lower contract prices since any difference between the cap and the acquisition price will add to profits. It seems unlikely that price-cap regulation will encourage the optimal amount of price variation, however, since the amount of price variation that is consistent with the interests of a wide range of customers is unlikely to be captured in a limited number of price caps.

#### **B. The Effect of Transaction Costs**

Efficiency is enhanced when the transaction costs involved in creating and enforcing contracts are minimized. Contracts that are otherwise desirable to both parties may not be possible to consummate if transaction costs are too high. Transaction costs will increase directly with the number

and variety of transactions that take place, which may be expected to be higher in the retail model since the number and variety of contracts in the retail model would exceed that of the wholesale model.

Acquiring information about the implications of contract options is a costly activity that can be accomplished more efficiently by some parties. For example, con-

---

*The larger the magnitude of transaction and information costs, the narrower the difference in efficiency of the wholesale and retail models.*

---

sumers are not part of the electricity industry and as a group will be less well-informed about the electric market than distribution companies and marketing companies. Moreover, because of the fixed costs involved in acquiring information, the larger distribution companies will be able to spread those costs over more units of electricity than the smaller marketing companies.

These cost considerations will limit the flexibility of customers and marketing companies to enter into unique contracts, and will encourage the standardization of contracts that may apply to

broader aggregates of customers. The larger the magnitude of transaction and information costs, the narrower the difference in efficiency of the wholesale and retail models.

#### **C. Allocating Risk**

Efficiency is enhanced if risks are borne by the party that is most willing and able to accept the risk. At least two considerations come into play here. First, risk should be borne by the least risk-averse parties in order to minimize the cost of insurance involved in power transactions. This condition is more likely to be achieved in the retail model because of competition among marketing companies. As indicated in Section II-A, marketing companies would be more inclined than distribution companies to offer terms that coincide with variations in risk aversion on the part of customers. Those customers who are least risk-averse would be able to absorb price risk in exchange for lower average prices, while other customers would be willing to pay for the cost of obtaining lower price risk.

The second consideration is that risk should be allocated to those parties with the greatest ability to control them, in order to provide the correct incentive to minimize risk. The primary sources of price risk come from variations in consumption and variations in the marginal cost of generation. Generating companies have relatively little ability to control their generation costs once their plants are built and the technology and fuel



requirements are set. Consumers have more flexibility to alter consumption patterns to avoid high-price periods, or to allow for some degree of interruptibility of consumption during peak periods. Again, the retail model is more likely to encourage these responses because of the incentive to offer terms that match consumer preferences.

### III. The Array of Products and Services Offered to Consumers

The considerations that lead suppliers to respond to customer's risk preferences, as just described, extend to the variety of power services and related products offered to customers. Again, the retail model is expected to be superior to the wholesale model in the diversity of products and services, and greater diversity enhances economic efficiency.

While all of the power supplied to the spot market is of homogeneous quality, the quality of service provided by the distribution and marketing companies can vary in terms of the flexibility, firmness and duration of service provided to the customer. Here, flexibility refers to degree of variability in contract demand, firmness refers to the prospects for interruption, and duration refers to the length of the contract. Higher-quality service in each dimension generally implies a higher average cost of service.

Marketing companies in the retail model may be expected to of-

fer a range of options that trade off quality and price of service in order to serve the diversity of consumer preferences. In designing these trade-offs, marketers will be particularly interested in cutting consumption during periods when the spot price is high. Distribution companies in the wholesale model will also have an incentive to reduce the volume of service when the spot price is high, although the strength of this



incentive will depend on how they are regulated. For example, distribution companies would be more inclined to offer interruptible service contracts under price-cap regulation than under cost-based regulation because they can increase earnings by reducing their purchased power costs. Nevertheless, temporary losses would be suffered when the spot price exceeds the price cap. To avoid this risk, the distribution company may prefer to enter into a contract with a generation company that establishes the maximum price for power. The average price of power may rise as a

result, but at least the full cost could be passed along to customers. Whatever form of regulation is applied, it would necessarily restrict the ability of the distribution company to respond to fluctuations in the spot price compared to an unregulated marketing company. The reduction in flexibility leads to a reduction in efficiency that must be balanced against the need to restrain the exercise of market power.

Constraints on flexibility may also limit the distribution company's incentive to offer more efficient cooling, heating and lighting equipment, as well as sophisticated load-monitoring equipment, remote control appliances, and other demand-side management (DSM) devices. While there is an incentive on the part of distribution companies to control consumption when the spot price of electricity is high, it is diluted unless the savings created by DSM translate directly into profits. If profits rise with the volume of power sales, as in cost-based regulation, the regulator would have to offset the bias in favor of selling power with special incentives for marketing DSM options.

In contrast to regulated distribution companies, the unregulated marketing companies stand to earn a profit whether they sell power or other products to customers. Moreover, because they are in competition with each other, the marketing companies would attempt to differentiate their energy service offerings as



much as possible to gain an advantage. Some retail marketers may choose to specialize in a particular type of electricity service. For example, a retail marketing company may choose to specialize in renewable energy or "green" power by signing contracts for differences primarily with solar and wind generators and then selling electricity to customers who are willing to pay a higher price for power generated using these renewable technologies.

#### **IV. Technological Improvements for Consumers and Suppliers**

The relative economic efficiency of the two competitive models depends in part on whether market participants face the appropriate incentives to develop new technologies that will lower the cost of supplying electricity, lower the cost of using electricity, or expand the range of productive uses of electricity. Incentives will be appropriate if innovative activities are pursued up to the point where their marginal benefit to society is equal to their marginal cost.

**W**ith regard to innovations in power supply—which include more efficient generation technologies, new methods of monitoring transmission system use and electricity consumption, new methods of metering electricity use and new electricity storage technologies that might reduce supply costs in peak periods—the incentives are unlikely to differ markedly between the wholesale and retail models, particularly if

price cap regulation is applied to the regulated distribution companies. The status of the generating companies is the same in both models and, since the profits earned from cost-cutting measures can be retained, both would have an incentive to adopt technologies that reduce supply costs. The desire to minimize costs will also put pressure on equipment suppliers to develop new technologies.



The incentives for demand-side innovations—such as new energy-efficient appliances and equipment, new uses of electricity such as electric vehicles, and new ways to shift load from high-cost to low-cost periods—are stronger in the retail model than in the wholesale model. The reason for the difference is, again, the result of the pressures that accompany a competitive environment. The inability of customers in the wholesale model to express their demand for differentiated products would limit the incentives of suppliers to seek out new technologies for which customers may have a pref-

erence. The retail electricity pricing structure would also affect the types of products and services demanded by electricity customers. For example, if regulation doesn't encourage differentiation of retail electricity prices by time of day, then consumers would be less likely to demand new small-scale energy storage technologies that would assist in shifting demand from peak periods to off-peak periods. Under retail competition these non-regulatory barriers are substantially reduced, if not eliminated.

#### **V. Transaction Costs and Competition in Retail Sales**

Transaction costs involved in creating and enforcing contracts, as noted above, may limit the ability of marketing companies to reflect the full range of consumer interests when negotiating with generating companies, and may constitute a cost advantage for the larger distribution companies in the wholesale model. A similar cost advantage may arise in connection with transaction costs involved in making power sales to customers. These transaction costs refer primarily to the costs of participating in the electricity spot market and arranging power sales to customers. These costs tend to vary with the number of power transactions rather than the size of the power transaction. Consequently, transaction costs per unit of electricity sold tend to decline as the size of the marketing company increases.

The transaction cost issue may be crucial in determining whether



competition among marketing companies in the retail model is feasible, and thus in determining whether the retail model itself is feasible. To make the transition from wholesale to retail competition successful, the monopoly distribution companies must be replaced by several competing marketing companies. If transaction costs are important, however, the economic advantages of large size would encourage the merger of smaller marketing companies, working against any effort to disaggregate larger distribution companies into smaller units. The minimum efficient size of a power marketer may be so large that only a very few competitors can survive in the same market. Consequently, competition in the retail market may fail to materialize, and the advantages of the retail model in terms of contracting for power supplies and diversifying the products and services available to customers, as described above, may fail to materialize as well. Unfortunately, the importance of these transactions costs is unknown.

## VI. Investment in Transmission Capacity

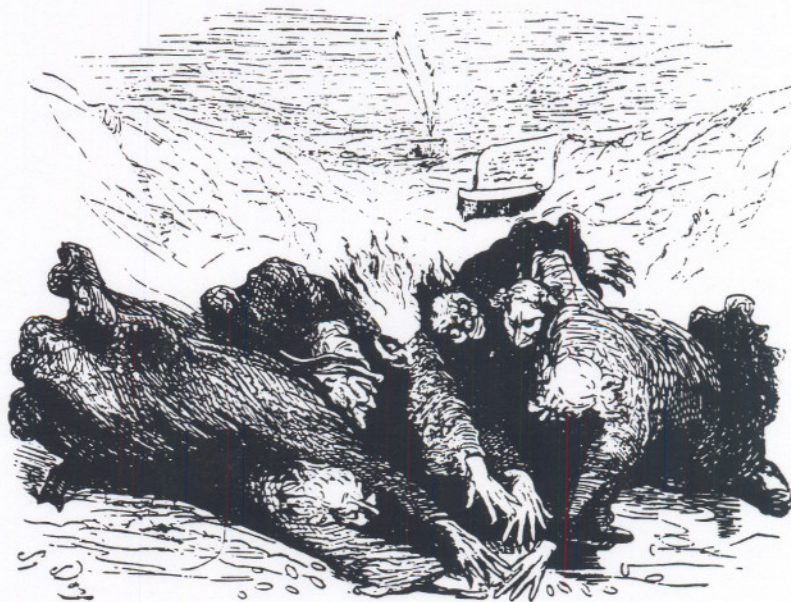
Both competitive models envision that the impetus for expanding transmission capacity will come from the parties who will benefit from the expansion, and that those who benefit will be expected to pay for the expansion. At question is whether the optimal amount of investment is likely to take place and whether

the answer will differ between the two market models.

When there is congestion on the grid, spot prices for power would vary according to the location of the nodes that connect generators and customers. Some generators would receive lower prices for their power than others, and some customers would be required to pay higher prices compared to others, because congestion will not allow power to flow from low- to high-priced nodes to remove the price differences. Customers buying at high-priced nodes and generators selling at low-priced nodes would have an incentive to cooperate and invest in additional transmission facilities that would relieve the transmission constraint. Ideally, the investment in new capacity will take place up to the point that the benefit gained

from additional expansion just equals the additional cost of expansion.

Working against this ideal outcome is the fact that the benefits from investment in transmission capacity cannot be fully appropriated by those bearing the cost of the investment. Investment that is aimed to relieve a specific constraint somewhere on the grid will serve to increase capacity throughout the grid and, consequently, serve to benefit all parties connected to the grid. The problem with this situation is that some parties may try to "free-ride" on the improvements paid for by others, by holding back and waiting for others to take action first, thereby causing the total amount of investment to be less than it should be. The amount of investment will be inadequate because the benefits that would ac-



*With over supply, seller bids may be fast and furious.*



crue to any subset of parties contemplating a specific addition to capacity on the grid will be less than the benefits that would accrue to all parties connected to the grid. Individual investors would take into account in their decisions only the benefits they receive and not those received by third parties. This result implies that market incentives will in general lead to an underinvestment in transmission capacity.

The possibility of underinvestment is less serious in the wholesale model than in the retail model, because the cost of additions to transmission capacity will likely be a smaller share of the total cost of power transactions. This conclusion follows because of economies of scale in transmission expansion, and because the magnitude of individual power purchase transactions arranged by distribution companies in the wholesale model will generally be greater than the transactions arranged by smaller marketing companies in the retail model. With larger power transactions, the cost of transmission expansion becomes a smaller part of the overall cost of the transaction, and the parties involved would be less inclined to risk losing the transaction by resorting to free-riding. In the retail model, in contrast, the smaller marketing companies will not be able to exploit the scale economies in transmission and the incentive to free-ride will be stronger.

While the tendency to free-ride will be smaller in the wholesale model, and more economies of

scale will be exploited relative to the retail model, underinvestment is still a problem because investors do not receive all of the benefits from their investment. To solve the underinvestment problem will require intervention on the part of the ISO to make up any deficiencies. The ISO would have to participate in transmission-planning decisions with interested parties and determine when and by how much the social benefits of investment exceed



the private benefits of the interested parties. Because of scale economies and the lumpiness of transmission upgrades, moreover, the ISO may find that small additional investments will achieve large additions to capacity. The additional increments to investment provided by the ISO could be reimbursed through the access charge paid by all entities connected to the grid.

## VII. Conclusion

Our preliminary look at five factors affecting relative efficiency is-

sues does not unambiguously favor either model as a goal for electricity restructuring, as some observers might claim. In the retail model, where individual consumer preferences are more likely to be served, the contract market is likely to work more efficiently, the array of products and services will be greater, and technological innovation will be faster. In the wholesale model, transaction costs are likely to be lower and investment in transmission capacity is more likely to take place at a socially desirable level. How these different factors will balance out is a subject that requires further research.

**H**owever, one thing is clear. The full benefits of retail competition will be achieved only if retail electricity markets are truly competitive. In order for electricity customers, particularly households and small commercial and industrial customers, to realize lower electricity prices and greater service choices under retail competition, they must face a real choice among several competing marketing companies. Therefore, just as state policy makers and electricity regulators are seeking ways to ensure that generation markets are competitive after restructuring, so, too, must they seek to ensure that retail electricity markets are also competitive. ■

## Endnotes

1. An externality occurs when the action of one party affects the well-being of others, either positively or negatively, and these effects are ignored in the decision to take the action.