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With Strong and Active Faith

For many years now, TVA, like electric utilities all across the United States, has been preparing for deregulation. In anticipation of open-market competition, power companies have been improving operations, cutting costs, and pricing electricity to be competitive in the new market. The process of restructuring the electric utility industry, however, is moving more slowly than many predicted. Complicated and important issues, such as the continuing role of public power, remain to be settled.

The electric utility industry is the dominant industry in America today. This $300-billion-a-year business affects virtually every aspect of our lives. So important is it that FORUM is devoting an entire issue to the changes affecting the industry and the future role of public power.

The role of public power cuts to the core of the ultimate role of all utilities—namely, to serve the public as a whole. The decisions Congress and the states make about the utility industry during the next few years will affect all Americans in a deep and personal way.

Public power utilities traditionally have set a standard for public responsibility against which private companies can be measured. In a restructured market, public power should continue to set the standard for public service, to our customers and our communities, even as we set new standards for sustainable development. Electric utilities must do more than just generate inexpensive electric power; we must also serve the public good.

TVA will approach deregulation thoughtfully and with careful deliberation. We will measure the success of our efforts in more than just pennies saved on our electric bills. We will measure our ultimate success against the higher standard of public good.

The day before he died, while working on remarks for a Jefferson day lecture, President Franklin Roosevelt wrote, "The only limit to our realization of tomorrow will be our doubts of today. Let us move forward with strong and active faith."

These are powerful words that can serve us well during the months ahead. As restructuring proceeds, we must continue to balance our commitment to the bottom line with a commitment to our customers and to the public good.

Craven Crowell
Tennessee Valley Authority

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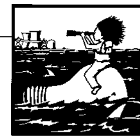


Electricity's Reconstructed Future

The electric utility industry is the largest industrial sector in America. It is so large, in fact, that one observer remarked that deregulating the industry is like deregulating the economy itself. And yet industry deregulation—or *restructuring*, as many policymakers prefer—is a sleeper issue. Most Americans haven't a clue what restructuring is all about. And they won't know until it's too late for them to do anything about it. But restructuring of the industry will affect us—all of us—and in fact has already altered the lives of citizens in those states that have begun restructuring.

As Susan Kaplan of Harvard notes, the path to a competitive electricity market is complex and confusing and the benefits unclear. While close to half the states have begun some degree of restructuring and many others are considering legislation, a number of states, especially those where the cost of electricity is lowest, want to maintain the status quo, Kaplan says.

Kaplan believes that the kinks and problems will get worked out as restructuring proceeds but that questions about technology, economics, and the roles of government and the market nonetheless will occupy policymakers for years to come.

To set the foundation for restructuring, Richard Hirsh of Virginia Polytechnic University provides an historical overlay. He begins with the regulation of electricity 100 years ago when natural monopolies began to form. By the 1960s and 1970s, the seeds for restructuring were sown as economies of scale broke down, small technologies arose, and independent power producers began selling cheap electricity on the wholesale market.

The Energy Policy Act of 1992 permitted wholesale competition, opened access to transmission lines, and allowed the states to permit retail competition. Hirsh sees retail competition as the wave of the future.

Governor Mike Johanns of Nebraska believes Congress needs to protect consumers, but the governor is not impressed with Congress's early efforts. "If Congress does not establish an effective framework to ensure that wholesale competition works properly," the governor warns, "we are headed for trouble."

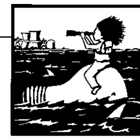
Johanns particularly wants all parties to have equal access to the transmission system, and he is concerned about monopolistic abuses. As co-chair of the Governors' Public Power Alliance, Johanns is working with several governors to help ensure that deregulation does not harm public power consumers. These governors consider H.R. 2944—the most active deregulation bill to date—as falling far short of this goal.

Environmental Defense's Dirk Forrister and Dan Dudek see deregulation as an opportunity for utility companies to develop strong environmental strategies that will help them become more competitive. Some states have already built air quality improvements and incentives for renewable energy in their deregulation statutes, and similar provisions are likely to be key ingredients of any federal legislation.

While some companies have resorted to litigation to slow the pace of environmental change, Forrister and Dudek believe these companies are allowing market opportunities to slip away while they are tied up in costly litigation. Instead, the companies should be using market-based approaches to environmental improvements that put them ahead of the environmental compliance curve, and they should be building a corporate image of environmental leadership that promotes customer loyalty.

Only a few years ago, policymakers were predicting that we'd already be experiencing substantial benefits from restructuring. For the most part, that hasn't happened yet. It's simply too early to identify the long-term effects or to say who the winners and losers will be in electricity's reconstructed future.

The Editors



Restructuring: The Story Continues

Moving the electricity industry from a government-regulated monopoly to a market-driven enterprise is no simple matter.

BY SUSAN B. KAPLAN

Every American uses electricity. Yet when we turn on a light or toast a bagel, few of us are aware of the numerous, complex public policy issues associated with this everyday commodity. Awareness, however, may soon increase as the electricity industry is restructured—*deregulated* is the more common, but less accurate, term—to allow market forces rather than governmental edicts to manage it.

As was the case with natural gas and telecommunications—industries that have already undergone deregulation—restructuring of the electricity industry will hopefully lead to competition, a more efficient market, and lower prices. But the path to a restructured electricity market is complex and marked by widespread confusion. Meanwhile, the ultimate benefits remain unclear.

From Monopoly to Market

Historically, the electricity industry has been viewed as a natural monopoly; it was thought that the cost of electricity would be lower if only one firm in a defined region undertook generation, transmission, and distribution of electricity. Natural or not, monopoly status required government approval, and with approval came regulation and the demand that the industry meet certain social goals, such as providing service to everyone.

That industry structure has recently come into question, however. To begin with, technological changes have created alternatives to the vertically integrated power company, thus eroding the rationale for a natural monopoly. Second, in the 1970s, utilities incurred enormous cost overruns building and operating nuclear power plants, and this led many people to question the regulatory system. And third, large industrial and commercial electricity customers saw the potential for lower prices in a competitive market and began to call for restructuring. In 1992, Congress and the president responded.

Several key federal laws form the legal basis for electricity restructuring. In addition, many states have passed, and still others are contemplating, their own restructuring laws.

■ **Public Utility Holding Company Act of 1935**. PUHCA changed a complicated industrial structure into the current system of state-regulated utilities. It also gave the Securities and Exchange Commission power to limit acquisition of assets to geographically contiguous areas and to prohibit certain loans and contracts among the operating subsidiaries of an electricity holding company. Critics, however, suggest that PUHCA has protected utilities from competition to the detriment of consumers by restricting the actions that holding companies can take. For example, because each operating subsidiary must be managed independently, there is little incentive to exploit potential scale economies, especially since each subsidiary's regulated level of profit is simply a function of its costs.

■ **Public Utility Regulatory Policies Act of 1978**. Enacted by Congress to reduce dependence on foreign oil, PURPA requires utilities to buy power from nonutility companies that generate excess power in the course of another process, such as generating steam to operate industrial equipment. Proposed legislation in Congress would repeal those mandated purchases because they are seen as inconsistent with an open market.

■ **Energy Policy Act and FERC Order 888**. The Energy Policy Act of 1992 empowers the Federal Energy Regulatory Commission to require that transmission-owning utilities transmit power from generators to other utilities and to electricity wholesalers at reasonable, nondiscriminatory rates based on the transmitters' costs. Thus, under the act, a utility company in the Southeast can buy power from a utility in the Pacific Northwest, and the intervening transmission-owning utilities are required to send—or wheel—the electricity from the seller to the buyer. To implement the legislation, FERC issued Order 888, which describes the terms and conditions for open access to the transmission system.[1]

■ **FERC Order 2000.** Nearly as significant as Order 888, FERC Order 2000, which was issued in 1999, strongly encourages—but falls just short of mandating—all utilities that own, operate, or control electric transmission facilities, to join a regional transmission organization. RTOs are regional institutions for electricity markets. They coordinate the physical dispatch of power and oversee a bidding process to establish a price that is transparent to all market participants. [2]

In addition to these enacted changes, the Clinton administration has submitted to Congress two very similar electricity restructuring bills—both titled the Comprehensive Electricity Competition Act. The 1999 version primarily differs from the 1998 version in that it includes a few provisions designed to increase support for the legislation. For example, it increases the requirement for renewable energy from 5.5 to 7.5 percent. The bills set a deadline for retail access but allow states to opt out of this requirement.

Numerous other restructuring bills have also been introduced in Congress, most recently H.R. 2944, sponsored by Rep. Joe Barton of Texas, which defers to the states on numerous issues. These bills are notable as attempts to reach compromise on basic issues. Passage of federal legislation is uncertain, however, because agreement has not been reached on such key issues as mandatory retail competition in the states, environmental requirements, federal and state jurisdictional boundaries, and mandatory participation in RTOs.

More than 20 states—primarily those with high electricity costs—have passed legislation introducing some level of retail competition. Many others are considering such a move. However, several states with moderate to low electricity costs—primarily in the South and West—see restructuring as unnecessary. They ask, if it ain't broke, why fix it?

Several states with moderate to low electricity costs—primarily in the South and West—see restructuring as unnecessary.

Social Goals

When utilities functioned as monopolies, they had an explicit social contract with the American people. In exchange for monopoly status and rates that guaranteed costs would be covered, companies agreed not only to provide electricity, but also to support a broad range of social objectives, including support of low-income customers, consumer protection, promotion of renewable energy technologies, and environmental protection. The effect of restructuring on these social goals remains to be seen.

With strong support behind them, programs designed to assure service for low-income customers appear to be relatively safe. Indeed, while the issue is being worked out state by state, safeguards to protect low-income consumers have generally been included in state restructuring plans.

But beyond assuring reliable and affordable service to low-income customers, restructuring raises a number of new consumer-protection issues. For example, how can consumers prevent the unauthorized change of their service provider? And how can customers ensure they will receive information about bills and the source of their electricity?

Finally, demand-side management programs can help protect the environment by promoting energy efficiency. This can be accomplished by shifting demand to different times of day. For example, some utility companies offer small reductions in electricity bills if their customers agree to have their power "cycled," or turned off, for varying periods of time during peak demand periods. Other programs encourage manufacturers to make more efficient appliances and builders to construct energy-efficient buildings.

Of those California residential customers who have chosen a new energy supplier, many have shown a willingness to pay more for green power.

Regulators recognize that residential consumers lack the time and information resources of larger consumers and that these smaller consumers need education and information about the new electricity market.

The environmental consequences of electricity restructuring are likewise uncertain because the future depends largely on choices not yet made.[3] Will we witness an increase in the burning of coal—the nation's most abundant energy source—in aging, inefficient, heavily polluting plants? Will new clean-coal technologies reduce the environmental costs of burning coal? Or will clean fuels like natural gas, wind, and solar power emerge as true alternatives?

One method for encouraging environmental protection is to require that a certain percentage of retailed electricity come from renewable sources. Another method is to charge customers an extra fee that supports renewable energy programs. Fifteen of the 20-plus states that have encouraged retail electric competition have included such provisions in their plans.[4]

Retail Competition

Retail competition allows residents and businesses to purchase power from the supplier of their choice. Of the states that have enacted retail competition, Pennsylvania has the most customers who have switched power providers. According to a December 1998 survey, 9 percent of Pennsylvania's residential electricity customers had already chosen a new supplier.

In other states, notably California and Massachusetts, things are evolving more slowly. It's worth noting, however, that of the small fraction of California residential customers who have chosen a new energy supplier, many have shown a willingness to pay more for green power, from renewable energy sources.

One of the keys to encouraging retail competition is, of course, price. Particularly important is the standard-offer price, which is the price of electricity for retail customers who do not choose an alternative supplier. If the standard offer is set too low, new suppliers entering the market will be unable to compete. This was the case in Massachusetts, where new suppliers have been unable to enter the market and, as a result, residential customers do not yet have real choice. Indeed, new market entrants in several states have pulled out after concluding that the environment was not ripe for competition.

A second important element is to determine who will serve those customers who do not choose a supplier. Should these customers remain, by default, with their original supplier? Some would argue that this gives unfair advantage to the incumbent provider. Conversely, randomly assigning customers to new suppliers raises concern about shifting customers without their consent.

Another key to retail competition is the shopping credit, also called the "price to compare." This credit—designed to encourage customers to shop around for their electricity provider—is the default price, or the price at which a utility will sell electricity in the absence of competition. If, in the presence of competition, the price of generation is less than the shopping credit, consumers save money.

For example, if Ms. Small Consumer has a shopping credit—set by state regulators—of 3.87 cents per kilowatt-hour for generation, and the price of generation offered by a supplier is 3.35 cents per kilowatt-hour, she saves 0.52 cents per kilowatt-hour. The idea is to set the shopping credit high enough that providers can compete by beating it.

Finally, the transition period is also critical and involves trade-offs.[5]

Some utilities will lose money on investments in power plants or on contracts they made when they expected to keep selling power at a rate based on their costs rather than at market-driven prices. These lost moneys are called stranded costs, and they are estimated to approach $200 billion nationally.

To help recover these costs during the transition period, some states are levying what they call a competitive transition charge, which is a fee tacked onto each customer's electricity bill. These fees go to existing power companies to cover their stranded costs. This lowers their cost of production and makes it harder for new companies to enter the market. The larger the stranded cost charge, the more it equalizes prices among old and new power companies—reducing the incentive to switch.

California set a shorter period of time than other states for recovering stranded costs. As a result, California's competitive transition charge is higher and customers—who save less on their bills as a result—have less incentive to switch. Thus, it is difficult for competition to begin until the transition period ends. Pennsylvania chose the opposite path; customers pay the competitive transition charge over a longer period of time and competition takes root sooner.

While restructuring has resulted in lower electricity prices for large industrial and commercial customers, the evidence is not yet in on the benefits, or harm, to residential consumers. Most small consumers have not yet had a real opportunity to choose, although aggregation—groups of residential or small commercial customers joining to leverage their buying power to get a better rate—has reduced prices in some cases. In general, it will take longer for residential customers to reap benefits from restructuring.

Spreading the Wealth

Electric utilities have historically been vertically integrated, with generation, transmission, and distribution provided by a single company. Restructuring, however, is changing that. If competition is to flourish, control over transmission and distribution systems cannot rest with generators. Otherwise, the owner of the transmission and distribution systems could—in spite of the new open access requirements—block other generators from using their transmission lines by such ploys as claiming that a transmission could hurt reliability.

While restructuring has resulted in lower electricity prices for large customers, the evidence is not yet in on the benefits, or harm, to residential consumers.

To promote competition, proponents of unbundling advocate various degrees of separation of the services utilities provide. Solutions can be structural, such as requiring utilities to divest their generation. As a result, many companies now own either transmission and distribution systems or generation facilities, but not both.

Solutions can also be behavioral. For example, some state public utility commissions and independent system operators have developed codes of conduct—standards and rules to separate generation operations from transmission and distribution subsidiaries owned by the same company. The codes are also meant to eliminate unfair advantage by subsidiaries that have had privileged access to information held by the parent utilities. For example, Rhode Island's restructuring law requires affiliated generation and distribution companies to maintain separate accounting records. It also requires that their employees function independently, and it prohibits the sharing of information between such companies except through established, public channels.

Naturally, policymakers disagree about how far unbundling should go. For example, what about metering and billing customers for electricity use? Should these functions be unbundled so that energy service providers—new, nonutility players in the electricity market that broker power—can include them among the services and products they offer?

Some observers predict advances in metering technology that would enhance competition, for example, by telling customers how price varies according to time of day, allowing them to time their use and save money. At least at the beginning, however, this level of unbundling could be complicated and expensive to administer.

Operating the System

Electricity is an unusual commodity in that generating and distributing it requires close coordination with others in the same system. Up until now, coordination has been informally handled by companies through voluntary associations organized to optimize engineering standards. A restructured marketplace, however, with many new players, requires a new way of operating, one with a central operator to manage instantaneous coordination on the system and to balance supply and demand.

In addition, questions about how to dispatch electricity must be worked out. For instance, how do we adapt power pools to a competitive market so as to avoid abusive monopoly behavior? A power pool consists of two or more utilities that plan and coordinate their generation to supply electricity in the most reliable, economical way to meet their combined load. Pooling power generally involves two elements: coordination of the physical dispatch of power in an area by an independent operator—ensuring fairness among competitors—and a bidding process for the power, establishing a price that is transparent to all participants.

While there has been broad, though not universal, acceptance of the idea of an independent operator of transmission, debate continues over whether the operator should be a transmission company (transco), which owns the wires, or an independent system operator, which does not. Some say transcos can remedy underinvestment in transmission and increase reliability by avoiding the separation between system operation and transmission maintenance and operation that characterizes ISOs. Others fear that transcos will favor transmission to the detriment of generation companies. Because the transmission company controls access to grids, it has the potential, and a financial incentive, to charge generation companies higher rates than are required to move power. However, because higher fees are an obvious way to allocate use of the grid when demand exceeds capacity, excessive charges will be difficult to detect.

Some also believe ISOs offer better incentives for efficient management and administration—required by federal regulators—and are better able to meet the public interest primarily because board members have no financial interest in the performance of any market participant. Others think the separation of the functions of system control and transmission maintenance and operation will hurt reliability of service because there will be lesser coordination of these critical functions.

Pricing models are another point of contention in the ISO debate. In the locational marginal cost pricing model, transmission prices can vary depending on the amount of congestion that builds up on the transmission system. Locational marginal pricing assesses charges based on the amount of congestion that a particular transaction causes. Supporters of this model contend that it leads to more efficient pricing by allowing prices to more accurately reflect costs at different locations in the system, it allows the greatest amount of customer choice, and it provides the best opportunity for innovations.

By contrast, a zonal pricing system aggregates areas into a number of zones and sets a single price for each zone. While advocates of zonal pricing say it provides a foundation for a simpler competitive market structure by reducing the number of different prices, critics maintain that it fails to create efficient incentives to get the prices right.

Pricing transmission is a troublesome issue since most wholesale transmission customers choose their supplier from the marketplace. Thus, wholesale customers receive, and are able to respond to, market price signals. Retail customers, however, are still paying retail rates for transmission according to the traditional methodology of cost-of-service regulation, which is based on capital investment, depreciation, rate of return, and expenses. This dual pricing regime is not consistent with a competitive, efficient market and needs to be addressed by regulators.

Pricing distribution is another troublesome issue. Price caps are in place in some parts of the country to dampen market volatility. Some contend that these caps should remain in place until the market is more fully developed. Others are concerned that the caps impede market forces. Still others, who note the experiences in other countries and in telecommunications, are concerned that price caps do not ensure quality service; with limits on the prices they can charge, utilities could choose to make cutbacks in areas that affect service.

Maintaining Reliability

Hot summers in 1998 and 1999 resulted in blackouts in several large cities, including Chicago and New York, and called into question the reliability of the nation's electricity system. Indeed, the *Interim Report of the U.S. Department of Energy's Power Outage Study Team: Findings from the Summer of 1999* notes that the tools, technologies, and operating procedures for reliability management are not keeping pace with changes in the electric utility industry.[6] The report points to several culprits, including reduced spending on reliability, divided responsibility for reliability, and increased electricity use. To improve reliability, the report calls for incentives for utilities to maintain and upgrade facilities, as well as better information for system operators and engineers. Many in the industry feel that federal legislation addressing reliability is also essential.

More shortages may occur in the future, since fewer companies are acquiring and building generation. Shortages in transmission capacity are also expected to develop as Americans move further and further into suburbia and exurbia, and new transmission lines will be needed to serve them. Nonetheless, opposition to new lines on aesthetic grounds has increased.

Monitoring the Market

Implementation of the Energy Policy Act has focused primarily on supporting competition by eliminating vertical monopoly power, but that is not enough to ensure competitive pricing—at least not in the short run. The possibility also exists that one or more firms that dominate the same market can raise prices beyond what the market would bear in a truly competitive environment.

Two approaches have emerged for dealing with this problem—one structural, the other behavioral. A structural approach, for instance, might require that utilities break up into several competing entities. A good example of a behavioral approach is a market-monitoring plan, such as the one administered by the California independent system operator. Under that plan, the ISO monitors hourly market-clearing prices, investigates those that are anomalous, evaluates system conditions such as loads and outages, and scrutinizes participants' activities such as bidding patterns and strategies. By collecting and analyzing such information, the ISO can detect attempts to drive the competition out of a particular market or withhold power to drive the price of electricity up, and it has authority to impose sanctions. While some complain that such oversight constitutes "re-regulation," a degree of monitoring will continue to be necessary as the market develops.

Mergers are also increasingly a potential problem, as the electricity industry has recently seen an unprecedented wave of mergers. All proposed electric industry mergers must be approved by FERC, which takes into consideration the amount of market power likely to result. Often, states must also approve mergers. Failing all else, antitrust action remains a powerful tool in the fight against monopoly power.

A Continuing Process

The restructuring process is underway but is far from complete. The transition will continue, and as it does, it will work out kinks and problems. The process is complex, however, in that it raises intertwined questions about technology, economics, and the roles of government and the market. These are vexing questions that will occupy policymakers around the nation and the world for years to come.■

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NOTES

1. FERC Order No. 888, Docket Nos. RM95-8-000 and RM94-7-001 (April 24, 1996).

2. FERC Order No. 2000, Docket No. RM99-2-000 (December 20, 1999).

3. Ralph Cavanagh, "Congress and Electric Industry Restructuring: Environmental Imperatives," *Electricity Journal* 12(6) (July 1999), pp. 11-20.

4. Ryan Wiser, Kevin Porter, and Steve Clemmer, "Emerging Markets for Renewable Energy: The Role of State Policies during Restructuring," *Electricity Journal* 13(1) (January/February 2000), pp. 13-24.

5. Stranded costs represent losses utilities stand to incur in a restructured environment. They include prior investments in facilities that may not be recouped as well as future revenue that will be lost from prior contracts that called for sale of power at cost-based, rather than market-driven, prices. At issue is whether stranded costs can be recovered and, if so, how much can be recovered, by what means, and from whom. Not surprisingly, opinions vary over how much, if any, of the stranded costs the utility should pass on to consumers and how much should be the responsibility of utility shareholders. State legislators and public utility commissioners have dealt with the question in different ways. Most, although not all, have allowed utilities to recover prudently incurred, verifiable, nonmitigatable costs that are rendered otherwise unrecoverable because of the transition from monopoly to competition.

6. Available from the Power Outage Study team's website <http://tis.eh.doe.gov/post/interim.pdf>.

Revamping and Repowering

The origins of the restructured American electric utility industry offer perspective on its future.

BY RICHARD F. HIRSH

If you liked telecommunications deregulation, you'll love electric power restructuring. Already, telemarketers in several states are working overtime trying to convince customers to switch their power providers. Some suppliers offer low-cost electricity produced by old coal-burning plants; others strive to win environmentally conscious customers by promising power that comes from relatively pollution-free sources such as wind turbines. Many try to entice customers with discounts and premiums if they make the big switch.

For most of the 20th century, the electric power business was viewed as a natural monopoly, and customers could not choose their power suppliers. In theory, state regulatory commissions protected consumers against monopoly abuses and oversaw utility requests to construct power plants, to string up transmission and distribution lines, and to establish new rate schedules. Overall, few people complained as the price of electricity declined and as electrification appeared to make work more productive and life more pleasant. Meanwhile, utility companies and their stockholders watched earnings and dividends grow.

So why would anyone want to change an electric power system that appeared to provide universal benefits? The short answer is that the picture was not as rosy as it seemed. The seeds for restructuring actually were sown in the 1960s and 1970s, when a combination of technological and managerial problems struck the utility industry, and political forces coalesced to stimulate major changes in the status quo. In particular, the utility industry failed to continue making progress in employing traditional generation technology to lower the price of power. Moreover, new public policy following the 1973 energy crisis unexpectedly introduced a set of free-market principles to an industry that had seen few elements of competition before. In the 1980s, deregulation ideologues pointed to positive examples of restructuring in other industries, and they hoped to take advantage of new technologies to lower the cost of power, especially for large electricity users. When Congress, in 1992, passed legislation to reduce the impact of oil consumption after the Gulf War, the stage was set for deregulation and restructuring of the utility industry.[1]

Origins of Regulation

To understand deregulation and the restructuring of the utility industry, it may be useful to examine the origins of regulation in the Progressive era of American history—about 100 years ago. During this period of rapid industrialization, American political and economic leaders came to accept the notion that certain enterprises operated most efficiently without competition. The railroad industry, which started out early in the 19th century with competition among several companies along lucrative routes, is one of the most obvious examples of such monopolistic businesses. The huge capital investment made by the railroads meant they needed huge revenues to become profitable, a situation that often did not exist when many firms vied for the same customers. Consequently, railroad companies limited competition through mergers or the creation of trusts, which resulted in less costly service, though not necessarily lower prices to customers.

Recognizing the unusual nature

of such capital intensive industries, known as natural monopolies, politicians in the late 19th century played a critical role in forming regulatory bodies. They argued that these new types of businesses could benefit society if their cost savings, derived from economies of scale and reduced waste of material and capital resources, were passed on to customers.

But the politicians also realized that the public would not accept unfettered monopoly. They therefore invented the regulatory commission to oversee these industries and ensure that the benefits of monopoly flowed to customers. Utility managers were happy with this solution because they recognized that state commissions would ensure that customers paid rates high enough to maintain their firms' financial stability. Employed earlier in the railroad industry, regulation came to the electric utility industry first in New York and Wisconsin in 1907. By 1922, 37 states had commissions that watched over electric utility operations.[2]

Of course, regulation of investor-owned utilities was not the only model for organizing this natural monopoly industry. Another approach consisted of municipalization, in which city governments purchased privately owned utility companies, or built competing networks, and operated them for the supposed benefit of the citizens. Resonating with reform-minded politicians who sought to eliminate urban corruption, city ownership became a popular way to deal with utility consolidations.

By the time state regulation of investor-owned utilities began in 1907, more than 1,000 municipal systems had been established, constituting about 30 percent of the nation's power suppliers. Throughout the following decades, municipal, state, and federal governments continued to establish publicly owned power systems, often as ways to provide electrical service to underserved constituencies, such as rural residents neglected by investor-owned utilities. Usually exempt from state oversight, public power companies have coexisted in a sometimes uneasy truce with their regulated counterparts.

Technological Problems

Electric utilities appeared to be natural monopolies because they invested heavily in capital equipment to produce and distribute power. In cities where competition existed soon after Thomas Edison established the first power supply system in 1882, companies vied for customers, ripping up streets and erecting wooden poles for power lines. Realizing that competition often meant duplication of facilities and too few customers to make investments worthwhile, power companies merged and became near-monopolies. Regulation eliminated competition altogether and legitimated the status of utility companies as natural monopolies.

The early 20th century also witnessed a revolution in electricity-production technology. Taking advantage of the newly invented steam turbine—a device that sent steam passing through vanes attached to a shaft, causing it to rotate—power companies could bypass an apparent limit to the performance of reciprocating steam engines. Much more compact than the older steam engines, turbines could produce more power for use in turning generators, which churned out electricity for distribution to customers.

Moreover, steam turbines could be scaled up to provide more power when needed. As America became increasingly electrified, the capacity of steam turbine-generator sets grew accordingly. While the first steam turbine used by an electric utility in 1903 produced about 5 megawatts of power, the biggest, newly installed unit in 1929 generated about 200 megawatts. After World War II, when demand for power grew enormously, steam turbine units met the needs of utility companies, reaching 1,000 megawatts in 1965. Happily, increasingly large power plants usually meant lower-cost power—a perfect example of economies of scale that helped justify utilities' status as natural monopolies.

In addition, manufacturers of power equipment made gains in thermal efficiency. Using new and sometimes exotic metals to contain higher temperature and pressure steam in the turbines—as well as in the boilers that produced steam—equipment suppliers allowed utilities to make more electricity from less fuel. In Edison's first plant, only about 2.5 percent of the raw fuel was turned into electricity. By the 1960s, utilities converted, on average, about 33 percent of the fossil or nuclear fuel into power.

As utilities exploited the economies of scale and improved thermal efficiencies of newer power plants—along with higher-voltage transmission lines and improvements in other associated equipment—the price of electricity declined. Adjusted for inflation, residential customers in 1892 paid $4.52 (in 1996 dollars) for a kilowatt-hour of electricity, which explains why only the rich could afford the product. But in 1973, that same kilowatt-hour cost residential customers only about 8.4 cents.[3]

Even so, the rapidly falling cost of producing electricity allowed utility companies to earn consistently handsome profits, which made their securities appealing to conservative investors, especially after World War II. Because of these price reductions at a time when prices in the general economy increased, most people viewed the electric utility industry as an exemplary natural monopoly.

But during this celebration of the industry's successes, problems began to crop up that would soon cause severe dislocations in the industry's structure. First came an end to technological improvements in traditional steam-turbine technology. As early as the 1960s, utility engineers realized that the thermal efficiency of power plants seemed to have reached a critical barrier. Though some plants attained 40 percent efficiency, they also exhibited more outages, making them less economical to operate. Many utilities therefore remained content to operate plants that achieved lower efficiencies at higher rates of reliability.

Perhaps more disconcerting, engineers in the 1970s began finding that some huge power plants stopped exhibiting greater economies of scale. Due to increased complexity and the need for redundant systems, especially in nuclear plants, generating units proved less reliable as they grew ever larger. The optimum combination of scale economies and reliability seemed to hover around 600-800 megawatts in the 1970s, with little chance in the near future for further benefits from increasing scale.[4] In short, another barrier to improvements and cost reductions had emerged.

The end of improved thermal efficiencies, along with the end of increased economies of scale, meant that the utility industry could no longer mitigate price hikes in the general economy, as it had done in previous decades. As the cost of production increased, so did the cost and price of power. And when the energy crisis struck in 1973, electricity prices escalated as well, with the average residential customer paying just over 11 cents per kilowatt-hour in 1984. The halcyon days of the utility industry appeared to be over.[5]

The Birth of PURPA

In the tense environment that followed the energy crisis, the federal government stepped in. In his first major policy initiative after taking office in 1977, President Carter called for a "moral equivalent of war" when dealing with energy matters. Congress grudgingly obliged, passing a series of laws in 1978 that encouraged energy conservation, greater energy efficiency, and the exploitation of new domestic energy sources.

One piece of Carter's energy plan, the Public Utility Regulatory Policies Act, sought to revise the way people paid for electricity as a way to stimulate wiser use of the commodity. Most people viewed PURPA as fairly modest legislation that would have only subtle effects on rate designs.

PURPA turned out to have a significant impact on the utility industry, however, although for unanticipated reasons. Tucked into the law was a small section that required utilities to purchase and resell electricity produced by fuel-stingy nonutility generators of power. These "qualifying facilities" included existing industrial firms that produced power for themselves using highly efficient technologies, such as cogeneration equipment, which produces heat or steam in addition to electricity.

A paper company that needs process heat for its manufacturing systems, for example, produces steam in its boilers and sends it through a turbine to make electricity. Instead of venting the waste steam into the atmosphere or a river—the common approach used in utility power plants—the company employs the steam for its industrial processes. In this fashion, the firm obtains double duty from the raw fuel.

Before 1978, such companies could not easily sell excess electricity to utilities, which generally shunned purchasing electricity from outside suppliers. With PURPA in effect, however, utilities were forced to buy surplus electricity at a rate known as the "avoided cost" of power. In other words, utilities had to pay nonutilities a price for power that equaled the utilities' cost if they had produced it themselves. Likewise, PURPA required utilities to purchase power at this avoided-cost rate from companies that generated power from renewable resources, such as wind and flowing water. All in all, PURPA sought to encourage power production from highly efficient sources as a way to reduce the country's dependence on uncertain foreign sources of energy.

Deregulation Arrives

Implementation of PURPA had the unforeseen result of introducing competitive principles into a formerly monopolistic utility system. First, it effectively brought deregulation to the utility generation sector. After all, PURPA enabled nonutility companies to sell electricity to power companies, which had to pay rates that were sometimes tied to the high cost of oil. No longer did utilities monopolize power generation; they competed with other parties that employed unconventional technologies favored by PURPA.

Partly driven by state and federal tax incentives, along with federal support for research and development, entrepreneurs began experimenting with novel forms of small-scale generation—usually smaller than 80 megawatts of capacity. Some of these entrepreneurs spurred innovation in solar photovoltaic systems, while others worked with solar-thermal equipment, which used the sun's heat to turn water into steam for use in conventional steam turbines. Most successful of the renewable technologies, however, was the wind turbine. From 1980 to 1995, entrepreneurs pushed down the cost of wind-produced electricity from 40 cents to just 5 cents per kilowatt-hour, making it competitive with more traditional power technologies used by regulated utilities in several parts of the country.[6]

Bidding for Power

In a second way, PURPA brought another market principle to the utility industry. Though most observers did not believe much nonutility power would be offered to utilities, tax breaks and favorable regulatory rulings encouraged a huge production of nonutility power. Consequently, some utilities found themselves awash with nonutility power.

Complaining because they sometimes paid rates to nonutility generators that were higher than their own cost of production—some rates were fixed to the erroneously forecasted price of oil—utility managers in a few states convinced regulators to approve bidding schemes among qualified facilities. In such schemes, utilities announced their needs for certain amounts of capacity to meet demand, and they asked nonutility companies to offer bids for power at set prices. Utility managers and regulators then chose which nonutility companies would supply that power, using price, reliability, fuel diversity, and other factors as criteria for selection.

When put in practice, the bidding schemes sometimes yielded low-cost power using highly efficient generation technologies. To many regulators, utility managers, and observers, the bidding process appeared to meet the spirit and letter of PURPA, which sought to acquire the most efficiently produced electricity possible. It also introduced market pricing of electricity, another competitive principle being used in a formerly noncompetitive industry. With many producers of power, the forces of supply and demand worked to produce power at reasonable costs and with other favorable characteristics. In such a situation, some observers asked, why do we need regulation?

End of the Natural Monopoly

Perhaps most important, the experience of nonutilities, encouraged by PURPA, challenged a basic rationale for utility regulation—the existence of natural monopolies. For much of the 20th century, observers believed that utility companies constituted natural monopolies because they produced power at the lowest cost, much lower than if competitors vied to produce and sell power to the same customers. But as demonstrated by firms that exploited small-scale cogenerated power and wind-turbine power, others could indeed produce power as cheaply or more cheaply than the utilities could, especially as huge generation technology no longer reduced production costs.

Policymakers thus began to question whether utilities should remain regulated. As Federal Energy Regulatory Commission member Charles Stalon observed in 1987,

> The traditional defense of regulation has been economies of scale. There are no particular economies of scale apparent on the generating side any more, and therefore that argument . . . lacks persuasive force today.[7]

Gas Technology

Buttressing arguments against the natural monopoly rationale for utilities, advances in gas turbine technology occurred swiftly in the 1980s and 1990s, pushing down the production cost of electricity. First developed in the 1930s, gas turbines essentially were jet engines whose rotating shafts drove generators to make electricity. Producing small amounts of power—generally under 30 megawatts—these turbines proved most useful for meeting peak demand for short periods of time. Gas turbines were sometimes difficult to maintain, however, and they usually produced expensive electricity.

But during the Reagan presidency, government funding for research and development on military jet engines soared, and manufacturers quickly adapted improved turbines for power production needs. Consequently, the size of gas turbines grew—with capacities of up to 150 megawatts in the 1980s—and their fuel consumption decreased.[8] Simultaneously, their reliability increased, and the time needed to install them diminished. Not unexpectedly, they became the favorite technologies for companies that sought to install capacity quickly, especially as natural gas prices fell in the 1980s and 1990s.

Gas turbines also became well-accepted among nonutility generators when used in combined-cycle systems—generators in which the exhaust heat from the turbine produces steam that passes through a conventional steam turbine. Such systems attained overall thermal efficiencies of up to 50 percent by the mid-1990s, beating utility plant efficiencies at costs that fell below the average cost of produced by most regulated companies.[9] The experience with this improved technology suggested again that utilities did not necessarily possess the lowest-cost means of production—one of the traditional rationales for utility monopolies and regulation.

Ideologies and Politics

On a different level, many people who held different economic and political philosophies questioned the value of utility regulation. Academic critics of regulation in particular noted that regulation often yielded perverse incentives and results. The requirement to give utility companies ample returns on investment, for example, spurred complaints that some firms acted inefficiently and invested more in capital equipment than was necessary for providing services.[10] And instead of overseeing natural monopoly corporations, regulators in some cases became pawns of industry management. According to some observers, commissioners sometimes made decisions that pleased utility executives with the hope that they would be offered jobs with power companies after their tenure on commissions ended.[11]

But more impressive to policymakers and to the public at large were the apparently successful efforts made to deregulate other industries. Starting in the 1970s, the trucking, securities, natural gas, airline, and telecommunications industries saw retail price regulation dismantled. Consequently, new companies introduced novel services at lower prices than were available in the regulated environment.

The mantra of competition proved unassailable outside the borders of the United States, too. In England, Norway, Chile, and other countries, electricity deregulation came as a natural successor to deregulation of industries that had previously been overseen by stodgy, unimaginative bureaucrats. With the free market, innovative juices stirred, and the public seemed to benefit.

Adopting the rhetoric of the free market, advocates of large users of power stepped forward. Representing large industrial enterprises, groups such as the Electric Consumers Resource Council agitated in the 1980s and 1990s for the end of regulatory intrusions, which, they asserted, caused rates to be higher than necessary.[12] For example, ELCON argued for free access to transmission systems so all generators of power could competitively sell their commodity throughout the nation. Operating in an open market, large customers—and in theory, all customers—could shop around and obtain the lowest-priced electricity.

Energy Policy Act

As pressures for deregulation and restructuring intensified, the Gulf War of 1991 intervened. Though President Bush's administration had begun developing a new energy policy as early as 1989 to deal with the disturbingly large amount of oil being imported into the United States, the war provided the impetus for novel public policy.

When the Energy Policy Act emerged in 1992 after months of compromise, it provided numerous incentives for energy efficiency, renewable energy production, and increased domestic oil production. But it also sought to improve the efficiency of electric power production and distribution. Playing a significant role in molding the legislation, lobbyists for large power consumers sought open access of transmission lines so distant generating companies—especially those generating cheap power from gas-turbine facilities—could compete for consumers' business. At the same time, politicians proclaimed their belief in free-market mechanisms and the elimination of regulation of electricity transactions.

The Energy Policy Act of 1992 took some tentative steps to introduce more market principles into the utility business. Though the legislation did not authorize retail competition for electric power, it permitted competition for wholesale transactions, such as sales of electricity to municipal power systems and regional power marketers. To make these transactions possible, transmission lines would become common carriers available to all parties, such as the newly created electric wholesale generators. This class of nonutility generators did not need to meet the special requirements of PURPA's qualifying facilities, and their existence increased the number of competitors in the generation sector of the utility business. And while the legislation did not give the federal government the right to permit retail competition, it allowed the states to do so. The door to deregulation had therefore been opened.

Despite the apparent attractiveness of deregulation, not all parties favored it. Though welcoming competition—and hoping it would encourage increased use of relatively clean natural-gas-turbine power plants—environmental advocates worried that the end of regulation would mean that some states would abolish requirements for utilities to purchase a portion of their power from renewable energy producers. They also fretted that utility companies, free of regulatory mandates and hoping to reduce their cost of production in a competitive environment, would shun energy-efficiency programs.

Advocates for low-income and residential customers feared that deregulation would mean higher costs for their constituents, while large customers, who had greater market power, could negotiate lower-cost power. In state after state, as legislators and regulators took up consideration of utility restructuring, supporters of continued regulation and deregulation fought over these and other issues.

Restructuring Begins

Deregulation advocates scored their first victories in states where electricity rates exceeded the national average. New Hampshire, for example, had been burdened by high rates because of difficulties encountered by New England utility companies that had built expensive and often delayed nuclear power plants. In May 1996, therefore, state legislators relished being the first to begin a pilot program that allowed 11,000 residents to shop for power.

Power marketers swarmed into the state, trying to woo customers with promises of cheaper electricity from a variety of sources. Some even tried to sell more expensive "green" electricity generated from relatively benign generating technologies such as wind turbines. Legislation passed in May 1996 for retail deregulation for all customers to begin in January 1998, but legal actions by the state's utilities over the treatment of nuclear assets continues to delay full implementation of the law.[13]

Although not the first to pass restructuring legislation, California lawmakers, nevertheless, had a greater impact than those in New Hampshire. Often viewed as a trendsetting state for regulation and policy, California began the process of restructuring in 1994. More than two years of debates among constituents led to a restructuring bill that became law in September 1996. Taking into consideration concerns of environmental advocates and lobbyists for small customers—as well as lobbyists for large users—the law offered totally free markets for electricity by 1998. Though small customers could choose new suppliers of power, they could still purchase electricity from their former utilities at guaranteed discounted prices.

During a four-year period that would end in 2002, customers would pay a "competition transition charge" to help compensate utilities for stranded costs—those costs, such as expensive nuclear power plants, that were made in the regulated environment but that may not have much economic value in a competitive market. Some of the transition charge fund also went to support continuing research on renewable energy technologies and to pay for energy-efficiency efforts that utilities no longer wanted to make.[14]

Other states followed. As of March 2000, 24 states had established policies to allow for retail competition within the next few years.[15] On the surface, the results of deregulation efforts have been positive in states where the laws have already taken effect. Customers in most states have saved millions of dollars by shopping for new suppliers and taking advantage of mandated price cuts. Pennsylvania officials, for instance, think savings in their state would accrue to $1 billion per year if all customers shopped for power.[16]

Moreover, customers have seen their spectrum of choices increase. They can purchase power from "green" suppliers, which offer power generated from clean resources.[17] Alternatively, they can buy from "brown" suppliers, which use older, depreciated fossil fuel plants to produce cheap electricity. Furthermore, some companies have begun bundling services, offering customers one-stop shopping for all their electrical, gas, telecommunications, and cable-TV needs. Supporters of deregulation argued that novel services and options would accompany competition. In several cases, they have been proven correct.

Unintended Consequences

But below the surface, some disturbing and unexpected events occurred as deregulated power sales began. In California, for example, more than 250 companies registered to sell power when the state created a competitive market for electricity in April 1998. Some of the firms, however, had poor or unscrupulous managements. Within a year, the number of new companies serving Californians had dropped to fewer than 10, and customers of the departed firms had bad first impressions of deregulation.[18]

Competition has also been accompanied by major shifts in ownership patterns of power companies. Though the industry had previously seen creation of some large, interstate utility firms, laws passed in the 1930s generally kept them from spreading too far from their home states. Many firms have merged with others and have become behemoths, suggesting to some that competition from new market entrants might be stymied.

Perhaps more disturbing to some observers, several large American utilities have been purchased by foreign utility companies. As recently as March 2000, the British utility giant PowerGen had begun acquiring LG&E Energy Corporation, a Fortune 500 company.[19] And ScottishPower, based in Glasgow, Scotland, now owns PacifiCorp, a large utility company serving customers in six western states.[20]

Despite some unanticipated occurrences, deregulation of the retail sale of electricity appears to be the trend of the future. Consumer expectations of lower prices and new services, along with memories of disappointing experiences with regulation, drive the trend. The White House and Congress, for example, continue to propose bills that would provide a national framework for restructuring, with various requirements for the provision of certain public benefits such as the use of environmentally benign renewable energy technologies. Meanwhile, the states themselves continue to craft laws and regulations to open electricity markets to the forces of competition.

So if you haven't already received any of those annoying telemarketing calls from power providers at dinnertime, you can expect to be hearing from them soon. Electric power restructuring is here...and it's here to stay.■

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NOTES

1. I prefer to use the term *restructuring* rather than *deregulation* because, even in an era when generation and retail sales of power are deregulated, much regulation in the utility system will remain. Transmission and distribution of power will continue to be regulated by state commissions, and plenty of regulations concerning environmental safeguards will stay in place—or be added to.

2. George L. Priest, "The Origins of Utility Regulation and the 'Theories of Regulation' Debate," *Journal of Law and Economics* 36 (1993), p. 296.

3. Richard F. Hirsh, *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System* (Cambridge, MA: MIT Press, 1999), p. 48.

4. Verne W. Loose and Theresa Flaim, "Economies of Scale and Economics of Large Versus Small Generating Units," *Energy Systems and Policy* 4 (1980), p. 43.

5. For more details of the managerial and technical problems encountered by the utility industry, see Richard F. Hirsh, *Technology and Transformation in the American Electric Utility Industry* (New York: Cambridge University Press, 1989).

6. Richard H. Rosenzweig, "The Federal Interest in Electric Restructuring," *Public Utilities Fortnightly* 133 (November 1, 1995), pp. 17-9.

7. Response to members' questions by FERC Commissioner Charles G. Stalon, "Public Utility Regulatory Policies Act," Committee on Energy and Commerce, Subcommittee on Energy and Power (September 22-23, 1987), p. 164; FERC Chairman Martha Hesse agreed in a comment on p. 5. For more discussion of the impact of PURPA, see Richard F. Hirsh, "PURPA: The Spur to Competition and Utility Restructuring," *Electricity Journal* 12 (August/September 1999), pp. 60-72; and Hirsh, *Power Loss*, chapters 4-7.

8. Taylor Moore, "Utility Turbopower for the 1990s," *EPRI Journal* 13 (April/May 1988), p. 7.

9. Dennis Wamsted, "Siemens: New Turbine is World's Most Efficient," *Energy Daily* (January 27, 1995), pp. 1, 4.

10. See Harvey Averch and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint," *American Economic Review* 52 (1962), p. 1052-69.

11. Recent examples of "regulatory capture" are described in Peter Bradford, "A Regulatory Compact Worthy of the Name," *Electricity Journal* 8 (November 1995), pp. 12-15. For a historical view of the influence held by utility companies over regulators, see Hirsh, *Power Loss*, pp. 41-46.

12. In 1999, ELCON's member companies consumed almost 6 percent of the country's electricity supply. *ELCON Report*, No. 3 (1999), p. 8, at <http://www.elcon.org/Documents/Er12_99w.pdf>.

13. New Hampshire's tortuous road toward deregulation is summarized in U.S. Department of Energy, Energy Information Administration, "Status of State Electric Industry Restructuring Activity as of February 1, 2000," at <http://www.eia.doe.gov/cneaf/electricity/chg_str/tab5rev.html>, and New Hampshire Public Utilities Commission, "Electric Choice Update," at <http://www.poweris choice.com/pagesUpdate.html>.

14. California Assembly Bill AB 1890, for amending Chapter 2.3, "Electrical Restructuring," of the state's Public Utilities Code, Article 7, Research, Environmental, and Low-Income Funds, Section 381(c)(1) to (c)(3).

15. U.S. DOE, EIA, "Status of State Electric Industry Restructuring Activity as of March 1, 2000" <http://www.eia.doe.gov/cneaf/electricity/chg_str/regmap.html>.

16. News Release from Pennsylvania Energy Choice Program, "Five Million PA Electric Customers to Receive Instructional Information on Electric Choice Program," September 2, 1999, at <http://www.electri choice.com/public/press.htm>.

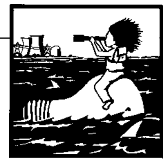
17. One such company, Green Mountain Energy, sells to environmentally conscious customers in California and elsewhere who pay a premium to purchase power generated by wind, biomass, geothermal, and water resources. See <http://greenmountain.com/electricity/products/compare_ca.asp>.

18. Warren W. Byrne, "Green Power in California: First Year Review from a Business Perspective" (February 2000), at <http://www.cleanpower.org/crrp/b.htm/>.

19. James Ritchie, "British Utility Giant to Acquire Louisville Fortune 500 Company" (Associated Press Newswires, February 28, 2000), available from Dow Jones Interactive.

20. The merger was completed in November 1999. See <http://www.scottishpower.co.uk/merger/>.

21. This article condenses many arguments taken from the author's book, *Power Loss*. The author has retained copyright.



Consumer Alert

Congress must act appropriately, or electric utility restructuring will raise prices for the small consumer.

BY MIKE JOHANNS

As the 106th Congress draws to a close, it is clear that private utilities are winning the battle for control of the electric utility industry. At the same time, public power interests are losing key protections traditionally offered them by the federal government. But the real losers in this fight may well be the small customer and communities that have traditionally relied on public power.

What is Public Power?

Public power, delivered through power districts, cooperatives, and municipal electric utilities, exists in every state except Hawaii. One of every four American consumers—almost 70 million Americans—receives power from customer-owned electric systems. These local assets have made enormous contributions to the nation's economic prosperity for more than 115 years. Their local ownership and not-for-profit structure make them quite different from private, for-profit utilities.

That is why public power systems will require different solutions to the challenges of the new marketplace envisioned by restructuring advocates. Many states that have embarked upon the deregulatory path, such as California and Massachusetts, have acknowledged this fundamental tenet.

Because of Nebraska's reliance on consumer-owned utilities, we often include rural electric cooperatives—nonprofit, customer-owned utilities that distribute power in rural areas—as part of a broader public power community. However, there are key legal differences between cooperatives and governmental utilities such as municipal electric utilities, especially on tax and governance issues.

Like public hospitals, public schools, water, sewer, parks, and police and fire departments, public power electric utilities are local institutions that address a basic community need; they operate to provide an essential public service at a reasonable, not-for-profit price, just like any other municipal service. Public power's first and only purpose is to provide reliable, efficient service to customers at the lowest possible cost.

Public power systems are governed democratically through state, regional, and local governing bodies. They operate in the sunshine, subject to open meeting laws, public records laws, and conflict-of-interest rules.

Round One

While comprehensive federal legislation to restructure the electric utility industry remains a top priority for proponents of competition and deregulation, it faces several obstacles in Congress. The lack of legislative days left in the session, internal disagreements among energy committee leaders on strategy, and a lack of consensus on certain key policy issues all make passage of a bill difficult this year. One thing is certain, though; over the next several months, and possibly years, electricity restructuring will receive a great deal of attention from policymakers and interest groups in Washington.

Consumers, however, must also make their voices heard in the debate, for the consumer will perhaps bear the brunt of restructuring. Whatever Congress decides, or if it fails to act, consumers will be affected. So far the results don't appear promising. Congress, which is still smarting from the decade-long fight over telecommunications deregulation, clearly has a daunting task in restructuring the $200-billion-a-year electricity industry. And Congress has only one chance to get it right, as the bill it finally passes will affect consumers for years into the future.

Unless Congress is very careful in crafting legislation, restructuring of the electric utility industry will inevitably drive residential consumer rates higher. Economist and consumer consultant Eugene Coyle believes that specific industries, including electricity, have certain characteristics that force industry participants—in this case utilities—"to discriminate among the customers or to cooperate or illegally collude to set prices, or to do both." In other words, these industries practice price discrimination like that practiced in the airline industry, in which people in hub cities receive greatly discounted fares, while people in remote areas pay higher prices for the same distance traveled.

Because of the economic clout of large consumers, price discrimination inevitably means residential and small business customers will pay more than large industries that receive volume discounts. Therefore, any legislation Congress considers passing must include safeguards against widescale price discrimination that would adversely affect the small consumer, municipalities, and electric cooperatives.

In his recent report *Price Discrimination, Electronic Redlining, and Price Fixing in Deregulated Electric Power*, Coyle notes that the largest customers will be able to switch fuels as prices rise and fall, build their own generating plants, or move to areas where electricity is cheaper. To counter that possibility, electric utility companies could offer such low prices that these large consumers will be effectively locked in to the company.

But those with fewer options, especially low-income customers, will likely be charged higher prices per kilowatt-hour. This means the targets of discrimination will be residential customers and small businesses. Instead of possibly benefiting from a competitive electricity market, small business and residential customers may be forced to subsidize large customers.[1]

Thus, Coyle advises, Congress needs to protect consumers. But Round One of the legislative debate on restructuring has not gone well. Consumers and consumer-oriented organizations in Washington want federal legislation to restructure the electricity industry, but they also want Congress to ensure a truly competitive market and effective wholesale competition by dealing with issues such as inadequate transmission facilities and access to transmission, concentration of generation assets, and manipulation of markets through nonregulated affiliate operations of larger monopolies.

So far, Congress has failed that test. H.R. 2944, the Electricity Competition and Reliability Act, approved by a House subcommittee toward the end of 1999, does not accomplish these goals. Many key government officials and outside critics share this view. Energy Secretary Bill Richardson, for example, voiced White House opposition to the bill, saying that it "fails to include many of the provisions necessary to promote more reliable, efficient, and competitive markets." James Hoecker, chairman of the Federal Energy Regulatory Commission, the industry regulator, claimed the bill "represents an unfortunate retreat from the goal of a competitive, efficient, and transparent wholesale market ."[2]

This is not a strong beginning, but it is not too late for Congress to act appropriately. H.R. 2944 now resides in the full House Commerce Committee, which has jurisdiction over electricity legislation. All consumers—even those from states with relatively low-cost electric rates—can benefit from competition in the wholesale electricity market, but if Congress does not establish an effective framework to ensure that wholesale competition works properly, we are heading for trouble.

Governors' Alliance

Today, nearly half the states have deregulated all or part of their respective electricity sectors. Twenty-four states representing nearly 60 percent of the U.S. population have passed legislation or regulations designed to foster competition. Protection against market abuses and fraudulent practices, limits to concentrated ownership of generation and transmission resources, and flexible aggregation programs in state laws have all been designed to promote a more competitive environment.

Before we rush headlong into yet another federal experiment in the deregulation of an essential public service, however, we should pause and take stock of the legacy of prior initiatives, recognizing that the absence or reduction of regulation does not in itself necessarily increase competition. Without the proper market characteristics—such as a variety of willing buyers and sellers, the ability of those buyers and sellers to reach each other, and access to transparent and comparable information—competition will not develop and consumers will pay the price. This is certainly the case in rural Nebraska, where deregulation could make the cost of electricity soar in remote rural areas. Can we realistically expect electric industry competition when population density in some rural areas is less than two customers per mile of line?

Surprisingly, however, larger cities may also feel the pinch of higher prices from unregulated competition. Just across the Missouri River from Omaha, in Council Bluffs, Iowa—population 54,000—the local investor-owned utility tried to open the electric market to other suppliers. Not a single utility—other than a subsidiary of the local utility—wanted to compete for customers in this first test of electricity competition in Iowa.

In 1997, six governors formed an alliance to ensure that federal initiatives do not disadvantage the millions of Americans who are served by locally and consumer-owned electric utilities. The Governors' Public Power Alliance is a bipartisan organization made up of governors from Tennessee, Nebraska, Alaska, South Dakota, Puerto Rico, and Washington.[3] These are states—or in Puerto Rico's case, a commonwealth—where public power has traditionally helped ensure that small customers and those in remote rural areas have adequate electric service.

The alliance believes that a key element of any federal policy should be a commitment to respect state and local decision making and that it is inappropriate for the federal government to preempt state and local restructuring efforts. However, several issues, including nondiscriminatory access to the interstate transmission network and the prevention of monopolistic abuses in the wholesale power market, are solely within federal jurisdiction and must be addressed to open the doors to competition. Without the requisite balance of state and federal cooperation, a fair, truly competitive marketplace in electricity may not develop.

Nebraskans have already borne the brunt of deregulation in other sectors. Airline deregulation has resulted in a dramatic loss of air service in rural Nebraska. In the communications industry, a significant rate shift is now well under way, and the trends are already clear: residential customers will end up paying more than large businesses. Worse yet, in some rural areas, there is no access to advanced telecommunications technology at any price, since companies prefer to target urban markets. Lack of access to the telecommunications grid could compromise the ability of rural communities to improve business opportunities, obtain access to state-of-the-art healthcare, and obtain educational opportunities available through the Internet.

Tennessee, like Nebraska, has special concerns about restructuring. With few exceptions, Tennesseans receive electricity from the public power community: municipally owned and operated, locally regulated electric utilities, or electric cooperatives. For example, Memphis, Nashville, Knoxville, Germantown, Covington, and Tullahoma are all public power communities in which municipal utilities purchase power generated by TVA.

In 1997, the Tennessee General Assembly created a special joint committee to study electricity restructuring. The committee continued through 1998 to examine the anticipated impact of restructuring on consumers. In 1999, the Tennessee Regulatory Authority issued a report discussing 10 topics to consider in restructuring.[4] These include reliability, market power, and taxes, as well as local control and other regulatory issues. Tennessee wants to determine for itself the best way to assure continued availability to its citizens of reliable, low-cost electric power in the event that deregulation brings strong retail competition from outside the TVA grid.

Nebraskans likewise have a longstanding tradition of enjoying the benefits of public power. At the beginning of the century, Republican Senator George Norris fought to create public power for all Nebraska to give consumers local control, reliable service, and low rates. As a result, every resident receives electricity from a municipality, a public power district, or a rural electric cooperative. No other state can make that claim. In fact, it was Senator Norris who introduced legislation to create TVA in 1933.

Nebraska was a pioneer as well in deregulation of the wholesale electric industry. In the late 1960s, long before the Energy Policy Act of 1992, Nebraska had wholesale wheeling, which allows one utility to purchase electricity from a distant utility that then delivers, or wheels, the electricity to the utility that operates the transmission network. Today, that pioneering tradition continues, and Nebraskans are better off because of it.

Still, like so many other states, Nebraska is studying its own options for restructuring. The state legislature recently approved a bill that would monitor the progress of national and state restructuring activities and their possible impact on Nebraska. This could lead Nebraska to create its own plan for retail competition.

Restructuring Principles

While restructuring the electric utility industry and introducing competition may give consumers new choices from electric power providers, consumers have always had a choice between creating their own public power systems or awarding franchises to private power companies. We believe this choice should be maintained for all Americans.

We are still concerned that consumers served by locally owned electric systems will be overlooked in federal legislative and regulatory proposals. That is why the Governors' Alliance adopted several principles to guide our analysis of federal efforts to restructure the industry.

- **Autonomy.** A cornerstone of federal policy should be a commitment to respect state and local decision making and not attempt to overrule it. For example, several states have established renewable energy goals and established funding mechanisms for projects that benefit the public good. The federal government need not mandate similar programs.
- **Competition.** Certain issues are solely within federal jurisdiction and must be addressed to open the door to retail competition and foster the development of competitive markets. These issues include taxes, reliability, and market power—the ability of the transmission owner, for example, to deny or restrict transmission access to its competitors.
- **Barriers.** Federal barriers to competition should be eliminated. These barriers include restrictions found in the federal tax code, existing levels of market power, and confusion over federal and state roles.
- **Abuse.** Federal legislation is necessary to establish additional protections for consumers against the establishment and abuse of market power.

Several of these same principles, including provisions that allow a municipality to aggregate—or group—its customers, are found in various federal legislative proposals. Clearly, numbers count; five communities purchasing power together should be in a stronger position than any single community.

Off to a Bad Start

These principles are lacking in H.R. 2944 the only restructuring legislation approved by a congressional panel thus far. The bill is rife with flaws. The measure contains virtually no provisions to protect against market power abuses. In addition, it makes no attempt to define the limits of state and federal jurisdiction, giving private utilities full power to generate, transmit, and sell power at whatever price the market will bear. There are no provisions for federal oversight of mergers, which may allow large monopolies to corner a large market.

The bill also fails to address the question of who pays for economic losses from capital investments, such as failed nuclear plants, and other hidden costs—known as stranded costs—that have under public power been absorbed by federal or state agencies. And there is no mention of regional transmission organizations, which are independent entities consisting of transmission owners and users in a given state or region. The development of regional transmission organizations is a critical factor in breaking the monopolist's hold on access to the transmission network.

One critic said H.R. 2944 would simply deregulate the monopolies rather than encourage competition. Numerous national organizations representing various stakeholders also opposed the bill. Americans for Affordable Electricity, the American Public Power Association, Consumer Federation of America, the Electricity Consumers Resource Council—a group representing large electricity users—and the Electric Power Supply Association all agreed that the bill does not establish an effective framework to ensure that wholesale competition works properly. Instead, these groups assert the bill makes it easier for large companies to increase their monopoly power and grow with fewer competitors and very little accountability.

One Step Back

If consumers are to receive the benefits promised by electricity competition, certain federal barriers must be removed. For example, new entrants into competitive generation markets must be given the ability to interconnect to the national grid, and the federal tax code must be updated to account for changes in energy policy.

The tax code should not restrict entry into competitive markets by placing severe financial punishments on operations. In addition, federal oversight agencies, including the Federal Energy Regulatory Commission, must be given authority to help implement an effectively functioning marketplace.

FERC Chairman James Hoecker agrees. He says that H.R. 2944 "moves in a direction that is contrary, not only to Commission policy, but to economic and operational developments in the marketplace itself." FERC Commissioner William Massey also takes exception to the measure.

Massey, for example, has voiced concerns over the bill's deficiencies in clarifying FERC authority over power transmission. "Different transmission rules set by individual states will create seams between states, resulting in discriminatory access in favor of in-state load, and...sharp balkanization of the markets," he says.[5]

Massey compares the transmission network to the highway system. He often uses the famous Washington Beltway, I-495, for illustration. During times of extreme traffic congestion—practically a daily occurrence—when only one lane is available, what would happen if Virginia transportation authorities suddenly decide to favor Virginia vehicles? Traffic from the District of Columbia, Maryland, and other states would be left helpless.

But then suppose Maryland decides to take the same action. Outrageous? Certainly, but if the same policies were followed in the electricity industry, similar disruptions to commerce would occur, Massey asserts.

In the absence of federal legislation, Massey suggests that Congress support the intent of FERC Order No. 2000, its Final Rule on regional transmission organizations (RTOs), issued in December 1999.[6] The order, a critical and positive development in the electricity industry, adopts a voluntary approach to RTO participation and initiates a regional collaborative process to foster quick RTO formation. Ultimately, FERC does not directly compel any transmission owner to join an RTO, but provides a veiled threat of further consequences for any noncomplying utilities.

Other critics claim H.R. 2944 actually makes it easier for large monopolistic companies to increase their monopoly power and grow unfettered with less regulation and fewer competitors. For example, the bill was amended to strip FERC of its authority to review mergers from the point of view of their effect on competition and would force FERC to review mergers within a new, tighter timeframe. If the timetable were not met, the merger would be approved automatically.

H.R. 2944 also calls for the repeal of the Public Utility Holding Company Act, the 1935 antitrust legislation that was designed to combat the anticompetitive, anticonsumer, and anti-investor activities—such as anticompetitive consolidation, inadequate financial disclosure, abusive affiliate transactions, and deceptive accounting methods—that several large holding companies were practicing in the 1920s and early 1930s.

PUHCA is still one of the few federal statutes with consumer protection provisions, and companies subject to the law should be relieved of its restrictions only when effective competition is in place as an alternative.

Soon after passage of the bill, Republicans and Democrats criticized H.R. 2944. Republican House member Steve Largent from Oklahoma, a key member of the subcommittee who ended up voting for subcommittee passage, said the bill "left us a far cry from effective competition. I'm confident in full committee we'll be able to craft legislation that achieves an open, transparent and competitive market." Massachusetts Representative Ed Markey, a top Democrat with long experience in federal energy legislation, declared the bill would need to be completely rewritten when it reached full committee level.

Essentially the only group to fully support the bill was the Edison Electric Institute, the national trade group for private, investor-owned utilities. Environmental organizations, small business groups, and residential customers opposed H.R. 2944, and not one consumer group supported the legislation. Commerce Committee Chairman Tom Bliley, a major supporter of competition in the electricity industry, also expressed strong reservations about the bill.

Private-use Restrictions

One positive aspect of H.R. 2944 that is absolutely critical to the public power community has been the adoption of the so-called private-use-tax language, which provides relief to municipal utilities when using tax-exempt bonds in the transition from a regulated industry to open competition. Substantial portions of generation, transmission, and distribution facilities owned by public power systems are financed through the sale of tax-exempt bonds.

These bonds, like bonds for all types of governmental purposes, carry with them restrictions on the amount of private use allowed for those facilities. The general public is supposed to realize the benefit of lower prices from the use of tax-exempt financing, not individual private interests. Individualized contracts that convey to a specific customer a special price that is not available to all consumers in a given class and the transmission of for-profit electricity over nonprofit lines are examples of private use under the federal tax code.

While sound tax policies may warrant certain restrictions on private use of public facilities, public power facilities have been singled out for unduly restrictive treatment, including the imposition of additional restrictions under the Tax Reform Act of 1986.

The private-use restrictions—which previously had a negative but tolerable impact on the financing of community-owned electric output facilities—in their new form in a new competitive environment will restrict the financing of governmental facilities far beyond the intent of Congress as expressed in the Tax Reform Act of 1986.[7]

Today there is more than $70 billion in outstanding debt held by the municipal electric community across the country. To provide relief to millions of bondholders, Senators Slade Gorton and Bob Kerrey introduced S. 386, the Bond Fairness and Protection Act, early in the 106th Congress. The bill is a reasonable solution to the problems posed by the private use restrictions on present and future public power bonds. A companion bill, H.R. 721, has been introduced in the House of Representatives. The two bills, provisions of which were also included in H.R. 2944, enjoy numerous cosponsors in both chambers and await action by the tax committees.

The relief provided by the bills is basically a removal of the private-use restrictions from remaining debt in exchange for relinquishing the ability to issue new tax-exempt debt for competitive generation projects. The bill allows municipal systems flexibility in retaining existing customers through individual contracts and turning their transmission facilities over to an independent regional transmission operation without fear of violating the private use rules.

Winners and Losers

Chairman Bliley, Representative Barton, and others will continue to play key roles in the development of electricity restructuring policy. But the House will not be alone in pursuing federal legislation. The Senate Energy and Natural Resources Committee, led by Alaska Republican Frank Murkowski, will take the Senate lead. But Senator Murkowski, who introduced a proposal of his own, acknowledges that consensus on a comprehensive bill will be difficult to obtain, and Senate approval is highly unlikely this year.

In Congress, the monopolists clearly won round one. If public power is to survive, and if a truly competitive, fair marketplace can be created, consumers must make electricity restructuring one of their priorities. But Congress must act appropriately, or Eugene Coyle will be right: strong monopolies will rise up, and the small out-of-the-way consumers will lose out in the end.■

Mike Johanns is the governor of Nebraska and co-chair of the Governors' Public Power Alliance.

NOTES

1. Eugene P. Coyle, *Price Discrimination, Electronic Redlining, and Price Fixing in Deregulated Electric Power* (Washington, DC: American Public Power Association, 2000), p. xi.

2. FERC Chairman James J. Hoecker, in a letter to Rep. Edward Markey, December 23, 1999.

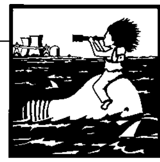
3. Don Sundquist (R-Tennessee) and I serve as co-chairs of the Governors' Alliance. Tony Knowles (D-Alaska) is vice chairman. Other Alliance members are William J. Janklow (R-South Dakota), Pedro Rosselló (New Progressive Party-Puerto Rico), and Gary Locke (D-Washington).

4. Tennessee Regulatory Authority, *First Report on Electric Deregulation in Tennessee*, (Nashville, TN: TRA, January 1999).

5. William L. Massey, "Legislation for Vibrant Competitive Markets," *Energy Daily Forum* (February 15, 2000).

6. Order No. 2000, *89 FERC Statutes and Regulations* ¶ 61,285 (Final Rule issued December 20, 1999) <http://www.ferc.fed.us/electric/rto.htm>.

7. Tax Reform Act of 1986, Pub. L. No. 99-514, codified as amended in scattered sections of 26 U.S.C.



Powerful Positions

Environmental leadership will help forward-thinking electric suppliers outdistance the competition.

BY DIRK FORRISTER AND DANIEL J. DUDEK

At the dawn of the 21st century, America's power sector is undergoing a dramatic transformation from old-fashioned monopolies to a modern, competitive industry. Change is coming at a rapid clip, driven by industry restructuring and consolidation, air quality challenges, and global climate change policies. The environmental challenges, will serve as a defining issue for power firms in this competitive new world: the firms that manage these changes the most effectively will be best positioned to see their market share grow in the next century.

Retail Competition

At present, nearly half of the states have adopted plans for retail competition in electricity, and more are moving forward every month.[1] From Massachusetts to California to Texas to Maryland, new laws are being implemented that give power customers the ability to vote with their wallets for their preferred energy sources—including an array of choices that are environmentally superior to the old monopoly's fuel supply. For virtually the first time in any industry, suppliers will directly compete on the environmental characteristics of their goods and services. Most state deregulation bills have included environmental protections such as renewable energy portfolio requirements, energy efficiency funding, and environmental labeling requirements.

At the federal level, President Clinton and key members of Congress have advanced legislative proposals to introduce retail electricity competition nationwide.[2] The administration's bill includes a solid package of environmental reforms like those adopted by so many states,[3] but the leading congressional proposals do not. After subcommittee skirmishes in the House of Representatives, legislation has been stalled for weeks in the full Commerce Committee, which makes the already dim outlook for enactment of any bill during this election year even dimmer.[4]

In the Senate, the pace is even slower, with a schedule for action only beginning to emerge. The absence of environmental provisions is now understood to be among the failings in garnering a winning legislative majority. One key Republican senator pledged to block any progress on the Senate floor unless a package of environmental reforms is included in the bill.[5] Even though time is running out this year, the current legislative activity increases the likelihood that a new Congress and a new administration will rally around a bill early in the next session.

Importantly, both of the leading presidential candidates support retail competition, and both have reason to support strong environmental provisions. Governor George W. Bush, the apparent Republican nominee, cites the recently enacted electricity competition legislation in Texas as one of his leading environmental accomplishments.[6] That law will drive a 10-fold increase in renewable energy in Texas and force additional cleanup of sulfur dioxide and nitrogen oxide beyond current federal minimums at aging fossil-fueled power plants.[7]

Vice President Gore has championed the administration's electricity proposal and its package of environmental provisions. He recently announced a new initiative to drive a further round of cuts in emissions from power plants—notably nitrogen oxide, sulfur dioxide, carbon dioxide, and mercury—which he said should be achieved through market-based incentives, like emissions trading, that would assure a cost effective result.[8]

These activities suggest that it is just a matter of time until American consumers have a choice of power supplier, in much the same way they can now choose telephone service from an array of competitive providers. These reforms should also help the environment, provided the right policies are in place to make sure "green" offerings can thrive. Recognizing the change that is underway, major regional power companies have launched national advertising campaigns to promote brand-name recognition, emphasizing their dedication to customer service and the cleanliness and reliability of their power. Clearly, their corporate communications departments understand what customer choice will mean and which attributes customers will value as they weigh offers from competing energy companies. Attention to environmental concerns will be a key selling point in this new market.

U.S. Air Quality

As electric power competition emerges, the U.S. Environmental Protection Agency is intensifying its implementation of the Clean Air Act. EPA's air quality programs address a variety of pollutants that cause urban smog, soot particles, toxic air pollution, acid rain, and poor visibility in parks. Parts of the act are working well, but other key parts are embroiled in litigation. Power firms are grappling with how to position themselves competitively to win the race for customers with this complex array of pollution measures chasing them.

■ **Acid rain and sulfur dioxide.** On the positive side, the federal acid rain program has prompted power companies to cut emissions of sulfur dioxide ahead of schedule and at a fraction of the predicted cost. Most observers attribute this success to the program's use of emissions trading, where firms achieving extra reductions can sell them on the open market to other firms that face higher costs of control. Allowances are trading in the market between $100 and $150 per ton, a fraction of the projected cost that ranged from $309 to $981.[9] In addition, firms have banked excess emissions reductions of more than 7 million tons since the program began in 1985, which is a remarkable environmental success.

■ **Urban smog and nitrogen oxide**. Unfortunately, progress on nitrogen oxide—a major contributor to smog, acid rain, and other environmental problems—has been tied up in the courts. After years of effort, EPA was unable to reach agreement among states, industry, and environmental and labor groups on how to reduce the regional transport of nitrogen oxides, which travel on prevailing winds from the Midwest to the Northeast, making it hard for downwind cities to control smog. On March 3, 2000, the federal court of appeals for the District of Columbia Circuit largely upheld EPA's program requiring major seasonal cuts in nitrogen oxide to address interstate smog pollution in the eastern United States.[10] EPA's initiative will require about a 1 million ton cut in nitrogen oxide pollution during the summer ozone season in 19 eastern states and Washington, D.C.[11] These states will likely achieve most of their required reductions from the electric utility sector. Consequently, EPA's program will very likely entail substantial cuts in nitrogen oxide emissions from power plants.

Although the courts clarified the *how* of implementation, litigation continues on the *how much* required in the new ambient air quality standards for ground-level ozone and fine particles that EPA established in 1997.[12] After EPA proposed the new standards, industry opponents challenged them, asserting that they were too drastic and costly.[13] On May 14, 1999, a federal appeals court ruled in favor of industry and returned the air quality standards to EPA for further review, asserting that Congress was not allowed to delegate so much authority to EPA in setting environmental requirements.[14] This arcane theory called the *delegation doctrine* has not been accepted by the Supreme Court since two 1935 cases, and as a result the Supreme Court has accepted the government's request for review.[15]

In its quest to speed the cleanup of smog, EPA is implementing the pre-existing ozone standards in a number of major metropolitan areas, and these standards are spurring significant reductions in nitrogen oxide emissions. To ensure progress in cleaning the air, EPA is also working to enforce the older ozone standard in a number of areas across the country which are currently not meeting the standard while the Supreme Court reviews the dispute over the new standard.[16] In December 1999, EPA announced that the ozone air-quality plans for various serious and severe ozone areas were deficient. The agency called on state air-quality officials to make cuts in nitrogen oxide pollution in a number of major metropolitan areas.[17] Again, power plants are attractive targets for cuts in these major cities. The bottom line is clear. Firms are increasingly aware that no matter what action the Supreme Court takes, stricter controls are coming.

■ **Visibility, sulfur dioxide, and nitrogen oxide.** Even with significant cuts in sulfur dioxide and nitrogen oxide resulting from the ozone and acid rain programs, in some areas air pollution seriously impairs visibility in national parks. On July 1, 1999, EPA published a new program required by the Clean Air Act that will cut haze to improve visibility in 156 national parks and wilderness areas across the country, including the Grand Canyon and Great Smoky Mountains National Parks.[18] This program will affect sulfur dioxide and potentially cuts in particulate matter and nitrogen oxides at older electric-generating units.

■ **Fine particles, nitrogen oxides, and sulfur dioxide.** Even the visibility program is not likely to be the last word on sulfur dioxide and nitrogen oxide cuts. EPA is on track to complete a review of the fine-particle standards by 2002 regardless of the outcome in the legal wrangling over the 1997 ambient standards for fine particles. The fine-particle standard, whether revised or left intact, will force even further cuts to protect public health, since fine particles are believed to cause serious respiratory illness in humans, especially in children and the elderly. This time around, EPA's underlying record will be further bolstered by fine-particle monitoring data from across the country, which will reveal how many Americans are exposed to unhealthy concentrations of fine particles.

■ **Enforcement initiative.** As air quality programs are implemented, EPA's Enforcement Office seeks to force pollution reductions in power plants as a remedy for violations of long-standing clean air rules. In the fall of 1999, EPA launched a sweeping enforcement action against eight power companies for alleged violations of the Clean Air Act's new source review provisions.[19] The Act requires that when firms make major modifications to large stationary sources of pollution, including coal-fired power plants, they must conduct a review to ensure that the renovated plant will meet the same, tougher modern pollution standards as new plants. The theory is that some plant modifications are so substantial as to equate to a new plant on the old site, in the old shell.

In this enforcement initiative, EPA charged that major modifications were made at certain plants without conducting the new source review; the firms deny the charges. In addition to stiff monetary penalties, the actions seek major cuts in nitrogen oxide and sulfur dioxide to make up the reductions that the utilities should have made because of the new source review.

As the Clinton administration's tenure draws to a close, many observers are turning their attention to the presidential campaign in hopes that a new cast of characters in the White House, EPA, and the Justice Department will change the Agency's course and ease up on clean air programs.

Others, however, feel that the die is cast, that no matter who ends up as the next president, companies are going to be forced to reduce conventional pollutants. Their view is supported by an unprecedented, concerted grassroots environmental campaign to encourage the electric utility sector to clean up air pollution. Moreover, the lessons of the 104th Congress and the 30-year implementation record of the Clean Air Act strongly suggest that the public would not tolerate congressional or administration attempts to weaken or roll back either the enforcement actions or clean-air regulations.

Global Climate Change

Aside from clean air issues, yet another major environmental challenge is on the rise for power companies, which sense their fate. The United States is the world's largest greenhouse gas emitter, and power companies are among America's largest emitters, representing about a third of total emissions. There is growing pressure on the international stage, where firms see their future growth markets, for U.S. power companies to become leaders in addressing global climate change.

The emerging scientific consensus is that rising concentrations of greenhouse gases will cause serious changes to the Earth's climate. Every five years the Intergovernmental Panel on Climate Change, an international panel of scientists set up by the World Meteorological Organization and the United Nations Environment Programme, completes major assessments of the science of climate change. The third assessment, due early in 2001, will likely underscore the strength of this consensus, including important new information on regional impacts of the changing climate.

While the danger for particular locales cannot be accurately forecast, there are large hazards that become more likely over time and are worth guarding against. For example, scientists warn of higher temperatures, rising sea levels, more frequent episodes of severe weather—particularly floods and droughts—and the potential for the spread of certain infectious diseases and pests.[20]

Globally, the public is pressing for action. In December 1997, in Kyoto, Japan, the nations of the world agreed that the Rio Treaty's non-binding commitments were inadequate to address global warming and agreed upon the Kyoto Protocol as the next step for developed nations to take in reducing emissions. The protocol contains binding emissions targets combined with an array of economically flexible measures to assure that reductions can be made cost-effectively. A number of nations are beginning to adopt policies and measures to comply with the Kyoto Protocol[21] even before it is in force by 2002.[22]

As part of the flexibility contained in the Kyoto Protocol, the international community embraced the concept of international trading in emissions. These trades offer both participating firms a good deal—lower cost for compliance—and the environmental benefit is the same in the atmospheric global commons. In the end, this approach helps justify setting higher environmental goals, and U.S. power companies may enjoy a competitive advantage here: they are among the world's most experienced emissions traders, thanks to the federal acid rain program.

Ironically, though the United States played a major role in gaining international acceptance of the concept of trading in greenhouse gases in Kyoto, it is now among the slowest to develop domestic trading policies. Congress has made clear that it is not interested in adopting a greenhouse-gas control regime anytime soon. But abroad, the idea is picking up steam. Initially, nations were skeptical of whether the idea would work for them. But now that more of them have learned how it really works, country after country is developing domestic trading programs and plans to participate in the new global greenhouse-gas market.

■ **United Kingdom.** Prime Minister Tony Blair announced plans to impose an energy tax as a way of achieving greenhouse gas reductions. Concerned about the political momentum of this proposal, industry requested that it be offered the option to voluntarily adopt a cap-and-trade program, which allows emissions reductions as an alternative to the proposed tax. Firms would agree to strict limits on their emissions in return for the flexibility to achieve cuts using a trading system.

Blair accepted these overtures.[23] On December 21, 1999, the U.K. government announced an agreement with 10 major industry sectors for voluntary emissions reductions using energy-efficiency technologies and emissions trading. Compliant companies receive up to an 80-percent discount on the proposed tax.[24]

■ **France.** Prime Minister Lionel Jospin has announced a sweeping program of actions, also built around an energy tax, to move his nation toward its Kyoto target.[25] Again, industries are seeking a cap-and-trade alternative to the tax, and the French government is considering which sectors might appropriately take that approach.

■ **European Union.** On March 8, 2000, the European Commission, the governing body of the European Union that helps coordinate policies among member states, launched a consultation process aimed at exploring how emissions trading might fit with other action plans emerging in the European Union.[26] Although a number of other policies and measures are likely to emerge, the Commission expects that all available pollution-reduction tools, including international emissions trading, will be needed to meet the Kyoto obligations cost effectively.[27]

■ **Norway.** On December 17, 1999, Norway announced the outline of a domestic greenhouse gas cap-and-trade system that would go into effect in 2008, when the Kyoto's emission reduction goals begin to take hold.[28]

■ **New Zealand.** New Zealand's new government has also announced its intent to ratify the Kyoto Protocol and to work toward a goal of bringing the protocol into force in 2002.[29]

With these and other developments, Environmental Defense counts at least 19 countries that are in the process of examining opportunities for developing domestic emissions-trading systems or are expanding legal frameworks to establish trading programs.

Yet progress in the United States has stalled. President Clinton and bipartisan leaders on Capital Hill have signaled their preference for using emissions trading, most notably in proposals for "credit for early action" taken to reduce greenhouse gases.[30] But legislation has not moved past hearings. In addition, President Clinton, in his 1999 State of the Union Address, called on Congress to adopt a broad suite of tax incentives and international programs aimed at deploying new technologies to address climate change.[31]

Congress has yet to embrace these programs, even though this agenda is not as aggressive as many environmental activists want. Still, the drumbeat for action in the United States continues and is likely to intensify, particularly as members of Congress face the voters in November. After suspending his presidential campaign, Senator John McCain—who was unprepared on the campaign trail for the steady stream of questions about global warming from young people in town meetings across the country—returned to the Senate to chair hearings on the science of global warming.[32]

Private-Sector Initiatives

It isn't just government that is moving to address climate change. Even more dramatic change is underway in the private sector. Major multinational corporations have announced serious commitments to stabilize climate change and have introduced internal programs to meet them.

BP Amoco, for example, has committed to a 10-percent reduction of carbon dioxide and methane emissions below 1990 levels and is implementing this commitment through an internal emissions-trading system developed with the help of Environmental Defense.[33]

Royal Dutch Shell has also developed an internal greenhouse-gas trading system, which it will use to meet its corporate commitment of reducing emissions 10 percent below 1990 levels beginning in 2002.

The DuPont Corporation has committed to reducing its emissions by 65 percent below 1990 levels and has noted its intent to begin trading some of these reductions.

These are but a few among the growing number of corporations that recognize that a sustainable financial future depends upon a sustainable greenhouse gas policy. On the global stage, these kinds of partnerships are already making a difference. There is a ripe opportunity for major global power companies to add their names to the list of world leaders on climate change.

Industry Consolidation

As competition and environmental challenges grow, power companies are rapidly consolidating and diversifying. Electric utilities like Duke Energy and Houston Light and Power now own natural gas pipelines. Natural gas firms like Enron and Dynegy now own electric utilities. Traditionally clean-fueled California power companies like Southern California Edison and Pacific Gas and Electric now own old coal-fired generation plants in the industrial Midwest and New England. As a consequence, the traditional geographical boundaries separating major industry players are blurring. Southern Company, which operates out of Atlanta, has historically owned high-polluting power plants in upwind states in the South that contribute to air quality problems in downwind states in the Northeast. But now, they also own cleaner power plants in the downwind states, as well as pristine natural gas plants in California. They must answer to local officials and congressional delegations from all three regions, and they are increasingly taking notice of their emerging national reputation as a power producer.

If this picture were not already complex enough, there is yet another dimension. Power companies are globalizing, and a number of large energy systems are being privatized by their respective governments. Meanwhile, U.S. firms are taking equity positions in power operations abroad like never before. Power giants like Southern Company, Duke Energy, and Enron, for instance, now base nearly half their assets in other countries. Other power giants, like PacifiCorp, are majority owned by foreign companies, in this case Scottish Power. These global power firms understand the importance of a clean environmental record.

Strategic Goals

At the White House Conference on Climate Change, held at Georgetown University in the fall of 1997, President Clinton asked a panel of industry executives their opinion of the dire economic predictions of some industry analysts regarding the cost of addressing climate change. Tom Casten—the CEO of Trigen Corporation, a leading independent power developer—responded in rapid fashion: "Mr. President, I'm an entrepreneur. When people show me problems, I see opportunities."

As competition approaches, many companies are reverting to litigation as their preferred approach for handlinig environmental problems. Against this array of market and environmental policy development, many companies are oddly enough still stuck in their old ruts and are missing opportunities. Rather than getting on with the cleanup, these firms are pursuing round upon round of legal appeals and are losing time and money in court proceedings. They may also be allowing market opportunities to slip away. Instead of getting tangled in the courts, these companies could be more profitably devoting their resources to assessing their strengths, shoring up their weaknesses, and wooing new customers in a deregulated environment.

The litigation strategy has a variety of costs. Besides the direct costs associated with legal fees, firms that litigate rather than comply are establishing their brand image. They are distinguishing themselves as high-profile opponents of clean-air programs aimed at reducing urban smog and cutting haze in premier national parks. While litigation may succeed in slowing the environmental machinery in order to prolong planning, it is unlikely to significantly alter the outcome. The one constant since passage of the modern Clean Air Act in 1970 is broad-based public support for steady, continuing progress to cut air pollution and deliver cleaner, healthier air. Although this approach keeps attorneys in business, it also abandons real leadership and compounds uncertainty.

Power executives know that an aggressive strategy is the only approach that makes sense and allows companies to wrest some measure of control over their future.

An aggressive 21st-century environmental strategy would meet several goals. In particular, it would

- **seize** entrepreneurial opportunities to maximize the economic gain for the company by achieving environmental improvements with market-based approaches that put it ahead of the curve on compliance,
- **minimize** the economic uncertainty and unpreparedness by creating a crisp vision of the path forward, and
- **assure** long-term viability of the firm's economic future and customer base by demonstrating a corporate image of environmental leadership that promotes name recognition and brand loyalty among its customers.

Assessing Options

The potential outcomes of current lawsuits combined with EPA's implementation of air-quality programs are likely to include serious new control requirements for nitrogen oxide and sulfur dioxide for several reasons. First, the recent judicial decision affirmed EPA's call for major nitrogen oxide reductions in the eastern United States.[34] Second, EPA's sweeping power plant enforcement initiative could well prompt additional reductions in nitrogen oxide and sulfur dioxide. And third, substantial cuts in sulfur dioxide will likely be required under the national fine-particle standards and haze program.

No one expects these clean air requirements to go away, and in all likelihood they will be enhanced with greenhouse gas controls in the next few years. In addition, mercury is on the table as a toxic pollutant likely to need more stringent control. Given these trends, it is essential that companies develop comprehensive, aggressive strategies.

Assessing these strategies for dealing with conventional air pollutants is a hot topic in many power companies' environment, safety, and health divisions. Far too often, however, greenhouse gas assessments are either not included or are conducted with inadequate vigor.

Several years ahead of its time, the Tennessee Valley Authority conducted a little heralded review that assessed its climate change options. We at Environmental Defense participated in this study as peer reviewers and as part of a group representing a cross section of interested constituencies. The study revealed several important lessons:[35]

- **Investments** in conventional pollution equipment like scrubbers proved wasteful in climate change mitigation. In fact, they increased greenhouse-gas emissions by requiring additional energy to run the pollution-control equipment.
- **Aggressive** reductions in greenhouse-gas emissions were much cheaper if flexible approaches were available. These approaches include the flexibility to choose which greenhouse gases to control, the option of sequestering carbon in forests or other agricultural sinks, and the option of investing in international greenhouse-gas reduction projects.
- **Banking** was crucial to managing greenhouse-gas pollutants effectively. In banking, companies reduce pollutant emissions early on, essentially exceeding requirements, as a way of gaining flexibility to use the banked reductions later. For a problem like global warming, where greenhouse gases persist for hundreds of years in the atmosphere, it is acceptable to allow flexibility in timing, such as banking emissions for later use, without compromising the environmental integrity of the approach.

Absent flexible approaches, such as emissions trading, sequestration, and banking, the more significant emissions-reduction scenarios failed. TVA's computer model simply could not find an affordable result, given its assumptions.

Integrated Strategy

A recent development offers useful insight as to where the solutions to these complex problems may lie. On February 29, 2000, EPA entered a settlement of its enforcement action against Tampa Electric Company. In the agreement, TECO agreed to major cuts in nitrogen oxide and sulfur dioxide—85 percent off 1997 levels by 2010—and it will additionally achieve a 25-percent cut in carbon dioxide from the repowering of a single power station from coal to natural gas. These reductions will not only help with local air quality, but they will also offer an important contribution to global warming reductions. In a single, integrated, strategic move, TECO handled a full set of local and global pollutants and positioned itself as a clean energy company in the competitive national market that is emerging.

Like the TECO example, an integrated and aggressive strategy for power companies should be rooted in improved environmental performance. It should boast an agenda for reducing all forms of air pollution in a comprehensive strategy—as opposed to the usual piecemeal, pollutant-by-pollutant, approach. Such a strategy should

■ **cut** nitrogen oxide emissions, including fine particles, to help curb smog problems and improve the deleterious effects of acid deposition in sensitive ecosystems;

■ **commit** to further sulfur dioxide controls to further reduce acid rain, comply with the new program to cut haze in premier national parks and wilderness areas, and make progress on the fine particle standards likely to come into force soon;

■ **reduce** carbon dioxide emissions, building on the voluntary efforts made by many leading power companies under the DOE Climate Challenge program;[36]

■ **achieve** a voluntary reduction in mercury before law requires such reductions;[37]

■ **improve** a company's position in the competitive market.

By absorbing costs associated with reduction of pollutants early on, firms can increase the potential for recovering those costs prior to full-scale competition. The flexibility of these markets would allow companies to fine-tune investment and competitive market strategies while keeping costs down and increasing reductions in emissions. The strategy may even enable companies to improve their stock performance through new initiatives on Wall Street, for example, to rate companies based on their environmental as well as economic performance.[38]

New Partnerships

Power companies should also build partnerships with environmental advocates. These partnerships can help broaden the public's support for environmental gains and reduce the potential for challenges. Visible partnerships can reassure the public and government regulators of a company's commitment to environmental protection. For example, BP Amoco, as part of its commitment to reduce greenhouse gases, entered a partnership with Environmental Defense to collaborate on an internal corporate emissions-trading program to achieve the reductions at lowest cost. That system is now operational at BP Amoco's entities worldwide, with a current trading price of carbon of about $10 per ton, a fraction of the scare-tactic projections of industry opponents to climate action.[39]

This kind of partnership demonstrates environmental leadership not just by actions, but by the new alliances formed with environmental activists, like Environmental Defense, who might have been critics in the past.

Market for Greenhouse Gases

Some observers contend that the missing link to a truly integrated multi-pollutant strategy is an early credit program for greenhouse gases. Since the Kyoto Protocol's targets would take effect in 2008, some firms worry that if they started taking action now, they might not receive credit for those pre-2008 actions even though they would still be delivering benefits after 2008. In fact, enactment of early credit legislation would provide the best policy foundation for achieving low-cost reductions and for building experience in greenhouse-gas trading. It would provide a valuable platform for firms to step out early, in their economic interest, and launch action plans that enable them to earn bankable credits.[40] But Congress has been slow to act on legislation introduced by the late Senator John Chafee or by Representatives Rick Lazio and Cal Dooley that would authorize such a program.[41] Nonetheless, a significant market in greenhouse gas credits is emerging, and governments around the world and global companies are already moving to establish trading systems.

Financial institutions are also mobilizing. The World Bank launched its Prototype Carbon Fund in January and is seeking to raise $150 million for its initial capitalization.[42] The fund will invest in projects around the world that create greenhouse gas credits, and it will distribute shares of these credits as returns to its investors. Four governments—Finland, the Netherlands, Norway, and Sweden—have agreed to invest $10 million each while eight Japanese companies and one Belgian company have agreed to invest $5 million each.[43] Given their projections of where the carbon market is going, the expected price of greenhouse gas reductions is about $20 per ton.[44]

Earlier this year, in a similar initiative, the European Bank for Reconstruction and Development and the Dexia Group announced plans to collaborate on a greenhouse gas investment fund focused on emission-reduction opportunities in Central and Eastern Europe. The fund seeks to raise EUR 150 million (US$144 million).[45]

Meanwhile, private markets such as the International Petroleum Exchange in London and the Sydney Futures Exchange are also establishing carbon-trading exchanges. The Environmental Resources Trust, a U.S. nonprofit environmental organization, has launched its own Greenhouse Gas Registry for use by firms interested in tracking greenhouse-gas trades.

Markets around the world are also responding to the innovative greenhouse-gas emissions trading mechanisms included in the Kyoto Protocol. As of March 1, 2000 for instance, Environmental Defense has tracked eight public transactions totaling 102 million metric tons of carbon dioxide-equivalent emission reductions.[46] These emissions-trading transactions include sales of emissions reductions achieved by electric utilities that have switched to cleaner fuels, investments in forest protection and restoration of degraded lands, innovative technologies to capture methane from landfills and use it to generate electricity, and incentives for farmers to grow crops more sustainably and conserve soil carbon.[47]

The evolving electric power market offers energy executives unparalleled opportunities to impress customers, improve competitive advantage, grow their economic fortunes, and protect the environment. Indeed, governments are moving, companies are moving, and the markets are moving. It's a perfect time for smart companies to leave the competition in the dust.[48]■

Dirk Forrister is the Energy Program manager and Daniel J. Dudek is a senior economist at Environmental Defense.

NOTES

1. See <http://www.eia.doe.gov/cneaf/electricity/chg_str/regmap.html>.

2. See H.R. 1828, the administration's proposed bill introduced May 17, 1999, by Representatives Bliley and Dingell; also see S. 1047 and S. 1048, introduced May 13, 1999, by Senators Murkowski and Bingaman.

3. Ibid. The administration proposal includes a renewable energy portfolio standard that would require suppliers to have 7.5 percent of their power come from nonhydro renewables, a public benefits fund to support energy efficiency and low income programs, and "green" labeling provisions to help consumers identify and choose power that is environmentally friendly.

4. H.R. 2944, introduced September 24, 1999, by Representative Barton.

5. *Air Daily* 7(97), May 18, 2000, citing Senator James Jeffords.

6. Linda Edwards, "Bush's Green Record," letter to the editor, *San Francisco Chronicle* (March 9, 2000).

7. In addition to their well-known roles as acid rain precursors, both nitrogen oxide and sulfur dioxide transform into fine-particulate pollution, causing respiratory problems, regional haze, and poor visibility in national parks.

8. Lawrence L. Knutson, "30th Earth Day Brings New Proposals for the Environment," *Corpus Christi Caller Times*, Associated Press (April 23, 2000).

9. Robert W. Hahn and Carol A. May, "The Behavior of the Allowance Market," *The Electricity Journal* 7(2) (March 1994), pp. 28-37.

10. *Michigan v. EPA*, No. 98-1497 and consolidated cases (D.C. Circuit decided March 3, 2000).

11. Ibid. and 63 *Federal Register* 57,356 (1998). Emission reductions may be required beginning in May 2003, pursuant to state plans due as early as September 2000.

12. 62 *Federal Register* 38,856 (July 18, 1997), concerning the adoption of 8-hour ozone national ambient air quality standards; 62 *Federal Register* 38,652 (July 18, 1997), concerning the adoption of new fine particle national ambient air quality standards.

13. Numerous electric utilities and other industrial sectors filed petitions for judicial review challenging the standards. *American Trucking Associations v. EPA*, DC: Cir. Nos. 97-1440, 97-1441 and consolidated cases.

14. *American Trucking Associations, Inc. v. U.S. EPA*, 175 F.3d 1027, *reh'g granted in part, den'd in part*, 195 F.3d 4 (D.C. Cir. 1999).

15. *Browner v. American Trucking Associations, Inc.,* No. 99-1257 (S.Ct. cert. pet. granted May 22, 2000).

16. See 64 *Federal Register* 57,424 (October 25, 1999) and 64 *Federal Register* 60,478 (November 5, 1999).

17. Tom Kenworthy and D'Vera Cohn, "9 Metropolitan Areas Pushed to Toughen Smog Plans," *Washington Post* (December 2, 1999).

18. 64 *Federal Register* 35,714 (July 1, 1999).

19. David Stout, "U.S. Sues 7 Utilities on Air Pollution Charges, Citing 32 Coal-Fired Plants in 10 States," *New York Times* (November 4, 1999); see also EPA's Enforcement Office website at <http://es.epa.gov/oeca/ore/aed/coal/index.html>, which contains a list of power plants subject to enforcement action, copies of the complaints that have been filed, and press statements.

20. Robert T. Watson, Marufu C. Zinyowera, and Richard H. Moss, eds., "The Regional Impacts of Climate Change: An Assessment of Vulnerability," Summary for Policymakers, Special Report of IPCC Working Group II (Geneva: Intergovernmental Panel on Climate Control, November 1997).

21. International negotiators agreed on the Kyoto Protocol in December 1997, after concluding that the nonbinding reductions of greenhouse gases contained in the Framework Convention on Climate Change, also known as the Rio Treaty, were not adequately reducing emissions. They found that more cuts would be needed, so a range of reductions in six major greenhouse gases were agreed upon in Kyoto, along with a set of flexibility mechanisms that will assure that cuts can be made cooperatively at lower cost.

22. Kyoto Protocol's Article 25 provides that the treaty will enter into force after instruments are deposited with the UN that demonstrate that it has been ratified by 55 parties representing 55 percent of the Framework Convention's Annex 1 parties' carbon dioxide emissions in 1990.

23. Carl Mortished, "Top 25 Companies Seek Emissions Trading," *London Times* (June 28, 1999); see <http://www.Sunday-Times.co.uk>.

24. "Energy Intensive Sectors Agree on Efficiency Targets," Press Release (London: UK Department of the Environment, Transport and the Regions, December 21, 1999); see <http://www.press.detr.gov.uk/9912/1235.htm>; industry agreements cover cement, food and drink, glass, nonferrous metals, aluminum, paper, chemicals, foundries, steel, and ceramics.

25. "France Readies Tax to Fight Global Warming," Reuters (January 10, 2000); "France Unveils Plan to Fight Global Warming," Reuters (January 20, 2000).

26. Michael Smith, "EC to Support Emis-

sions Trading," *Financial Times* (March 7, 2000).

27. "Green Paper on Greenhouse Gas Emissions Trading within the European Union" (Brussels: European Commission, March 8, 2000).

28. "Report from the Commission that Has Outlined a System for Domestic Greenhouse Gas Emissions Trading," Press Release (Oslo, Norway: Ministry of the Environment, December 17, 1999); see <http://odin.dep.no/md/prm/1999/k4/991217fe.html>.

29. Phillip English, "NZ to Act on Global Warming Promise," *New Zealand Herald* (February 16, 2000).

30. H.R. 2520, introduced July 14, 1999, by Representative Rick Lazio et al.; S. 547, introduced March 4, 1999, by Senator John Chafee et al.

31. President's State of the Union Address (January 27, 2000) <http://www.whitehouse.gov/WH/SOTU00/sotu-text.html>.

32. "McCain: Global Warming for Real," Associated Press (May 17, 2000).

33. See <www.environmentaldefense.org>.

34. *Michigan v. EPA*, No. 98-1497 and consolidated cases (D.C. Circuit decided March 3, 2000).

35. "Economic Impacts of Climate Change Policies on TVA" (Fairfax, VA: ICF Resources, June 1993, updated November 1995).

36. This program, launched in 1994 as part of President Clinton's Climate Change Action Plan, mobilized nearly 600 power companies into action under voluntary agreements with the Department of Energy. Most of these agreements focused on year 2000 emissions goals, and more is needed for the coming decade to meet our international obligations.

37. Although the scientific evaluation of the problem with airborne mercury from power plants is still evolving, early reductions are warranted as a precautionary measure. Indeed, mercury is a known neurotoxin.

38. See Dow Jones Sustainability Group Index <http://indexes.dowjones.com/djsgi>.

39. Shell has likewise worked with Environmental Defense to design an internal emissions-trading program to help it achieve its global reduction target. And IBM and Johnson & Johnson recently joined the World Wildlife Fund to announce commitments to reduce greenhouse gases. Johnson & Johnson will reduce emissions by 7 percent between now and 2010. IBM will cut projected emissions by 4 percent per year.

40. Mark Hill and Jerry Golden, "Multi-Pollutant Control Strategies: *When Does Early CO2 Mitigation Make Sense*," Presentation at Electric Utilities Environmental Conference (Tucson, AZ: January 1999).

41. H.R. 2520; S. 547.

42. John J. Fialka, "World Bank Launches Trading Fund to Combat Carbon Dioxide Emissions," *Wall Street Journal* (January 19, 2000).

43. Dan Bilefsky, "World Bank: Bank Tries Carbon Control," *Financial Times* (January 19, 2000).

44. Ibid.

45. "EBRD and Dexia Sponsor an Innovative Equity Fund to Reduce Global Warming," Press Release (Dexia, February 15, 2000) <http://www.dexia.com/english/communique.php3?N=46>.

46. "Global Greenhouse Gas Emissions Trading: The Market is Moving," News Release (New York: EDF, November 4, 1999), charting 72 million metric tons as of that date; update pending publication.

47. Ibid.

48. The authors wish to thank Vickie Patton, attorney, and Elissa Gutt, program assistant, for their valuable contributions to this paper.

Consumer-Owned Utilities

Competition Comes to Town

Whether a means to an end, or an end unto itself as some claim, competition is now the name of the game in electricity. And with competition comes change—a whole lot of change. Like the telecommunications and airline industries before it, the electricity industry is moving—if a bit shakily—away from the regulated monopolies of Insull and Edison and toward the alternative suppliers, rate comparisons, open access, and other, sometimes bewildering, variables of the restructured landscape.

How will the nation's nearly 3,000 consumer-owned utilities—the municipally owned systems and customer-owned cooperatives, which together serve a quarter of the country's electricity customers—fare in that landscape? Success can be had, but it is not guaranteed.

Alan Richardson, executive director of the American Public Power Association, believes that "restructuring will allow public power to continue to thrive and prosper," but he challenges the assumptions that lead many to conclude that "competition and the wonders of the market" will, by themselves, benefit all consumers. Rather, he says, in a deregulated market, it is the big customers who will benefit most, having more choices and paying lower prices. Small business and residential customers, on the other hand, will get the short end of the stick, having fewer choices and paying higher prices.

Public ownership, Richardson argues, is a defense against such price discrimination. Because public power aims to serve customers rather than profit shareholders and because it is "truly a democratic institution," publicly owned utilities can "ensure just, reasonable, and, most important, nondiscriminatory rates for all classes of consumers."

Richardson calls on Congress to help the publics by putting in place a structure promoting competition in the interstate wholesale market—"the foundation on which the retail market must be built."

Discrimination is of particular concern to rural areas in this country. Remoteness, low population densities, and other rural traits often combine to make deregulation—whether of airlines, telecommunications, or electricity—painful for people and places beyond the urban fringe.

Rural electric cooperatives serve many of those people and places. Steven Lindenberg of the National Rural Electric Cooperative Association says the realities facing co-ops today are no less challenging than those they faced 70 years ago when they first electrified the countryside. Lindenberg, however, sees opportunities for cooperatives amid the challenges. One of the biggest opportunities is in new product development that will help co-ops offer the best customer service possible. Such products include so-called gateway devices that use smart technology to allow a customer's home or business to better manage energy use.

Narrowing the lens a bit, C. Clark Leone, manager of the Public Power Council, focuses on the changes afoot for consumer-owned electric utilities in the Pacific Northwest. There, the presence of federal hydropower facilities, large industrial users that receive power directly from those facilities, investor-owned utilities, and consumer-owned utilities make for a complex situation. Throw in federal and state regulatory changes and you have the makings of quite a tussle. Nonetheless, Leone, too, sees a bright future for public power.

Finally, Professors David Daniel and Douglas Gegax of New Mexico State University provide a blow-by-blow account of the 30-year tussle between Las Cruces, New Mexico, and its power provider, El Paso Electric Company. As Daniel and Gegax show, the future for consumer-owned utilities may be bright in a restructured landscape, but the competition can be downright tough.

The Editors

Public Power as Protector

Consumer-owned electric utilities stand ready to serve their communities, but a few obstacles remain in their way.

BY ALAN H. RICHARDSON

Public power is facing profound changes in the delivery of electric utility services. Those who don't understand the democratic, community-based roots of public power believe that choice, competition, and open markets will be its death. Those who do understand public power and its consumer orientation believe that restructuring will allow public power to continue to thrive and prosper.

Stakeholders in the debate all pay homage to the proposition that industry restructuring must benefit all consumers. But most stakeholders have done little to assess the probability of success. Instead, they have allowed the debate to proceed on assumptions and clichés about the benefits of competition and the wonders of the market.

Many of these assumptions and clichés have now been challenged in a recent report, *Price Discrimination, Electronic Redlining, and Price Fixing in Deregulated Electric Power*, by Eugene Coyle, an economist active in industry restructuring debates.[1] While Coyle's conclusions regarding the benefits of restructuring for small consumers are pessimistic, they also describe the positive impact that electric industry restructuring will have on the nation's consumer-owned utilities, both now and into the future.

False Assumptions

Coyle argues that policymakers have proceeded on the assumption that competition is always good and that markets always work, when the reality is that for small business and residential customers the result may be otherwise. In fact, a deregulated retail market "cannot provide rates that will be 'just, reasonable, and non-discriminatory' as is now required in the statutes or regulations of most states."[2]

In many cases, competition is regarded as the end, not the means to the end, when, in fact, the desired ends for consumers are lower rates and better service. Competition produces these ends in some industries, but not others. According to Coyle, we don't yet know how deregulated electric markets will behave, and it is dangerous to blithely assume the market will perform better than regulation.

Consider airlines, for example. Airlines charge their passengers highly variable prices for tickets in an effort to fill all their seats. Likewise, under deregulation, electric utilities will charge their industrial customers bargain-basement prices, while their small customers, who have little choice in their source of power, make up the difference with higher rates. Competition will not change this. Even if there were many suppliers, price discrimination would continue.

In Coyle's view, price discrimination is unavoidable, and it can be controlled in the future just as it has been in the past by regulation or public ownership.

Public ownership means that a utility is oriented toward serving the people, not making a profit for its shareholders. And because public power is truly a democratic institution, local control over utility operations—including rates—helps to ensure just, reasonable, and, most important, nondiscriminatory rates for all classes of consumers.

Positive Effects

Interest in forming new public power systems is higher today than at any time in the past two decades. Communities from Buffalo, New York, to Portland, Oregon, and points in between, are contacting the American Public Power Association for information on the benefits of public power.

While community leaders are unlikely to have rigorously analyzed the consequences of industry restructuring for consumers, they seem to understand intuitively that consumers are at risk. And they see public ownership as a means of avoiding that risk while capturing the benefits of lower cost and better service that have been the hallmarks of public power for over a century.

As one community activist in Portland put it, "With all the madness of deregulation, it is my view that the best thing Portland can do is gain as much control of its energy future as it can."

Restructuring is having a positive effect on public power. It is also having a positive effect on existing public power systems.

Public power is a community asset that can be disposed of if it no longer serves the purposes for which it was created. And from time to time, community leaders examine their community-owned utilities to ensure that they continue to benefit citizen-owners.

Anxiety about the ability of small, community-owned utilities to operate in an environment marked by massive consolidations and the risks in the new, deregulated environment have also prompted some communities to explore privatization.

Further, there is a lot of hype about the number of customers needed for a utility to be truly competitive. Self-serving consultants and some merger-mad investor-owned utilities suggest that no fewer than 5 million, better yet 10 million, customers are required. Since the largest publicly owned utility, Los Angeles Department of Water and Power, serves about 1.3 million customers, however, and most of the nation's 2,000 publicly owned systems serve communities of 10,000 or fewer public power will obviously never reach the critical mass of customers that some suggest is necessary to survive.

When community leaders cut through the rhetoric, look at the benefits provided by their locally owned utility, and consider their options in a restructured environment, they almost invariably conclude that privatization makes no sense.

This occurred most recently in Memphis, Tennessee, and Tallahassee, Florida. Both considered privatization. Both rejected it.

When community leaders consider their options in a restructured environment, they almost invariably conclude that privatization makes no sense.

In the end, utility service is local service. In a restructured environment, customers place a high value on price but an even higher value on service. In this respect, public power excels. The utility manager lives across town, not across the country or the ocean. Local service is responsive service. This explains why, when natural disasters strike, electric service tends to be restored most quickly in communities with public power.

Local service is also community-oriented and community-controlled. These attributes have always been important. They are even more important in a deregulated environment where consumers can compare local service from their community-owned utility with the distant and impersonal service offered by mega-utilities with corporate headquarters several states away. Iowans, for example, have watched as seven investor-owned utilities consolidated into two, followed by cost-cutting measures that eliminated local service centers. Local service is what public power has been, is now, and will continue to be about.

Congressional Debate

Coyle may be right when he says that the promise of retail competition is an empty one for small consumers. Regardless, it is difficult to imagine retail competition working well for anyone, large or small, if Congress fails to put in place a structure that promotes competition in the interstate wholesale power market. The wholesale power market is, after all, the foundation on which the retail market must be built. The industry today is characterized by relatively few players who control the arteries of commerce—transmission—as well as vast amounts of generation. Consequently, the owners of these strategic assets can manipulate them to frustrate competition. Much work is needed to deal with these market power problems in interstate commerce.

Unfortunately, some members of Congress seem to believe the states can do it all. According to this view, the best thing Congress could do to promote wholesale competition is to repeal various federal regulatory statutes, such as the Public Utility Holding Company Act of 1935, restrain the Federal Energy Regulatory Commission from interfering in industry, and trust the market to sort out market power problems.

Not surprisingly, debates in Congress have been driven by clichés about the market—by sound bytes, not sound public policy. How often have we heard such phrases as "deregulate, don't re-regulate," "let the markets work," and "grow business, not government"? Lost in this rhetoric is the interstate nature of the industry. Congress alone has the ability, indeed the responsibility, to address interstate issues, and serious interstate commerce issues must be addressed if Congress is to promote competition in the wholesale power market.

The exercise of market power to control transmission access is one of the most fundamental issues that Congress must address.

Price spikes and power shortages during the past two summers are a clear indication that something is dramatically wrong in the wholesale power market. Part of the problem is that load growth has devoured most of the surplus generation capacity. There has been some reluctance to build new capacity until the rules of the game are more clearly defined. Thus, congressional action is necessary and should occur sooner rather than later.

A more compelling reason for Congress to act is to stamp out abuses of market power. Market power—the ability to set prices above those that would exist in a truly competitive environment—is the antithesis of competition. The exercise of market power to control transmission access is one of the most fundamental issues that Congress must address. Transmission lines are the arteries of commerce in the interstate electric market, and interstate competition cannot flourish while those who have commercial interests in wholesale power transactions retain control over transmission facilities.

Consumer-owned utilities are predominately net purchasers of power, and they almost always depend on others for transmission. If Congress ensures that all transmission users have fair and nondiscriminatory access to the grid, federal restructuring legislation will have a positive effect on consumer-owned utilities as well as all consumers.

Clearly, the Energy Policy Act did not solve transmission access problems. FERC itself has acknowledged this and is taking steps to deal with the issue by encouraging the formation of regional transmission organizations. But the extent of FERC's authority under existing law is subject to debate. Congress should resolve the uncertainty by enhancing FERC's authority to promote or require regional transmission organizations that are truly independent of those entities engaged in commercial transactions in the wholesale power market.

So far, Congress has been reluctant to address this problem in a meaningful way. Indeed, H.R. 2944, the industry restructuring legislation now pending before the House Commerce Committee, would undermine the very concept of independence of regional transmission organizations.[3]

Megamergers, Megathreats

Congress should also address the increasingly significant problem of the consolidation of utilities through mergers and acquisitions. Putting aside the fact that every merger takes at least one competitor out of the market, the mega mergers underway today, and those likely in the future, threaten the long-term viability of effective competition in the wholesale power market.

According to 1999 data from the Energy Information Administration, investor-owned utilities have been involved in 26 mergers—with 16 more pending—since 1992, and the industry is becoming more concentrated as a result. Indeed, the amount of investor-owned generation capacity held by the 10 largest investor-owned utilities jumped from 36 percent to 51 percent in that time.[4]

This high level of concentration is not healthy for consumers or consumer-owned utilities. Many mergers are being pursued as a defense against competition. While not all mergers will adversely affect consumers and the market, some will. And part of FERC's responsibility in reviewing and approving proposed mergers should be to determine whether they would promote competition. If they will not, they should be rejected.

Rather than enhancing FERC's authority to review and reject proposed mergers that will undermine competition, H.R. 2944 sharply curtails FERC's authority by requiring FERC action within 180 days; inaction would automatically result in approval. Restricting FERC's authority in these ways will not promote competition. Indeed, it will have the opposite effect.

Complicating the merger issue is H.R. 2944's proposed repeal of the Public Utility Holding Company Act of 1935. A repeal of PUHCA would remove a significant obstacle to additional megamergers and foreign acquisition of domestic utilities because PUHCA prevents a holding company from owning electric utilities that are not interconnected or capable of being operated as a single interconnected system. Most observers agree that repeal of PUHCA will spawn a new wave of mergers.

There were sound public policy reasons behind these corporate structure provisions of PUHCA, and the consequences of removing them should be carefully considered. While it may be appropriate to modify or repeal PUHCA, this action should not occur until significant consumer protection provisions are enacted to replace those that would be lost once PUHCA is stricken from the books. H.R. 2944 does not contain any such provisions.

Furthermore, H.R. 2944 imposes new barriers to the creation of public power systems by imposing stranded-cost provisions that are so excessive as to make creation of new systems uneconomical. Under H.R. 2944, communities establishing a new public power system would be saddled with stranded costs "based on the weighted average remaining useful life of generation assets owned or power purchased under contract by the public utility and included in wholesale or retail rates in effect on July 9, 1996."[5] The remaining useful life of these assets or contracts is likely to extend over several decades.

Contrast this with the time frame provided under state restructuring legislation for stranded-cost recovery—on average about seven years—and it is clear that H.R. 2944 has little to do with stranded-cost recovery and everything to do with making the creation of new public power systems uneconomical.

This conclusion is further buttressed by the requirement that the calculation be based on assets owned or power purchased under contract in effect on July 9, 1996, even though these assets may have been sold, the contracts terminated, and all stranded costs associated with them fully recovered pursuant to state legislation.

Public power systems are one of the best avenues for protection of consumers from discriminatory treatment in a deregulated environment.

Consumer Protection

Despite the obstacles, public power systems are viable competitors. They are one of the best avenues for protection of consumers from discriminatory treatment in a deregulated environment. For legislation that purports to promote competition and advance the interests of all consumers, provisions that prevent competition and essentially deny communities the right to take charge of their own electric utility affairs are inexplicable.

Restructuring holds many challenges for consumer-owned utilities. It is critical that Congress does what is necessary to deal with market power problems in the interstate electric market. Consumer-owned utilities operate in the wholesale market where competition can work for the benefit of all consumers.

Unfortunately, the House Energy and Power Subcommittee got off on the wrong foot with H.R. 2944. It will inhibit, rather than promote, competition. Many participants in the restructuring debate, including Department of Energy Secretary Bill Richardson and FERC Chairman James Hoecker, share this view.

If Congress gets it right, if it creates an industry structure that promotes wholesale competition, public power will benefit. Its options in the wholesale power market will increase as the market power of incumbents is controlled or eliminated. If Congress does not get it right, however, if it fails to solve market power issues, we will end up with deregulated monopolies, not a deregulated market. In that case, restructuring will benefit neither consumers nor consumer-owned utilities.

Whether state restructuring in the retail electric markets will provide benefits for all electric consumers remains an unanswered question. Coyle believes that it won't. He argues that price discrimination is inevitable and that small residential and commercial customers will suffer. If that happens, consumer-owned utilities will protect their consumers against price discrimination, just as they have in the past. Communities that are served by local, consumer-owned electric utility understand this and will preserve these locally owned assets. And communities that are not served by consumer-owned utilities will recognize public power as an increasingly attractive option.■

Alan H. Richardson is executive director of the American Public Power Association, in Washington, DC.

NOTES

1. Eugene P. Coyle, *Price Discrimination, Electronic Redlining, and Price Fixing in Deregulated Electric Power* (Washington, DC: American Public Power Association, 2000).

2. Coyle, *Price Discrimination*, p. vii.

3. H.R. 2944, the Electricity Competition and Reliability Act.

4. Energy Information Administration, U.S. Department of Energy, *The Changing Structure of the Electric Power Industry 1999: Mergers and Other Corporate Combinations* (Washington, DC: DOE, 1999).

5. H.R. 2944, the Electricity Competition and Reliability Act, was reported by the Subcommittee on Energy and Power on October 27, 1999. The quotation is from the committee print, p. 18.

Electric Cooperatives in a Deregulated Market

With the help of applied research, electric cooperatives are expanding their horizons beyond rural America.

BY STEVEN P. LINDENBERG

Sixty-five years ago, the federal government passed the Rural Electrification Act, promising rural Americans that they, too, would enjoy the benefits of electric power. That promise, however, stopped short of explaining exactly how it was supposed to happen. The legislation that created the Rural Electrification Administration (REA) was more of an open appeal to encourage the construction and operation of generating plants, electric transmission lines, and distribution systems to serve rural areas. In return, those constructing such operations could expect low-interest loans from the federal government.

There weren't a lot of takers, at least at first. While financing a rural electric system was a concern, the real showstopper was that electric utilities are complex, technical businesses, and the challenges of designing, constructing, and operating electric transmissions and distribution in rural American was something no existing organization wanted to tackle.

Those already in the electric utility business knew that the economics of providing affordable power to isolated farm families held out little hope of cost recovery, let alone profits within normal return-on-investment time requirements. In addition, the capital-intensive nature of the business and the commitment of investor-owned utilities to regulatory realities and rate structures that locked them into particular markets discouraged the risk of extending service beyond urban centers. As tax-based entities, municipal utilities did not feel it their responsibility to embrace anything outside city limits. Faced with those harsh realities, it wasn't long before it became clear that solving the problem of serving rural America required the development of new engineering approaches and an entirely new and innovative financing mechanism.

The grand experiment with the cooperative structure began as a grassroots effort, strongly supported by the federal government. In the end, it became one of America's most dramatic success stories. Dedicated local residents and capable federal employees shared the responsibility for design, construction, and operations.

In the late 1930s, rural America possessed few of the skills required to create and manage an electric utility, but there was plenty of determination. With REA supplying the engineering standards and guidelines, based on contemporary practice and adjusted for rural settings, and with the local community providing the labor and oversight through democratically elected directors, the result was a rural America that was almost entirely electrified by the mid-1950s. Today, over 30 million consumers are served by rural electric cooperatives.

Stasis and Change

As the electric utility industry now enters a period of rapid deregulation, the realities facing the rural electric cooperative industry are no less challenging than they were in the 1930s. The needs then were for basic electrical engineering and construction skills. Today's needs include new technical, business, and marketing skills necessary to successfully manage a competitive enterprise and stay within the cooperative structure of local control.

This overarching challenge hovers over the entire electric utility industry. The abundance and efficiency of electricity has led to many new electrical devices that have changed the way Americans work and that require highly reliable service. Moreover, the landscape of rural America has changed as well. Where the original program served mainly farmsteads, today's rural electric cooperative program serves essentially every type of commercial and business enterprise imaginable as well as suburban subdivisions and entire communities.

This transition—from an almost entirely rural electric distribution network to a modern all-purpose electric generation, transmission, and distribution system that offers a wide variety of ancillary products and services—was possible only with routine and substantial investments in research and development, much of which was supported by cooperatives. The earliest Atomic Energy Commission commercial nuclear demonstration plants, for instance, were built and operated at sites owned by cooperatives. Electric cooperatives were some of the first organizations to use advanced emission controls on coal generation. And cooperatives supported development and deployment of consumer end-use products such as geothermal heat pumps, load-control devices, and advanced automatic meter reading equipment.

As the electric cooperative industry became a state-of-the-art electric power provider, it also naturally assumed a larger and larger role in the economic well-being of rural America.

Economic Growth

It is almost universally recognized that rural electric cooperatives and, to a lesser extent, their rural telephone counterparts, are the most active and progressive agencies for rural economic development in America; as fee-based enterprises, they have a vested interest in the financial viability of their service territories.

This role was not necessarily foreordained, however. No requirement in the REA legislation mandated that electric cooperatives engage in rural economic development. It was rightly assumed that the availability of electricity would, in and of itself, attract commerce and industry and would make agriculture much more efficient. The efficiencies that accompanied electrification, however, also precipitated a growing concentration of agricultural output in corporate hands and a concomitant decline of the subsistence-level family farm.

The population shifts of the 1940s and 1950s turned America into an urban nation and left many rural areas in need of revitalization. By then, electric cooperatives were in place and quickly emerged as the best-suited local agents to manage that revitalization. They had local business experience to share with fledgling organizations and an interest in expanding the employment opportunities and use of electricity in their service territories. These enthusiasms were often reinforced by a willingness to make capital available for community and economic development in the form of co-op grants and loans. Financial mechanisms were established that gave cooperatives access to funds for developmental purposes. Federal regulation was established that helped locally elected co-op boards make margins from the electric enterprise available for community efforts. This new role brought with it the sophisticated skills needed to oversee large-scale projects intended to build economic infrastructure in rural America.

Other rural areas served by rural electric cooperatives benefited substantially from the demographic changes, to the point that today there are over a dozen cooperatives serving more than 100,000 homes and businesses in largely suburban areas. Nonetheless, regardless of size, the very different needs of their service territories required that all electric cooperatives use applied research to solve the technical and management challenges presented in providing their territories with safe, reliable, and affordable electric power.

Deregulation's Lessons

As the monopoly compact, established by Samuel Insull and Thomas Edison in the early days of the last century, is being restructured in this century, both the business and technology of electricity will undergo dramatic change. Every other industry that has been restructured in the past two decades has experienced similar patterns affecting their technical and business activities.

Airlines use new planes with more fuel-efficient engines and computer modeling to adjust thousands of tariffs hourly to assure high passenger loads and increased revenue, while at the same time Internet sales are avoiding travel agent expenses. Trucking firms have installed onboard digital devices—vehicle tracking and national computer-aided dispatch centers—to maintain contact and increase efficient use of equipment and staff. Additionally, telecommunications providers could not have predicted the forces that would replace their former, slower-paced monopolistic practices with aggressive, market-oriented strategies.

The greatest impact of the realignment in the telecommunications business has been made by new competitors entering the marketplace. These companies are using technology as a competitive advantage, and this has resulted in many new telephonic devices. While prices for traditional telephone service has gone down, new applications, such as call waiting, caller ID, teleconferencing, and wireless services, have actually increased revenue. New methods of service delivery, which might have been phased in much more slowly in the regulated telecommunications industry, have become available almost overnight.

If this experience is used as a model for the emerging electrical service business, one can imagine the exciting opportunities the future holds for electric cooperatives. Cooperatives remain principally in the most underserved parts of America, and because they are cooperatives, they are correctly perceived as consumer-oriented in a time of large global companies interested only in market share.

CRN Research

Within the co-op segment of the utility industry, a strong research and development program already exists. This program greatly strengthens the position of cooperatives in a restructured marketplace.

The Cooperative Research Network (CRN)—the research arm of the National Rural Electric Cooperative Association—is helping co-operatives prepare for the restructured marketplace. Feeling the need to better control their own technical and business destiny because of impending deregulation, electric cooperatives have redirected their 25-year-old research program to focus on knowledge transfer and new product development.

During 1999, the four technical units within CRN—Automation, Telecommunications & Information Technology; Distribution Operations; Marketing & Energy Services; and Power Supply—committed funds to 32 projects aimed at improving services that cooperatives offer to their customers. Following are examples of projects falling within each of these four broad areas, which are considered essential to the survival of electric cooperatives in a competitive marketplace:

■ **Automation, Telecommunications & Information Technology**. *Automating a Distribution Cooperative from A-Z*, a recently funded manual that describes the interrelated nature of technology and business automation, makes the case that most of the information generated by automated systems is relevant, not just to operating a technically efficient system, but also has important implications for improved customer service and marketing of new services and products. As with all co-op projects, the ultimate purpose of CRN-funded research is to enable co-ops to offer the best customer service possible.

■ **Distribution Operations**. Over the years, co-op staffs have effectively incorporated the experience of others to maximize the efficiency of their electric distribution service. This model has been the foundation for CRN distribution research. In 1999, CRN staff completed projects that described the efficient application of geographic information systems and mapping logistics to aid engineering and business functions. A new substation design manual was delivered to update co-op engineers on current equipment applications and design practice. A comprehensive description and comparison of the various distribution grade utility poles available on the market was completed and calculations for structural integrity were included. These and other products have helped co-op engineers stay on the leading edge of reliable distribution operation.

■ **Marketing & Energy Services.** In keeping with the new market-oriented operating philosophy, CRN funded a gateway demonstration project that provided 50 residential customers in each of four co-op territories with a variety of so-called "gateway devices"—that is, two-way communication centers that allow the co-op to monitor electric service and other residential functions while sending control signals or electronic messages back to the consumer. These gateways allow appliances or other functions in the residential consumer's home to become "smart" in the way they use or manage energy. Heating and cooling systems can be monitored while consumers are at home or on vacation, and they can be controlled based on energy use and current electrical rates. Consumers are allowed to override the system after they have been informed of the expected expense. Co-ops can monitor such activities as occupant health status, smoke alarms, and flooding conditions.

Within the industry, a heated discussion is waxing over the future of such devices. While a broad array of potential commercial devices designed for this purpose is on the market, there is no published comparison of the devices that allows a cooperative to decide which to offer its customers. By conducting test installations, cooperative staff are learning the technical and logistical problems and solutions to making these systems work. Entrance, midterm and exit interviews with the co-op consumers will give CRN researchers a clear picture of perceived product value. Providing this type of practical advice is one of CRN's primary purposes, giving cooperatives a competitive advantage among customers by supplying advanced knowledge for technical and business decisions.

Among the changes that have happened in the electric cooperative industry during the past 40 years has been the steady growth of commercial and industrial accounts. Before World War II, commercial and industrial accounts were less than 5 percent of the cooperatives' total business. Today, such accounts are closer to a third of all sales nationally and in some service territories are edging closer to 50 percent.

In a deregulated marketplace, large electric power users will be able to shop for the services and price they desire. This will put pressure on the cooperatives to treat them as a special class of customer. Cooperatives have therefore asked CRN to determine what would create loyalty to the cooperative among this market segment.

In response, CRN conducted a survey of consumers in investor-owned, municipal, and co-op territories. The results of the survey indicate that electric cooperatives are faring well with their commercial and industrial customers and, in many areas, are viewed more favorably than investor-owned utilities. Although cost obviously matters, the survey showed that these customers respond favorably to any energy provider who clearly understands their business problems.

■ **Power Supply**. The federal government's encouragement to develop alternative energy sources in the 1970s led eventually to the introduction of fuel cells and microturbines. From these options has sprung a new market force: distributed generation, which includes small sources of power, such as wind turbines, fuel cells, and solar panels, that can be established onsite or nearby to meet the energy needs of consumers. Although there are limitations on how far distributed generation can be exploited, it is becoming a potentially attractive alternative to central power stations. For that reason, CRN has worked to identify economically attractive, emerging distributed generation technologies and to transform them into fully evaluated commercial products ready for cooperative application.

Inventing the Future

These examples of projects funded during the past year are representative of CRN's commitment to support activities that better prepare the electric cooperative industry to compete in a deregulated marketplace. Gone—or more accurately, deemphasized—are fundamental research projects that would make only small incremental changes in a distribution system's operation, as well as projects that have no foreseeable market application within a reasonable period. The focus today is on applied research that can make cooperatives competitive.

This conscious choice grows out of the need of electric cooperatives to differentiate themselves from their competitors; they want to demonstrate to their owner-consumers that their needs will continue to dictate the policies of the electric cooperative industry.

The new deregulated marketplace will be demanding and will present many challenges. Among the toughest of these challenges will be developing the personnel who will need to transform technically competent electric cooperatives into highly sophisticated providers of energy services with strong technical, business, and marketing skills. As in the 1930s and 1940s, when skilled utility technicians were scarce in rural America, expert automation engineers and marketers with business acumen are scarce today outside major metropolitan centers. Electric cooperatives will have to implement creative recruiting and retention programs to attract people with these skills. But this time around, CRN has made the commitment to help attract these people and create a stimulating, rewarding workplace within the electric cooperative industry, by developing, testing, and delivering 21st century business technology and knowledge.

The electric cooperative industry is following the advice of respected business author Peter Drucker that "the best way to predict the future is to invent it." During the first half of the 20th century, electric cooperatives learned how to conquer distance and terrain to reach remote rural customers. Today, electric cooperatives are expanding beyond rural America. They are equipping themselves with the skills, knowledge, and resources to become an even larger player in the restructured utility market of the 21st century.■

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Quo Vadis?

Public power in the Northwest is changing in the face of restructuring and growing environmental concerns.

BY C. CLARK LEONE

Consumer-owned electric utilities, sometimes called public power or publics, come in different shapes and sizes. Take, for example, the Pacific Northwest states of Washington, Oregon, Idaho, and Montana. Municipal electric utilities serve the residents, industries, and businesses of Tacoma and Seattle, Washington. Electric cooperatives serve mainly ranchers in remote, rural areas of the four states, although a cooperative also serves suburban residents and businesses near Salem, Oregon's capital.

Mutual electric utilities, similar in form to cooperatives, may also serve either rural or urban customers. People's utility districts serve rural and urban customers in Oregon. And, finally, public utility districts provide electricity to entire counties in Washington.[1]

Whatever the form, the hallmark of public power is that, unlike investor-owned utilities (IOUs), publics are nonprofit organizations that are owned by the people they serve. An IOU operates not only to provide electricity to its customers, but also to earn dividends for its owners/shareholders, who may live anywhere on the planet. Unlike IOUs, public power also has a statutory priority right to federally generated power at cost.

Territorial Disputes

The Pacific Northwest was a crucible for public power, and most consumer-owned utilities were born into an atmosphere of unrest and tension.[2] Several factors contributed to the establishment of publics in the late 19th and early 20th centuries, including the failure of IOUs to serve remote rural areas; high rates charged by IOUs relative to those charged by existing municipals; a general fear of monopolies that included railroad and river transportation monopolies as well as IOUs; distrust of Eastern financiers; and a backlash against the false information IOUs spread in their attempts to counteract the political lure of public power. But the central issue and ensuing battle was about who would control the Columbia River and its tributaries, whether for irrigation, navigation, flood control, or hydropower. Through the mid-1930s, public and private utility providers in the Northwest engaged in a territorial struggle over who would get to serve where. Then the federal government weighed in.

Franklin Roosevelt's New Deal brought increased federal regulation over IOUs because of their financial misconduct. The federal government initiated low-cost loan programs to extend the benefits of electric power to farmers. Public works projects resulted in the construction of the Bonneville and Grand Coulee dams on the Columbia River. Indeed, the Bonneville Project Act of 1937, creating the Bonneville Power Administration (BPA), settled a three-year battle between public and private power for control over the rights to market hydropower generated by dams owned by the U.S. Army Corps of Engineers and the Bureau of Reclamation. The law was to ensure that federal hydropower generation facilities were operated for the benefit of the public and that BPA gave priority in the wholesaling of federal hydropower to the publics at cost-based rates.[3]

During World War II and the following decade, an uneasy truce developed between publics and IOUs. Both sides agreed to operate Northwest hydro resources as if the region were served by one utility, regardless of ownership. BPA allowed nonfederal power over its transmission lines to accommodate coordinated operations and to reduce the risk of short-term power shortages.

During that time, a large portion of the power generated by

BPA was purchased by the aluminum industry, which had grown large meeting the materiel demands of war. Aluminum plants sprouted in the Northwest and, like the IOUs and publics, bought their electricity directly from BPA. Hence their collective name, direct-service industries.[4]

Another era of distrust and bitterness dawned in 1976 when BPA announced that because of predicted load growth and power shortages, it would be unable to provide power to any newly formed publics, and direct-service industry contracts would not be renewed. Indeed, BPA gave notice that it would not meet even public power's load growth after mid-1983.

Work began on legislation to avert what nearly developed into warfare over the allocation of low-cost federal power.[5] Finally, in 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act, establishing a new set of definitions, values, and relationships in the region. The act paved the way for the emergence of yet a fourth heavyweight in regional electric industry politics: environmental interests. It did so by requiring conservation measures to reduce the use of power and procedures to mitigate damage to fish and wildlife.

Relative peace prevailed for a number of years. Each of BPA's three customer groups—direct-service industries, investor-owned utilities, and the publics—were granted a boon by the legislation, while the environmental interests got ever-increasing BPA funding for conservation programs, including efforts to help salmon reach their spawning beds upstream of the dams.[6] But then in the mid-1990s, new national laws and regulations appeared, as did low wholesale market prices for electricity, leading to the current era of fear and loathing between publics and IOUs, with direct-service industries and environmental interests also playing major roles.

Voluntary Compliance

Even today, the Pacific Northwest region's utility industry is in flux. At the federal level, the Energy Policy Act of 1992 encourages competition in the marketplace for wholesale electric power. The Energy Policy Act freed investor-owned utilities from regulation of wholesale power just as the airline, railroad, trucking, gas, and telecommunication industries had been earlier set free.[7] On the heels of that law came the Federal Energy Regulatory Commission's regulations directing IOUs to "volunteer" to form regional transmission organizations (RTOs)—groups that coordinate transmission planning and operation within a region. FERC will continue to regulate transmission rates, but RTOs must operate independently from the entities that generate and market power, and they must offer wholesale transmission access to all comers. Deregulation and the formation of RTOs are enormous changes from the traditional operations of vertically integrated, regulated, monopolistic IOUs.

Although the Bonneville Power Administration is generally exempted from provisions of these new regulatory requirements, it declared that it would voluntarily comply. As a result, BPA divided itself into two administrative parts: a power generation and marketing division and a transmission division. This division plays havoc with BPA's rate-setting process; BPA's total revenues must offset its total costs, but now each separate division sets its own rates, and employees in the two divisions are prohibited by internal fiat from interacting to any great degree with one another. This leads to uncertainties as to BPA's ability to ensure that overall revenues actually reflect the cost of operations.

Like PBA, consumer-owned utilities are not generally subject to the Energy Policy Act or to the RTO rules. Nevertheless, some publics feel they ought to join an RTO, and discussions among regional interest groups about how to organize one and what form it should take, are occurring.

In the late 1990s, utilities in the Pacific Northwest spent a great deal of time and effort attempting to establish an RTO. This first attempt came to naught chiefly because it would have resulted in huge cost shifts among utilities, both publics and IOUs. RTOs would average costs—blending high-cost with low-cost transmission. For example, PacifiCorp would see its costs drop because its newer transmission facilities are very expensive, while costs for Idaho Power Company would rise because the company's facilities are much cheaper. Worse, no benefits for the cost shifts could be found. Indeed, because the Northwest's power resources and transmission services have been operated for many years as if the region were served by one utility, many question whether an RTO will create any economic benefits at all for consumers.

Market Shifts

The market has had a tremendous impact on industry politics in the Northwest. In 1995, for the first time, the market price for wholesale energy fell below Bonneville Power Administration's rates.[8] Even though BPA reduced its rates by 13 percent through cost-cutting in 1996, customers left or tried to leave BPA in droves in search of cheaper rates. Several direct-service industries strong-armed BPA into special deals at a rate above market, but below BPA's cost-based rate to publics. And many publics turned to other suppliers for up to 30 percent of their load. Nothing is forever, however. Market prices rose above BPA's rates in 1998, and now those same customers are anxious to buy all their power from BPA. And, for the near term, BPA has little incentive to reduce or contain its costs.

Here is the math of the situation. BPA has approximately 6,400 average megawatts of energy to sell to regional customers.[9] Publics now take about 4,300 average megawatts but may increase this load when new contracts are signed this year. Since 1981, investor-owned utilities have received payments from BPA to make up the difference between their higher retail residential rates and the retail residential rates charged by publics. Now, IOUs find those payments shrinking.[10] BPA therefore wants to provide the IOUs annually with the equivalent of 1,000 megawatts in monetary payments plus 900 to 1,200 megawatts of power. Direct-service industries have no statutory right to federal power, yet through intense pressure on the Secretary of Energy, they have cornered BPA into offering them 1,440 megawatts. Thus BPA must supply more power than is currently produced, and at market prices. BPA wants to meld the market price of that power into the lower cost of federal power. To do that, BPA would, in its periodic hearings to set rates, add to the cost of federal power the higher cost of the market power it had to purchase. Moreover, environmental interests are demanding nearly $1 billion per year from BPA to breach dams and continue other programs that they say will save fish.

Native Unrest

Adding to regional unrest and political maneuvering are several groups whose actions threaten the preferential right of public utilities to buy at cost federal power, which they resell to their customers at cost. For example, the governor of Oregon—apparently aided and abetted by some investor-owned utilities and the state regulatory commission—seeks more of the cheaper federal power for Oregon's residential consumers, who are, of course, voters. IOUs currently serve 75 percent of Oregon's population. Another group, led by direct-service industries, has hatched a plan to eliminate BPA's power marketing activities by forming a cooperative that would buy federal power directly from the Corps of Engineers and Bureau of Reclamation. Both of these schemes would require statutory changes to end public utilities' preferential access to federal power. Then, too, interest groups outside the region advocate that BPA sell power at market rates, thus threatening the requirement that BPA sell power at cost-based rates.[11]

Changing Times

Congress and FERC have nagged and prodded states into considering deregulation of retail rates. Two of the four Northwest states now have retail deregulation statutes. Montana's 1998 law gives publics the choice of offering their consumers access to other providers through the publics' transmission system. If the utility chooses to offer access, it must certify that it has adopted a plan for an orderly transition to provide choice for all consumers. If the utility chooses not to offer its customers access to other providers, it is precluded from serving consumers in another utility's service territory. Investor-owned utilities, on the other hand, must allow their consumers access to the open market in any case.

Oregon's statute, passed in 1999, requires IOUs to let their commercial and industrial consumers buy power in a competitive market by October 1, 2001. IOUs must offer their residential customers a portfolio of options, including power from environmentally benign sources. As is the case in Montana, Oregon's consumer-owned utilities are not subject to the mandates affecting IOUs. On the other hand, if a public utility acts to serve consumers outside its service territory, then it is subject to the reciprocity requirements and must provide its own consumers with access to the market.

The theory behind allowing publics to opt out of providing open access to their consumers relates to their structure. Accountability to their consumer-owners—in short, local control—is what sets them apart. It remains to be seen whether, over the long haul, local governance will be sufficient to let consumer-owners chart their own course, or whether the states or the federal government will deem it necessary to preempt self-determination and mandate retail access.

Yet more change is occurring at the state level in the Northwest. Publics are beginning to offer other products such as cable television, Internet service, and related telecommunications services. IOUs and telecommunications companies are challenging publics in court and in the state legislatures to halt these activities. These challenges appear to be anticompetitive in an era when competition is the goal *du jour*.

IOU mergers are having an impact on regional politics, as well. Until 1998, the six regional IOUs were locally headquartered. In that year, Enron, a Houston-based energy marketer and developer, bought Portland General, one of the three IOUs operating in Oregon.[12] PacifiCorp, the largest IOU in the Northwest, was purchased in 1999 by Scottish Power, a large IOU in Great Britain.

A locally owned and controlled utility could be very attractive to consumers confronted with distant marketers and corporate headquarters. New public power systems—municipals, public utility districts, and cooperatives—might emerge as a means of assuring affordable basic service in a deregulated world. Indeed, all four Northwest states allow the formation of these entities, and IOUs see them as a threat.

In a nutshell, the sources of change in the Northwest utility industry are wholesale rate deregulation; new institutional structures such as regional transmission organizations; retail rate deregulation, which allows consumers access to the marketplace; threats to the preferred status and cost-based rates of federal power; challenges to publics offering telecommunications services to their consumers; and mergers within the IOU ranks.

Public power in the Northwest could, uncharacteristically, bemoan its fate at the hands of such changes. But, being a scrappy bunch, publics will see reasons for continuing to flourish. Many have always been poles-and-wires utilities and do not have assets with enormous investment costs that some of the changes could put at risk. Moreover, they pride themselves on being responsive to the needs of their communities and will most assuredly continue to fend off threats to their existence.■

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NOTES

1. Nearly 3,000 consumer-owned utilities operate in the United States, providing service to a quarter of the nation's population and operating in every state. The Pacific Northwest is home to 61 cooperatives and mutuals; 28 people's or public utility districts; and 17 municipals. Combined, they provide electricity to just under half of the region's 10 million residents. The balance is served by six investor-owned utilities. A people's utility district (as it is called in Oregon) or a public utility district (the nomenclature in Washington) is a governmental corporation established by voters to supply electric or other utility service. Cooperatives and mutuals, unlike public utility districts and municipals, are not governmental entities; they are private, nonprofit corporations. Cooperatives are owned and governed by their members–the people they serve. Mutuals are a variant; they are owned by the property owners who receive service. Customers who don't own the property served cannot vote for board members.

2. Material for this section is extracted from Public Power Council, *Public Power Fundamentals* (Portland, Oregon: PPC, 1995).

3. Bonneville Project Act of 1937, 16 U.S.C. § 832c(a) (1994).

4. Initially, BPA provided cheap power to the aluminum industry to help support the war effort. Later, cheap federal power served as an inticement to bring large industrial plants, with thousands of jobs, into the region. At this writing, BPA sells power to 11 direct-service industries.

5. Another factor contributing to regional unrest was the $2.25 billion default on the bonds that the Washington Public Power Supply System sold to construct several nuclear plants.

6. Since passage of the Pacific Northwest Electric Power Planning and Conservation Act, BPA has paid over $3 billion to various entities for programs–many having conflicting goals–to improve salmon runs. Despite the time and money spent, results are negligible or worse than before.

7. IOU activities are regulated at the wholesale level by the Federal Energy Regulatory Commission, and at the retail level by state utility commissions. Publics are generally not subject to FERC or state regulation. They are regulated by their owners through elected mayors and city councils (municipalities); elected boards of commissioners (both people's utility districts and public utility districts); or elected boards of directors (cooperatives and mutuals). BPA is not subject to state regulation, nor is it subject to the same kind of FERC regulation as are IOUs.

8. Market price fell to an average of 1.2 cents per kilowatt-hour; the BPA rate to publics averaged 2 cents per kilowatt-hour.

9. The amount of energy available to serve regional loads has been steadily reduced since the late 1980s because the Army Corps of Engineers and Bureau of Reclamation must operate the dams in a manner that allegedly will increase salmon runs. Indeed, under the banner of saving fish, there is a movement afoot to breach, or tear out, four dams that together have a capacity of about 4,000 megawatts.

10. As mandated by the Northwest Power Act–and to create peace in 1980–BPA had been paying IOUs to sell power cheaper than the IOUs' going rates so that residential consumers of IOU power would be paying the same as residential consumers of public power.

11. Selling federal power at market rates would mean that if market price again dipped below BPA's costs, BPA's repayments to the Treasury would be in jeopardy. See *Public Utilities Fortnightly* 138 (4) (Feb. 15, 2000), p. 23.

12. Enron appeared poised to take the retail energy market by storm. Increasing market prices, as well as the failure of the Oregon legislature to open the state up promptly to retail competition, were evidently a great disappointment to Enron, for it recently announced the sale of Portland General to Sierra Resources, a Nevada IOU.

A Cautionary Tale on Municipalization

After a long, bitter fight against El Paso Electric Company, the city of Las Cruces decided not to municipalize.

BY DAVID DANIEL AND DOUGLAS GEGAX

Deregulation of the electricity industry offers customers in many states the chance to get a better deal. No longer bound to incumbent generators of electricity, which are typically investor-owned utilities, customers are free to shop the power market in search of lower rates.

Deregulation, however, is not the only path available to get rid of the incumbent. Across the nation, municipalities are going a step further and forming their own electric utilities by acquiring distribution systems and securing alternative generation sources.

Las Cruces, New Mexico, was almost one of them. Rising costs, unexpected obligations, and changes in the regulatory environment, however, ultimately prompted Las Cruces to settle its fight with the local incumbent utility and cease its efforts. For cities and towns contemplating municipalization, the experience of Las Cruces is highly instructive.

The Impetus

The conflict between Las Cruces and El Paso Electric Company—the investor-owned utility that serves the Las Cruces area—began nearly 30 years ago, long before deregulation. In the mid-1970s, EPE—along with six other utilities from New Mexico, Arizona, and California—decided to invest in the Palo Verde Nuclear Generation Station, which was to be built near Phoenix. EPE reasoned that it had little or no excess electricity generation capacity, it faced increasing demand for electricity in its service area, and it projected a continuation of high prices for oil and natural gas, which were the fuel sources for alternative electric generation technologies.

The pro-nuclear sentiment of the 1970s, of course, was not limited to EPE. Across the nation, utilities in dire need of new generation capacity at that time viewed nuclear as the best investment. A national desire to be independent from Mideast oil producers while addressing environmental concerns about coal-burning generation plants also bolstered the wave of nuclear investment proposals.[1]

Nonetheless, the city of Las Cruces opposed the Palo Verde investment, believing that EPE's estimate of future demand for electricity was high, as was its future price estimates of oil and natural gas. City officials were also concerned that EPE had not recognized future energy-conservation technologies that could reduce electricity consumption, and that rate increases would be required to cover the costs.

As it turned out, the city was largely correct. Demand did not increase dramatically because population growth in the area did not reach EPE's projections. Moreover, uranium mines in the area that had boomed during Palo Verde's planning stage—and were themselves enormous consumers of electricity—shut down as the uranium industry collapsed, and conservation efforts by homeowners and businesses reduced the need for generation capacity.

Nevertheless, construction proceeded—albeit with delays and unexpected surges in interest rates that led to cost overruns—and Palo Verde came online in 1988. In the end, however, the huge cost, coupled with lack of demand, meant that EPE was unable to sell enough electricity to cover its investment. Consequently, electricity rates began to soar. Because Las Cruces' contract with EPE was to expire in

1993, city officials began investigating alternative sources. The Las Cruces city council subsequently passed an ordinance in 1991 to establish a municipal electric utility.[2]

As with most municipal electric utilities, the city's plan called for Las Cruces to own the local distribution system—which it would purchase from EPE—but not an electric-generation plant. Consequently, the city would have to buy wholesale power and arrange for its transmission from the wholesaler's generation plant to the city's distribution system.

In 1994, the city signed with Southwestern Public Service Company to supply power and to operate and maintain the distribution system. City projections, at that point, indicated that electricity consumers would get a maximum potential savings—over the price that EPE would have charged—of 29 percent over a 14-year period.

The savings, however, were predicated on several assumptions:

- EPE's distribution system serving the city would be purchased for $20-30 million, which was EPE's original cost, minus depreciation.
- The city's costs in establishing a municipal utility would be limited almost entirely to the cost of acquiring the distribution system.
- EPE's future rates would not deviate from projections made in 1994.

By 1999, none of these assumptions held true. The cost of the distribution system would be greater than EPE's depreciated book value, the city's costs in setting up the municipality would include substantial stranded generation costs, and EPE would reduce its rates to 8 percent below the city's projected levels. Furthermore, the plan to reduce rates by 29 percent did not take into account the state of New Mexico adopting electricity deregulation that would allow customers to pay competitive market-based prices for energy regardless of who owns the distribution system.

Buying the System

EPE had no intention of giving up Las Cruces without a fight. It initially refused to sell its local distribution system to the city. Consequently, in 1994, the city began condemnation proceedings, and a series of legal skirmishes followed. After the state legislature intervened, however, and the New Mexico Supreme Court gave its approval, the city prevailed, winning the right to condemn the system. The year was 1998.

Paying for the distribution system, of course, was another matter. Before the right-to-condemnation issue was settled, the city had begun securing the financial means to acquire the system. In 1992, the state authorized the city to sell up to $90 million in tax-free municipal bonds.

To mobilize community support for its municipalization efforts and to receive local approval for the required issuance of bonds, the city then held a bond election in 1994. Leading up to the election, city leaders promised a 20 percent reduction in rates—hedging slightly from the original projection of a 29 percent rate reduction—if citizens would "pull the plug" on EPE.[3] The question passed, and the city issued and sold $72.5 million in bonds.[4]

Not surprisingly, EPE objected and filed suit in the state district court, alleging that the city needed approval of the New Mexico Public Utility Commission to sell the bonds. The suit was ultimately dismissed. The city then had the right and the money to purchase EPE's distribution system.

Just Compensation

The Fifth Amendment to the U.S. Constitution establishes the right to due process and just compensation for confiscated property. Arriving at a price that would justly compensate EPE for its distribution system, however, was no easy matter. Estimates were all over the map. A consulting firm hired by EPE valued the system at about $200 million. In response, two appraisers hired by the city separately valued the system at $37.9 and $38.7 million. Later, three more appraisals were obtained—one by the city at $36 million, one by EPE at $60 million, and one by an independent appraiser at $42 million.

Why the discrepancies? Three types of valuations were actually made: market value, which includes compensation for lost future profits and is generally the highest valuation; replacement value, which is the cost to rebuild the system; and depreciated book value, which is based on the owner's original costs of purchase less accumulative depreciation and is often the lowest valuation.[5]

Because New Mexico is a "fair value" state, determination of just compensation would have to consider all three types of valuation. Thus, the resulting number would be lower than fair market value, but higher than EPE's depreciated book value. This meant that the city's distribution costs, to be considered in any future municipal utility rate determination, would have been greater than EPE's distribution cost. As a result, customers would have paid more for distribution under municipalization than under EPE, even though the physical system would not have changed. As the city decided not to municipalize before a valuation was determined, we do not know what this amount would have been.

Unexpected Obligations

In addition to buying power from a supplier and obtaining the distribution system, the city had to resolve the question of transmitting—or wheeling—that power from the supplier to its distribution system. And that, again, involved EPE; power would have to be wheeled from Southwestern Public Service's generation plant over EPE transmission lines to Las Cruces.

The Federal Energy Regulatory Commission's Order 888 obligates transmission facility owners to transmit wholesale power for third-party transactions. Additionally, the fees for such transmission must be nondiscriminatory—that is, the fees must equal what the transmission owner charges its own customers for the same service. Because the transaction between Las Cruces and Southwestern Public Service would be of the wholesale variety, the FERC would have jurisdiction.[6]

Prior to the issuance of FERC Order 888, EPE would not have been obligated to transmit another company's wholesale power to the city, and the wholesale power agreement between Southwestern Public Service and the city could never have occurred—unless, of course, EPE voluntarily offered its transmission services, which is a dubious proposition.

The obligation to wheel under FERC Order 888, however, is subject to transmission availability. And EPE insisted it did not have adequate transmission capacity to accommodate the wholesale power agreement between Las Cruces and Southwestern Public Service. Consequently, Southwestern Public Service and the city sought and received a ruling from FERC that EPE did have sufficient capacity and would have to provide transmission access to accommodate the city.

FERC Order 888 presented a good-news/bad-news situation for the city. The good news was that EPE had to connect Las Cruces with the outside world. The bad news was that the city would be obligated to pay 100 percent of EPE's stranded costs associated with the generation investment dedicated to the city. Specifically, Order 888 states that if a utility loses customers solely because of the order itself, those customers are obligated to pay the generation costs—the stranded costs—associated with the generation capacity dedicated to those lost customers. Thus, the city could not pull the plug on EPE without paying these stranded costs. In May 1998, FERC ruled that the city's stranded-generation cost obligation to EPE would be $53 million.[7]

The city had not expected this obligation. Indeed, it had assumed that the distribution acquisition costs would comprise most, if not all, of the costs of establishing a municipal utility. When stranded costs were added to the cost of acquiring EPE's distribution system—and, of course, there was the city's mounting legal fees—the initial costs of municipalization approached $110 million dollars, which was significantly greater than the $30 million anticipated in 1994 when the city promised to reduce rates by 20 percent.

The straw that broke municipalization's back, however, was yet to come—deregulation of New Mexico's electricity industry.

The New Act

Prior to deregulation, many cities across the nation municipalized their utilities to get a better deal on rates. For municipalization to be cost-effective, however, the wholesale price a municipal utility could get must be lower than the energy component of the final retail price offered by an incumbent utility. That would have been the case for Las Cruces' retail customers in the late 1980s and early 1990s. Deregulation, however, changed all that.

New Mexico's Electric Utility Industry Restructuring Act of 1999 deregulates the generation component of electricity rates and ensures that all customers will soon pay competitive, market-based prices for energy, whether or not a city municipalizes.

Thus, in a deregulated environment, there are no special bargains on energy available to a city through municipalization. By way of comparison, under deregulation of the telecommunications industry, retail customers must specifically choose a long-distance provider. Under electricity deregulation, however, customers will benefit from competition even if they do not specifically choose an alternative electricity generation supplier.

Retail customers that do not choose a supplier can ask their local distributor to do so for them. This arrangement is referred to as a "standard-offer contract" or "default full-service contract."[8] Under such an arrangement, the local distribution company—whether, in this case, EPE or the city of Las Cruces—must purchase competitive wholesale electricity on behalf of its retail customers. The local distribution company must then pass the costs of this purchased wholesale energy to its retail customers without any markup in price.[9]

New Mexico's deregulation efforts also affect the recovery of stranded costs. Recall that if the city had municipalized, FERC would have required the city to pay 100 percent of the $53 million in stranded cost. Under state deregulation, and with EPE maintaining ownership of the distribution system, customers would be required to pay a minimum of 50 percent of the stranded cost; stockholders would have to absorb the rest.[10] Therefore, as was the case with distribution costs, the city's customers would have paid more stranded generation costs under municipalization.

The New Mexico deregulation bill also states that municipal utility boards have the option not to participate in deregulation, except for Las Cruces in the event that it should municipalize.[11] Therefore, if the city had become a municipal electric utility, it would have been obligated to offer nondiscriminatory open access to alternative generation suppliers, which certainly would have been ironic. If customers chose alternative suppliers, the city would not only have had to pay 100 percent of EPE's stranded cost, it would also have had to pay a portion of the contracted power with Southwestern Public Service that was left stranded because of lost customers, and it would not have had a corresponding stream of electric revenues to make the payments.

Finally, the price paid by customers for transmission service would have been the same whether or not the city municipalized, because under both federal and state rules, utilities cannot discriminate in their pricing and availability of transmission services.

Losing the Edge

Let's revisit the sequence of events that led to Las Cruces's decision not to municipalize. In 1994, Las Cruces believed a municipal takeover of EPE's distribution system would lower electricity rates. That did not prove true, however, because of a variety of obstacles including, notably, deregulation. Indeed, under deregulation, municipalization provides few benefits.

First, competitive wholesale power procurement is not an additional benefit to a municipal utility in a world of deregulation where all local distribution companies can access the same wholesale power rates.

Second, while FERC Order 888 makes it easier to gain transmission access to alternative wholesale suppliers, it obligates municipalized entities seeking a wholesale transaction arrangement to pay the stranded costs of the utility providing the transmission lines.

Third, cities contemplating condemning an incumbent's distribution system should expect a costly fight and should expect to pay more than the incumbent's depreciated book value. In these situations, the customers who ultimately use the power will end up paying more for what they already have—through a higher distribution component of their electric rate.[12]

Of course, a municipal could opt to maintain the distribution component of the rate at the pre-municipalization level. In this way, it might appear as if electricity prices have not increased. However, the additional cost must be paid somehow and, absent an increase in electric bills, this cost most likely would be covered by property taxes.

These obstacles notwithstanding, some cities might still wish to municipalize because of access to cheap financing via tax-free municipal bonds—though that alone may not be enough to tip the scale in favor of municipalization—or to use green energy sources that the market may fail to deliver.[13] Based solely on price, however, municipals may well have lost their edge.■

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NOTES

1. Coal is the primary energy source in U.S. electrical generation.

2. In January 1992, things worsened for EPE. As a result of its enormous amounts of excess generation capacity and failing diversification efforts, EPE declared bankruptcy. EPE finally came out of bankruptcy in January 1996. However, the initial declaration of bankruptcy gave the city more political fodder for establishing a municipal electric utility.

3. A key assumption in delivering the reduction in rates was that the costs to set up the municipal utility would be no more than $30 million. If the $72.5 million had actually been spent on setting up a utility, however, most likely there would have been a very small, if not a zero, reduction in rates. Apparently then, the city was willing to forge on with its municipalization efforts even if it became merely a break-even proposition. This is a testament to how bitter the fight between the city and EPE had become.

4. Actually, the voters approved the issuing of up to $90 million of municipal revenue bonds that could be used for, among other things, establishing a municipal electric utility.

5. Depreciated book value represents the costs that EPE's regulated rates covered.

6. FERC regulates wholesale energy transactions and the use of transmission in interstate commerce. State public utility commissions regulate retail rates. With EPE being the incumbent utility, the city's customers are retail customers of EPE, and therefore the public utility commission has jurisdiction over rates as well as the determination of stranded cost under deregulation. With municipalization, the city's relationship with Southwestern Public Service would have become a wholesale relationship and, therefore, FERC would have

had jurisdiction over issues of transmission access and stranded costs.

7. Because this was a precedent-setting case–it was the first Order 888 stranded-cost decision FERC was to rule on–FERC tried to get the two parties to settle their differences on the stranded-cost obligation themselves. Not surprisingly, the city and EPE were unable to do that.

8. Indeed, in California and the Northeast states where deregulation has been in effect for a couple of years, the vast majority of customers (98 percent in California) are on the standard-offer contract.

9. There are, of course, charges for distribution and other services.

10. In order for the incumbent utility to obtain more than the minimum 50 percent, the New Mexico deregulation bill states that the incumbent utility must show, by a preponderance of evidence, that it is in the overall public interest to do so. As such, there is a very heavy burden of proof on the incumbent to get more than 50 percent.

11. Earlier legislation had granted Las Cruces the exclusive right to condemn EPE's distribution system. Thus the exception was, in a sense, a quid-pro-quo arrangement to keep the city from using municipalization as a way of precluding its citizens from enjoying the benefits of deregulation.

12. In the final settlement that ended municipalization efforts, EPE paid the city almost $21 million to offset the city's costs incurred during the fight and to purchase a newly constructed substation that the city built in anticipation of acquiring the distribution system. Since municipalization proved not to be cost-effective, the settlement was a good thing for the city. An interesting issue that remains is what the city plans to do with the $72.5 million it obtained by issuing bonds in 1995. Apparently, the city is leaning towards using the funds to pay off the bonds earlier than when they are due.

13. The Sacramento Municipal Utility District in California is a good example of a municipal utility aggressively promoting decentralized green power.

Open Access

Gridlock Ahead?

The North American electric grid, with its myriad generators, wires, switches, breakers, and more, moving vast amounts of electricity to virtually every point on the continent is aptly called the world's largest machine, says TVA Executive Vice President Terry Boston. Unfortunately, that machine has been sputtering a bit as of late. Witness the string of blackouts last summer that left hundreds of thousands without power.

What's happening? Boston says part of the problem rests with restructuring, which has the electric utility industry "sprinting toward competition before it can walk." The result? Reliability suffers and "instead of acting as a lifeline, electricity is in danger of becoming just a bottom line." Indeed, Boston, citing a Department of Energy report on the blackouts, warns that: "the necessary operating practices, regulatory policies, and technological tools for dealing with the changes are not yet in place to assure an acceptable level of reliability." Simply put, the transmission system—the lines and facilities that move electricity from generator to consumer—cannot handle the flood of activity unleashed by restructuring.

Of course, not all competition is bad; many can benefit from the lower prices that competition and added generation will bring. However, unless improvements to the transmission system are made along with increases in generation, says Boston, "we may be putting out the fire with gasoline."

Paul Sotkiewicz, an economist at the Federal Energy Regulatory Commission, echoes those concerns about reliability and raises others such as market power and rate pancaking. The former refers to utilities interfering with competition; the latter, to the stacking of charge upon charge to transmit electricity across multiple systems. In response to these concerns, FERC, in December 1999, issued Order 2000 encouraging utilities to form regional transmission organizations. If successful, RTOs will help ensure that competition achieves its goals of increased efficiency and lower rates without jeopardizing reliability. That is, they "will handle the problems, and realize the benefits, of restructuring."

East Kentucky Power Cooperative is familiar with RTOs. In fact, it helped organize one. It has not joined, however. Why? According to Paul Atchison, vice president of Power Delivery at the cooperative, an appropriately sized RTO could definitely help with the problems wrought by restructuring. But before EKPC signs on the dotted line, a few issues must be resolved—things like transmission rates and tax-exempt status. In short, the benefits to EKPC's customers of joining would have to outweigh the costs.

Reliability, market power, and pricing aside, another aspect of the relationship between restructuring and the transmission of electricity bears examination: the propensity of a small number of public utilities to behave like for-profit businesses rather than nonprofit institutions dedicated to serving the public good. Ralph Cavanagh of the Natural Resources Defense Council provides a startling example: public utilities building duplicate distribution systems to cherrypick choice customers from neighboring power grids. Says Cavanagh, "This behavior invites comparisons to rapacious enterprises dominated by short-term shareholder interests. Yet those responsible are nonprofit institutions with a long history of local control and community service."

Indeed, this behavior leads Cavanagh to question the justification for public power in today's environment where "privately owned companies [are] seemingly able and eager to provide service for all." The claim that public power is cheaper leaves public utilities vulnerable in an age of competition. Instead, he argues, "a more compelling mission statement for public power starts with the image of America's hometown electricity company, committed to serving poor and rich alike, helping all customers use electricity more efficiently, and promoting cleaner power sources." Pretty good goals all in all.

The Editors

Electricity: Lifeline, or Bottom Line?

If we're not careful, the benefits of competition may be overshadowed by a loss of reliability.

BY TERRY BOSTON

On a blistering day last July, two large cables at a Chicago substation failed, triggering a local blackout that sent hundreds of air-conditioning deprived residents to hospitals and a few, tragically, to cemeteries. At its worst, the blackout left more than 100,000 people without electricity, and thousands remained that way for the better part of three days.

This was only one in a string of blackouts during the summer of 1999 that afflicted hundreds of thousands in New York City, Long Island, New Jersey, the Delmarva Peninsula, and four Gulf states. And the problems were not confined to local power companies; several high-voltage transmission systems—designed to deliver vast amounts of power over great distances in all sorts of weather—strained to keep up with demand. Over the course of five tense weeks, two other blackouts hit Chicago while other electric systems suffered with voltage problems and a few teetered on the brink of collapse.

What's happening here? Why is the world's strongest, most reliable electric grid scrambling to keep up with hot, but not unprecedented, summer weather? And why is it hard for some transmission operators to make eye contact when asked about the prospects for this summer? The reasons are complex, and agreement is lacking, but many point to the pressures competition is placing on an industry still learning how to compete. In short, the move to restructure the electric utility industry has the industry sprinting toward competition before it can walk. As a consequence, the long-sacred focus on reliability is beginning to blur. Instead of filling its traditional role as a lifeline, electricity is in danger of becoming just a bottom line.

Lights Out

Blackouts—small or large—are nothing new; but the reasons for some of last summer's blackouts and near misses are disturbing. For example, the U.S. Department of Energy cited Chicago's Commonwealth Edison for scrimping on its substation maintenance budget—which went from a high of $47 million in 1991 to just $15 million in 1998—as it shifted money into its nuclear program and preparations for competition.[1] Other systems, including TVA's, were threatened when operators were unable to predict the massive amounts of power flowing across their systems from eager new sellers on one side to eager new buyers on the other.

Unless transmission operators

understand exactly where and when power will flow across their systems, lines that are already overburdened by severe weather can fail, triggering widespread disruptions. Looking at the blackouts of 1999, DOE concluded that ". . . the necessary operating practices, regulatory policies and technological tools for dealing with the changes [resulting from a restructured environment] are not yet in place to assure an acceptable level of reliability."[2]

Energy Secretary Bill Richardson and Federal Energy Regulatory Commission Chairman James Hoecker have warned of more blackouts this summer, and Richardson criticized policymakers who "haven't kept pace with the rapid changes in the electric utility industry."[3] While many would welcome legislation to ensure reliability, the industry desperately needs something more—time. Unless the industry has time to strengthen the grid, time to understand the new pressures that competitive pricing brings, and time to develop the complex computer modeling and analytical tools needed to safely manage the phenomenal increase in electricity transactions, many fear the grid may be headed for the most severe outages since the New York blackout of 1965. The Electric Power Research Institute estimates that power failures in the United States cost the economy approximately $50 billion per year.

The World's Largest Machine

Someone once called the North American electric grid—the massive conglomeration of generators, wires, switches, breakers, and related equipment that produces and moves electricity to almost every point on the continent—the world's largest machine. It's an apt description.

Originally, utilities were built to serve specific geographic regions and were physically isolated from one another. America literally had islands of electricity haves and seas of electricity have-nots. In fact, when TVA was created in 1933, only 3 percent of farms in the Tennessee Valley had electricity.[4] As technology improved and power plants increased in size, these islands grew and began to connect with one another. Many of the connections were established to promote reliability in the wake of the 1965 New York blackout, allowing power to be routed in any number of ways to circumvent local problems.

Today, a single massive, interconnected grid serves the eastern United States and eastern Canada, while two other grids serve Texas and the western half of the continent. On that grid, large transmission lines—some operating at up to 765 thousand volts—move electricity from generators to lower-voltage local distribution systems where smaller lines take it to individual consumers.

Transmission is critical because electricity cannot be stored. Natural gas can be kept in tanks and pork bellies can be stored in freezers, but electricity is consumed the moment it is produced. The challenge then is to make electricity instantly available in the exact amounts demanded 24 hours a day, seven days a week. If the amount of power delivered equals the amount consumed—every second of every day—and if power plants, lines, switches, breakers, and insulators all do their jobs properly, we have reliability. If any part of the machine fails, however, power is interrupted. Interruptions can range from a few milliseconds, unnoticed except by sensitive computer equipment and VCRs, to outages that plunge a single street or entire regions into darkness.

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Balance between neighboring power systems is also critical. If one system under-generates—either deliberately to exchange power, or accidentally because a power plant shuts down—imbalance results and electricity flows in from other systems like water through a breached levee. When that happens, systems can overload, and because they are designed to prevent problems from spreading, they automatically shut down. In the most extreme conditions—when weather forces heavy demand for electricity, and equipment over a wide area gets loaded to the maximum—losing a line may shift the burden to other lines, overloading them and causing them to fail. In those cases, power systems can begin to resemble a row of dominoes, which is what caused the West Coast blackout of 1996.

Enter Competition

Changes in national energy policy have encouraged the growth of independent power producers, electricity marketers, and brokers—all of whom differ fundamentally from existing utilities: they don't own their own lines. Consequently, these new entrants to the industry must rely on established transmission owners to provide the critical trade routes that move their product to market—even though at times they compete with those same transmission owners for capacity to serve native load customers. In fact, to promote competition, the Energy Policy Act of 1992 required utilities to provide these new players with transmission service virtually identical to the service they provide their own generators.

Traditionally, nature has posed the major threats to a reliable power delivery system. Tornadoes and ice destroy transmission structures. Lightning knocks out equipment. Trees grow and fall into power lines. And while those hazards still exist, competition challenges reliability in ways that we are just beginning to recognize and address.

Competition means that more and more power is flowing in more and more directions on the grid as the number of deals grows exponentially.

Planning in a Vacuum

Location is always a key consideration in building a new generating plant. Historically, plants were built where the transmission system could handle, or could be made to handle, the added power. In short, planning for new power plants always occurred in lockstep with planning for transmission. Plants were built where it made the most electrical sense, often near large concentrations of customers to minimize transmission problems.

Today, however, power plants are built wherever it makes the most economic sense for the growing number of new players. The most attractive locations seem to be where natural gas pipelines converge with transmission interconnections between utilities. The pipelines provide fuel for the plants; the interconnections allow quick access to market. However, the existing transmission facilities may not be adequate or may be used up by the introduction of more generators, exposing everyone who depends on the transmission system to greater risk of interruptions.

And we are not talking about a handful of new power plants. Gulf States near natural gas well heads are seeing hundreds of requests to connect from independent power producers with a combined generating capacity that the existing grid cannot possibly accommodate. At the same time, due to environmental and land-use concerns, building new lines has never been more difficult.

And while new plant owners must pay for any transmission upgrades necessary to connect to the grid, some owners question the need for improvements and others complain that utilities may be using the connection process to restrict access.

Operating Conflicts

Adopting the mindset of blue-water sailors—always assume that the boat is trying to sink and do your best to keep it afloat—transmission operators are doing their best to ensure reliability. Doing so is no easy task. Each day on the TVA system alone, hundreds of thousands of calculations are made to determine the demand for power, which plants to run, which to keep on backup, and which to shut down for maintenance. Operators also need to know which lines, substations, and switching equipment must be available at any given time, and which they can afford to take out of service temporarily for maintenance. Finally, they must know how much power will be flowing across their systems from producers on one side to consumers on the other. Without all that detailed information, the transmission system is extremely vulnerable, and ensuring reliability is simply not possible. And even with it, better tools are needed to instantly analyze the data and enable us to provide relief to the right place at the right time.

Competition means that more and more power is flowing in more and more directions on the grid as the number of deals between suppliers and customers grows exponentially. While TVA had about 20,000 interchange transactions with other utilities and marketers in 1996, it had nearly 300,000 in 1999. Since electricity follows the path of least resistance and respects no political or system boundaries, utilities sometimes find their lines clogged with power that they neither generated nor planned for. Because of the limited ability to predict how power actually will flow from moment to moment, power from most utilities—including TVA—sometimes inadvertently flows into or through neighboring systems.

In times of crisis, the added traffic can confound the efforts of operators to prevent a calamity. On a hot day last August, 10,000 megawatts—an output equivalent to that of eight large nuclear plants—flowed through the TVA system, three-quarters of it unplanned. The result: TVA—despite all its efforts— was one thin mishap away from a widespread blackout. In the future, as dozens of new plants are added to the grid, these inadvertent power flows—and the problems they cause—will only increase.

There is also concern about the ways some new merchant power plants—which are built to sell power wherever there is a buyer, not to serve a specific area—are being used. One marketer that owns merchant plants in TVA's region, aided by a puzzling interpretation of the rules by the National Electric Reliability Council—a utility-sponsored organization that promotes reliability—determined that its power plants can serve as transmission control areas and points of delivery for power transactions. Normally, a transmission control area contains generators and consumers of electricity and a control center responsible for ensuring that both the supply and demand for electricity are kept in balance. As a control area, the marketer would have the right to reserve space on TVA's transmission system, ostensibly to have large quantities of electricity delivered to its power plants.

Since a power plant consumes only minuscule amounts of electricity, however, delivering large amounts of power to one is physically impossible; and in fact, this marketer has no intention of receiving electricity at its plant. Instead, the arrangement serves the marketer by securing a needed path into TVA's transmission system. Later, when the marketer finds a buyer, it can inform TVA—with as little as 20 minutes' notice—that thousands of megawatts will be flowing across the transmission system, ready or not. We consider this a dangerous misuse of the transmission system and have determined that we will accommodate the marketer's transactions only if reliability can be protected.

Established electric utilities don't always wear the white hat. Competitive pressures can bring out rogue behavior in many organizations. Last summer, for example, one midwestern utility had more demand for electricity than it could supply. Normally in such circumstances, the price of power rises when demand exceeds the supply. If a utility cannot meet its contractual requirement, it should interrupt noncritical and keep critical loads, like hospitals, from being at risk. Instead of interrupting lucrative sales when power prices were exorbitantly high, however, the utility simply allowed its system to become a "black hole" on the grid. Because electricity flows to where it is needed, the utility sucked in power from other utilities without paying the high prices for it and increased the risk of blacking out its neighbors.

Build It and They Will Come

What would happen if, with air travel booming, there were suddenly a freeze on building new airports or expanding old ones? Air travel would likely peak according to the number of planes that airports could safely handle, and then level off. That is not what's happening in the electric utility industry. Nationally, electricity sales are growing at a rate of about 2 percent annually, closer to 3 percent in the southeastern region. To meet this growth and possibly make large profits during periods of extreme demand, new generating plants are being built at an unprecedented rate. At the same time, investment in transmission systems nationally has almost bottomed out. In airline terms, we are building planes and sending them from the gate with hoards of travelers onboard, even though we are dangerously short of runways. To make matters worse, those planes take off and land without talking to the control tower about their flight plan.

In airline terms, we are building planes and sending them from the gate with hoards of travelers onboard, even though we are dangerously short of runways.

Most of the nation's extra-high-voltage transmission lines were built after the infamous blackouts of the mid-60s. They were intended to enable bulk deliveries of power over long distances in the event of emergency—thus ensuring reliability. Today, however, those lines are largely used for day-to-day commerce. New players in the market argue that transmission owners still have the right to curtail transactions to protect reliability, but transmission providers know that every curtailment runs the risk of being challenged politically, publicly, and in the courts.

The societal cost of having too much transmission capacity is small compared to the societal cost of having too little. Yet industrywide transmission is not being built to support the new market. In 1990, utilities' 10-year plans called for a total of 13,000 miles of new transmission lines.[5] After passage of the Energy Policy Act in 1992, those plans began to nose-dive. By 1999, only 5,600 miles were still planned.[6] TVA, I'm pleased to note, has not followed this trend. While the miles of planned transmission lines in the United States have been halved, TVA has doubled its transmission capital budget. We built more than 160 miles of transmission line last year and will build a comparable amount this year to enhance reliability within the region.

The Public Good

Handled properly, competition can bring genuine benefits to society. Regions that have been plagued with high power costs may one day see lower rates. New participants in the industry may play an important role in bringing about this parity, and they should be encouraged to take part. Obstacles to a fair, open, and diverse marketplace should be removed, but carefully and for the right reasons. The public has far too much at stake to allow competition to jeopardize reliability. Already, the pendulum has swung so far in the direction of open competition that reliability is being compromised.

New participants in the industry tend to think of electricity as a commodity, to be bought and sold like any other. They are fond of comparing electricity to natural gas and seek an industry structure in which they can trade electricity without limits. But as long as electricity is dependent upon instantaneous transmission—until it can be stored efficiently for later use—we cannot afford to treat it as a simple commodity. The risks are far too great to permit this mindset to govern energy policy. New players, policymakers, and even many established utilities must come to realize that electric system reliability doesn't happen by itself. It takes planning, resources, and time to ensure that the nation's electric grid will continue to operate smoothly.

The North American grid can become a balanced playing field—accessible to all, supportive of open competition, and robust enough to withstand the worst that nature and growth can throw at it. Or it can decline into a choked and inefficient war zone where interruptions are commonplace, as industry players try to outdo each other in search of short-term profit. Restructuring can help create that balanced field by encouraging new generators to enter the market and relieve the current shortage of electricity production. Without comparable improvements in transmission, however, we may be putting out the fire with gasoline.■

Terry Boston is executive vice president of the Tennessee Valley Authority's Transmission/Power Supply Group, in Chattanooga, Tennessee.

NOTES

1. U.S. Department of Energy, Report of the U.S. Department of Energy's Power Outage Study Team (Final Report) (Washington, DC: March 2000), p.15.

2. Ibid, p.S2.

3. U.S. Department of Energy, *Energy Department Issues: Recommendations to Help Prevent Power Outages,* DOE News Release No. R-00-068 (Washington, DC: DOE 2000).

4.Tennessee Valley Authority, *A Student History of TVA* (Knoxville, TN: TVA, 1984), p.7

5. Lines of 230 kilovolts and greater.

6. North American Reliability Council, *Reliability Assessment: The Reliability of Bulk Electric Systems in North America* (Princeton, NJ: NERC, various years).

Opening the Lines

New federal regulations will boost competition. Getting public power to sign up, however, remains critical.

BY PAUL M. SOTKIEWICZ

Authorized by the Energy Policy Act of 1992, the Federal Energy Regulatory Commission has ordered transmission-owning utilities to allow other utilities to transmit electricity across their facilities—that is, to open their lines to the competition. Competition in this restructured electric industry, policymakers believe, will help achieve two goals: greater efficiency and lower rates.

And greater efficiency in the industry, which in turn helps reduce rates, can be achieved in four ways. First, competition will give consumers the chance to shop around, which should drive down the price of power. Second, lower prices from competition will drive inefficient, high-cost generators out of the industry. Third, it will reduce the likelihood of episodes of surpluses and shortages that occurred under the old regime. Finally, competition will help ensure that new generation capacity is built where demand is the greatest.

The results of competition will be felt both by utilities—even publicly owned utilities, which are not subject to FERC's actions—and their customers. For both, it represents quite a change. Under the old regulatory regime, the transmission system was part of a vertically integrated franchise monopoly in which one entity owned the generators and the transmission facilities and charged its captive customers regulated rates. Monopolies had no incentive to allow competitors access to its transmission system. Under the new regime, utilities must offer open access. First, however, a bit about how the electric system works.

Operating the System

Each transmission-owning utility—whether investor owned or publicly owned—is responsible for operating its transmission system in a way that provides safe, reliable service to its customers without causing harm to other utilities. Failing to do so can result in blackouts.[1]

Operating the system reliably requires many things. First, unlike other commodities, electricity generally cannot be stored. This means that transmission system operators must constantly balance supply and demand by calling on generating units to respond to second-by-second changes.

Second, since electricity follows the path of least resistance, its flow is difficult to control. Indeed, electricity flow can be controlled only insofar as a system operator can change which units are generating and how much they are generating—this is not a precise control method.

Third, to serve customers hundreds or even thousands of miles away, the operator must ensure there is enough voltage in the system to get the power to the customer. If voltages are not maintained, again, the transmission system can collapse and cause blackouts.

Fourth, the operator must keep power flows within prescribed limits to avoid transmission congestion, which can reduce reliability. Operators handle congestion by changing the output of generating units so that flows to the affected line or transformer can be reduced.

Finally, the operator must guard against contingencies that could hurt the system, such as the loss of a large generator or major piece of transmission equipment. To protect against such contingencies, the operator sets aside generation and transmission capacity in reserve.

To further complicate the job of the operator, systems do not operate in isolation; they are interconnected.[2] Consequently, operators must stay in constant communication with each other in order to track, and schedule, potential flows from one system to another to maintain reserves and avoid congestion.

Originally, utilities were connected with each other to share operating reserves. If a utility had a problem, neighboring utilities would come to its aid. In fact, the interconnection gave utilities the incentive to help their neighbors; if they did not help, problems in one system could spill over into neighboring systems. Moreover, the franchise monopoly status of utilities eliminated the threat of competition that might otherwise have stemmed from the interconnection. Today, however, absent monopoly status, interconnection makes competition physically possible. FERC Orders 888 and 889 mandating open access make it a reality.

Restructuring Orders

To facilitate competition in the wholesale electric market, FERC issued orders 888 and 889 in 1996. Order 888 required all investor-owned utilities (IOUs) that own, operate, or control transmission involved in interstate commerce to offer open and nondiscriminatory transmission access to those who request it.

Furthermore, it encouraged publicly owned utilities (POUs) that ask for and receive open access transmission service from an IOU to offer comparable service by offering open access to the IOU. At first glance, it may seem that FERC is asserting jurisdiction over POUs when in fact it has no power to do so. As the Commission pointed out in Order 888, however, FERC does not require POUs to provide access. They can opt out. And there are good reasons for doing so. For example, a POU could refuse to reciprocate if allowing open access would jeopardize its tax-exempt bond financing status. POUs often finance additions to generation and transmission by issuing bonds. Moreover, these bonds enjoy tax-exempt status because it is assumed that the generation and transmission assets are for the private use of the public power entity's owners: the customers. Therefore, POUs are required to receive the vast majority of their revenues from their customer-owners in order to preserve the tax-exempt status of the bonds they have issued. If the revenue received from other sources such as IOUs increased, a POU might lose its tax-exempt status for bond financing.

As an alternative, POUs also have the option of submitting to FERC the terms and conditions under which they offer access and asking FERC to issue a declaratory order stating that the POU's open access conditions meet FERC standards. By seeking a declaratory order, POUs can avoid the potential hassles of dealing with multiple reciprocal open-access agreements.

Order 888 also dictates that transmission owners, as part of their transmission service, must offer ancillary services—for example scheduling, system control, and dispatch; voltage support; energy imbalance service; and reserves—to help ensure system reliability.

Finally, Order 888 encouraged the development of independent system operators—entities that control and operate the transmission systems as a single system on behalf of many transmission-owning utilities. The rationale for an ISO is to eliminate the multiple access charges incurred by crossing multiple systems—known as rate pancaking—and levy only one charge for open-access transmission service.

According to Order 888, ISOs, among other things, must

- **be** independent from transmission and generation owners;
- **ensure** short-term reliability;
- **relieve** congestion;
- **post** information regarding the transmission system such as available transmission capacity, transmission maintenance schedules, and line deratings—reductions of capacity due to weather, maintenance, or other factors—for all potential competitors;
- **coordinate** with neighboring systems; and
- **price** transmission and ancillary services so as to promote efficient use of, and investment in, generation and transmission.

In addition, Order 889 required any utility offering open access to separate transmission and reliability functions from competitive merchant and marketing functions such as generation and trading. The purpose of this is to ensure that the wholesale market operations of the transmission-owning utility and its affiliates do not have preferential access to information about the transmission system. This information, such as maintenance schedules and available transmission capacity, must be posted on an open-access, same-time information system for competitors to see.

In conjunction with 888 and 889, FERC also allowed generation owners to charge market-based rates rather than the cost-based rates that prevailed prior to restructuring.

New Market Institutions

As a result of FERC's orders, two types of market institutions have evolved—bilateral trading markets and ISO markets. To date, the former has been the most prevalent institution, occurring almost nationwide with participating IOUs, public owned utilities, and power marketers—agents who act as a middlemen, buying power from a generator and reselling the power to a third party.

In bilateral markets, utilities, or power marketers, agree to sell electricity to another utility for a certain price. Since the seller and buyer may be separated by hundreds or even thousands of miles, however, they must also purchase transmission service from the system or systems that lie between them. In these markets, transmission service is obtained on a first-come, first-served basis. Once transmission is bought, the parties involved notify the system operators across whose systems the transaction is to flow, and the power flows from generator to consumer.

Unlike bilateral markets, ISO markets are highly centralized.[3] In these markets, generators bid on the amount of power they wish to sell and the price at which they are willing to sell it. In some, but not all, ISO market buyers also bid on the amount they wish to buy and the price they are willing to pay. In ISO markets that do not take bids from buyers, the demand for power is forecast by the ISO. As the market facilitator, the ISO then computes the market-clearing price—the price at which the quantity that generators are willing to supply is equal to the quantity of power demanded at that price. The electricity from generators whose bids are at or below the market-clearing price is then dispatched by the ISO, which makes sure the power is delivered in a safe, reliable manner.

Theory Meets Reality

In theory, market-based rates coupled with open access to the transmission system would allow generating companies to compete with one another in wholesale markets, thereby achieving the two goals of restructuring: greater efficiency and lower rates. And, in theory, open access and competition should be easy to implement. After all, we have been transmitting power reliably for nearly 100 years, FERC has cleared the way for nondiscriminatory open access, and the prevailing market structures are fairly straightforward. Unfortunately, the practice is far more complex than the theory.

Open access and competition in generation could jeopardize the reliability of the transmission system. In fact, transmission owners now have incentives to operate their systems in a manner that compromises reliability in exchange for financial gain. These incentives can promote a range of activities, from cutting back on maintenance to refusing to curtail problematic transmissions. Conversely, to reduce competition, transmission owners can use reliability as an excuse to restrict access to their systems.

Beyond that, the system simply was not built to handle the volume of trades now taking place.[4] As a result, transmission congestion is often a problem in the bilateral markets. Consequently, the North American Reliability Council has promulgated procedures—known as transmission-loading relief—that curtail or cut transactions that may overload transmission facilities. These curtailment procedures, however, are a nonmarket instrument in which transactions are cut, based upon impact on congestion rather than the participant's willingness to pay to ensure that a transaction will continue. Moreover, curtailment procedures can be requested by any operator as it sees fit. Indeed, better coordination and the use of market-based procedures could more efficiently avoid congestion.

Another problem in bilateral markets involves market power. For example, it has been alleged that a certain utility has reserved transmission capacity for its affiliates, thereby blocking other entities wishing to transmit on its system. Consequently, the affiliates can drive up the price in the bilateral market. There have also been allegations that some utilities are reserving more transmission capacity than is necessary to ensure reliability, again potentially excluding competitors from the market.

Another continuing problem in the bilateral markets is that of transmission rate pancaking. It still is the case that many transactions must cross several transmission systems, and with each system crossed they incur another access charge. Rate pancaking shrinks the number of potential competitors in any market by increasing the price they must charge for electricity. In effect, all other things being equal, the closest seller wins because it can offer a lower price.

ISOs—while not without problems—have done better than bilateral markets on some of these fronts. With regard to transmission congestion, three of the four ISOs have market-based congestion management plans; market participants can pay extra for congestion they cause and thereby ensure that their transactions go through. There are even price signals sent to generators as incentives for relieving congestion. Thus, market-based congestion management essentially means that power prices will differ by location when congestion is present. For example, generators on the downstream side of the congestion can get a higher price than they could without congestion. This higher price gives those generators the incentive to increase their output, which helps relieve congestion on the system.

By definition, ISOs should have no market-power problems since they are independent of generators and transmission owners and have no stake in the market. Nevertheless, the potential exists for a different type of market-power problem. In ISO markets, market power can be exercised by generation owners who dominate the market and therefore have the ability to withhold generation to increase prices.

Rate pancaking is not a problem for ISOs because, again by definition, they have only one systemwide transmission access charge.

Order 2000

In December 1999, because of the problems with congestion, perceived market power, and rate pancaking, the Federal Energy Regulatory Commission issued Order 2000. This order urged the electric power industry to form regional transmission organizations, of which an independent system operator is one type. Soon, it seems, all transmission-owning utilities under FERC jurisdiction will be part of an RTO. This raises a critical issue about the size of the region served by individual utilities.

For RTOs to be effective, they must have broad participation, including publicly owned utilities, within the geographic area they cover. And they must cover as large an area as possible. Otherwise, problems with market power, congestion, and reliability will persist. For example, the California ISO's area has holes in it where POUs have refused to join out of fear that they may lose their tax-exempt status for bond issues. In other regions, joining an ISO or RTO may violate state laws that dictate private use for POUs or other agreements that require POUs to retain full rate-making authority over their assets. Because joining an ISO or RTO necessarily means turning over control of transmission assets to a single entity for the use of all members, it is easy to see how private-use and rate-making clauses can be violated. The California POUs are also concerned that under a single transmission rate administered by the ISO, they won't recover the costs of their transmission system.

All is not lost, however. Two POUs have joined the New York ISO—the New York Power Authority and the Long Island Power Authority. For the Long Island Power Authority, special provisions were made to ensure its tax-exempt status and keep it from violating conditions for bond issuances. For the New York Power Authority, the ISO levies a special transmission charge to cover the authority's transmission costs.

The idea of restructuring is a good one. The realities of the situation, however, make for a long road. While ISOs and RTOs are the best way to open access and ensure competition, the public power sector must be included if RTOs are to have the full participation and appropriate size necessary to handle the problems, and realize the benefits, of restructuring.■

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NOTES

1. While the electric industry has no mandatory standards for the safe, reliable operation of systems, the North American Electric Reliability Council–which consists of generation owners, transmission owners, power marketers, and load serving utilities–sets forth voluntary standards. NERC was formed out of the recognition that more uniform reliability standards, operational practices, and coordination were needed after a 1965 blackout left the northeastern United States and parts of Canada in the dark.

2. There are four interconnection regions serving the continental United States and Canada. The Eastern Interconnect includes everything east of the Rocky Mountains except part of Texas and Quebec. The Western Interconnect includes everything west of the Rockies except Hawaii and Alaska. The Texas Interconnection includes most of Texas. Quebec has its own interconnection.

3. Currently there are four operational ISO markets: the California ISO, the New York ISO, ISO New England, and the Pennsylvania-New Jersey-Maryland Interconnection (PJM), which includes most of Pennsylvania, most of Maryland, all of Delaware and New Jersey, and the Delmarva Peninsula.

4. North American Electric Reliability Council, *Reliability Assessment: 1998-2007* (September 1998), p.6-7.

Wired Regions

Regional transmission organizations make sense in terms of improved efficiency and reduced cost. But for one Kentucky cooperative, the timing isn't quite right.

BY PAUL C. ATCHISON

East Kentucky Power Cooperative is a generation and transmission cooperative headquartered in Winchester, Kentucky, just outside of Lexington. Its owners—17 distribution cooperatives—take the electricity generated and transmitted by EKPC and distribute it to some 450,000 Kentuckians, most of them rural. That's approximately one-third of the state's population. Geographically, EKPC's territory covers the eastern two-thirds of the state, serving 89 of Kentucky's 120 counties. And with demand for its power growing at over 5 percent per year, EKPC is the fastest growing utility in the state.

Beginning in 1954 with the first generating plant ever financed by the Rural Electrification Administration, EKPC now owns and operates coal-fired units that generate 1,400 megawatts of power and oil-fired combustion turbines that produce 450 megawatts of power. EKPC has also applied to the Kentucky Public Service Commission for permission to construct two additional combustion turbines with a total capacity of 220 megawatts that would go online in 2001. In addition, EKPC purchases power from the Southeastern Power Administration, which markets most of the power generated by the U.S. Army Corps of Engineers in the Southeast, as well as various other utilities and marketers.

To transmit this power, EKPC owns and operates 2,300 miles (3,700 kilometers) of line and 270 distribution substations. It also has agreements with other transmission operators that allow the parties to use each other's lines to transmit power.

For the last 19 years, EKPC has operated its own North American Electric Reliability Council control area and is a member of the East Central Area Reliability Council. Electric reliability councils were developed by the industry following the Northeast blackout of 1965 as a way of improving system reliability.[1]

Finally, EKPC—along with investor-owned utilities, municipals, and other cooperatives in 14 states—helped form the Midwest Independent System Operator, a regional transmission organization developed to facilitate the transmission of power within the region.[2] While it has been approved by FERC, at this point the Midwest ISO is not operational and exists in name only.

Despite the Federal Energy Regulatory Commission's Order 2000 encouraging all transmission operators to join an RTO, EKPC opted to hold off joining the Midwest ISO until it could weigh the financial benefits of doing so.

Transfer of Power

As the wholesale power market has developed, transactions have increased at an astronomical rate. The existing transmission system was generally designed for utilities to transmit their own generation. It was not designed for the magnitude of system flows occurring today as a result of transactions between utilities literally hundreds and in many cases thousands of miles apart. Such transactions can overload the lines, causing the systems to crash.

In recent years, for example, transmission lines in Kentucky have been overloaded due to transactions between utilities one or two states removed from Kentucky. It is difficult, if not impossible, for EKPC to determine which transactions are causing the overload. Even if we could, we have no leverage to correct the problems or penalize those who cause them.

To resolve these difficulties, we are left to our own devices, which include either taking transmission lines out of service or redispatching our generation—that is, shifting load from one generator to another to reduce load on a congested facility. Taking lines out of service usually will not solve the problem. On the contrary, the physical laws governing an electric transmission system—electricity follows the path of least resistance—will cause flows on other lines to increase and usually make matters worse by overloading them. Continuing to sequentially remove overloaded lines from service tends to lead to system blackouts by increasing the likelihood that still other lines will become overloaded as they are forced to carry more and more of the load.

The other alternative of redispatching EKPC generation may not eliminate the overload, because generation and transactions on another system may be causing the problem. And even if it solves the immediate problem, it is unclear who should pay for the additional cost EKPC incurs by redispatching.[3]

There may be other more economical solutions to managing the congestion on another system, but these solutions are unknown or unavailable to EKPC. And here's where an appropriately sized regional transmission organization could help. Indeed, an RTO would likely know or could determine whose transactions were causing the transmission problems and it could exercise leverage to curtail the disrupting transactions.

The RTO would also know the least costly way to mitigate congestion and could provide access to transmission lines to those utilities wishing to transmit power if they are willing to absorb the added cost of transmitting power during high-use periods, when congestion mitigation measures are more costly. This approach will be most effective if RTOs are created to cover the largest area that is technically practical, which would reduce the number of seams separating RTOs. For example, if there were only four or five RTOs in the eastern United States, it would be relatively easy to determine whose transaction is causing the problem and shape the least expensive solution, even if the seller and buyer were located in other RTOs.

Another primary benefit of large RTOs is improved market efficiency, which will be achieved through reduced transmission costs and through equal access to the transmission network for all buyers and sellers. Transmission rates today are determined by dividing total annual transmission expenses by the sum of the monthly peak loads to yield a cost in dollars per kilowatt-month. These rates around the United States generally are about $1.25/kilowatt-month, plus or minus 50 cents. Since each utility charges a service fee for power that passes through its lines, however, the number of systems that must be crossed in the process of transmitting electricity can dramatically affect transmission service charges.

If there were a separate utility for each county in Kentucky, for instance, the path necessary for transmissions to cross the state might intersect 30 utilities and cost 30 times the average rate of $1.25 / kilowatt-month. If there were only one utility for the entire state, it might cost only $1.25/kilowatt-month to cross the state. Likewise, if an RTO covered 10 states, power could be transmitted across the entire area for $1.25/kilowatt-month.

This stacking up of transmission charges—known as pancaking—is causing significant disparity in power rates across the country. Larger RTOs will result in lower transmission charges due to less rate pancaking.

Larger RTOs mean larger, more efficient market areas and more equalized power costs across regions. Having larger market areas increases the choices among power suppliers and therefore helps stabilize and minimize prices throughout the country.

Conflicts of Interest

In the past, when a utility provided both transmission service and power supply, transmission providers were motivated to give preferential treatment to their own generation. The Federal Energy Regulatory Commission recognized this impediment to competition in previous orders and has developed codes of conduct to eliminate this problem. As long as one utility continues to provide both transmission service and power supply, however, the question of equal access to all buyers and sellers will remain a concern. An RTO providing transmission service—and with no interest in any marketer or power supplier—would make service equally available to all buyers and sellers and should eliminate this concern.

RTOs that can plan for the transmission needs of a region will create a more reliable, efficient, and lower-cost transmission system for the future. For transmission planners within individual utility systems, however, it is difficult, if not impossible, to see the big picture. Indeed, utilities are more likely to focus on their internal system problems. When coordinating with other utilities on regional problems, it is easy for them to overlook some of the other affected transmission owners. This can result in the proposal of ineffective and inefficient solutions.

And too, without RTOs, utilities are motivated to construct direct ties to their neighbors to avoid rate pancaking, even though the ties may not be needed for system reliability. Such intersystem connections would be reduced if these utilities were part of an RTO. Since members of RTOs can interchange power without needing direct ties or having to pay service fees, intersystem ties are not needed as long as the regional system can reliably accommodate the transactions. As a result, RTOs responsible for regional planning will construct only those lines needed for reliable system operations, and the cost of the transmission system and the resulting charges for using the system will be reduced.

Another benefit of an RTO is that it encourages the optimal location of generation plants along the transmission network. Generators desire a congestion-free transmission system to allow the maximum flexibility in moving their product to market. Better knowledge of the bottlenecks and their causes will enable better decisions in terms of locating generation on the transmission system in a way that will mitigate congestion. Siting a generation plant on the side of a system bottleneck where demand for power is heaviest may eliminate the need for new transmission lines. This will lead to a less expensive transmission system and, consequently, reduced transmission service charges.

ISOs versus Transcos

Regional transmission organizations come in two basic varieties: an independent system operator and a transmission company or "transco." ISOs and transcos can assume a variety of business forms, but generally ISOs are not-for-profit while transcos are profit-making enterprises. Indeed, a typical ISO is a not-for-profit organization that transmission owners entrust with the control, operations, and planning of their transmission systems. The independent board of the ISO is primarily concerned with serving the power buyers. As a result, a natural tension exists between maximizing reliability and minimizing costs, and only those transmission lines necessary to meet reliability standards are constructed.

Transcos, by contrast, are typically for-profit organizations, which, in addition to controlling, operating, and planning the regional transmission systems, also own the system. Their mission is to meet reliability standards, but instead of minimizing costs, they naturally try to maximize profits for their stockholders. Because greater investments means greater returns, transcos may justify construction of unneeded facilities to increase profits while increasing the transmission system cost and transmission service charges.

Of the two choices, East Kentucky Power Cooperative prefers ISOs. As a cooperative, EKPC is owned by member distribution systems that, in turn, are owned by the retail customers. Ultimately, our allegiance is solely to those customers, unlike investor owned utilities, whose fiduciary responsibility is to turn a profit for stockholders. Our mission is to provide value to the retail customer, our ultimate stockholder/owner. Providing a better product—reliability of service at a lower price—will provide greater value to the customer and enable EKPC to accomplish its mission as a consumer-owned organization. ISOs are much closer to our operating philosophy than are transcos.

If EKPC were to join an ISO, however, it would need the assurance that the payments it receives from the ISO are equivalent to its revenue needs. The ISO's surplus revenues could build a reserve fund to offset years of deficit revenues. Surpluses above an adequate reserve fund should be used to reduce rates to all transmission users. This would help fulfill the ISO mission of increasing value to all transmission users.

Why EKPC Said No

Earlier, I mentioned that EKPC helped form the Midwest ISO but elected not to join it. It should be obvious by now that EKPC is a strong supporter of RTOs. So why the reluctance to join? The answer is that there are troubling aspects of RTOs that must be addressed before EKPC embraces the concept.

RTOs use a systemwide average to compute transmission rates. This means that some transmission rates will increase and some will decrease. For a cooperative like EKPC that has low transmission rates, this can be a deal killer. EKPC's transmission rates are considerably lower than the average Midwest ISO rates. If the Midwest ISO were to adopt a systemwide average rate for its customers and were to apply that rate to EKPC's member systems, EKPC's rates would increase significantly.

This is one of the primary reasons EKPC opted not to join the Midwest ISO. In fact, unless the benefits deriving from power purchases or sales offset increased costs of transmission, our customers' interests would not be served. Remember that our mission is to provide value to our customers. If joining the ISO would cause customer costs to increase more than benefits, doing so would run counter to our interests and those of our consumer owners.

This problem can be eliminated by the use of the zonal pricing system, which allows a retail customer to purchase power from anywhere in the RTO and pay its host utility's transmission charge. This would permit EKPC member systems to keep their transmission charges the same if they should join an RTO.

Tax Bite

One obstacle cooperatives face in joining an RTO is the potential for becoming taxable. Internal Revenue Service regulations require a tax-exempt cooperative to receive at least 85 percent of its revenue from its members. If nonmember revenue exceeds 15 percent in a year, the cooperative loses its tax-exempt status for that year. Currently, EKPC's member systems pay the transmission service charges directly to EKPC. As a result, these charges are revenues to members and therefore tax exempt.

If these transmission service charges were paid to an RTO, however, in turn refunded them to EKPC as payment for EKPC's transmission expenses, the Internal Revenue Service could take the position that revenue from the RTO is nonmember revenue, and EKPC would lose its tax-exempt status and have to pay tax on its total income. This would effectively raise costs and result in higher rates for its member utilities and their member consumers.

This, of course, is unacceptable to EKPC and runs counter to the organization's mission to serve its customers. One possible solution is for the RTO to act as an agent collecting that portion of its transmission revenues and holding those revenues in a beneficial or constructive trust for the benefit of the cooperative. EKPC believes this conduit or pass-through arrangement would satisfy the IRS, since this type of revenue would retain its member-derived character.

State's Rights

Another concern is the potential impediment involved in constructing transmission lines that offer regional benefits but that require individual state approval. It is easy to imagine a transmission line planned by an RTO that promises obvious regional benefits but that passes through a state that sees no direct benefit for its residents. The state's regulatory commission could easily deny a Certificate of Public Convenience and Necessity to the utility trying to construct the transmission line and could stop the project in its tracks. Likewise a state siting authority could deny approval to locate a line within the state's boundaries, even though locating the line there would increase efficiency and improve the economy for the entire region.

To solve this problem, a multistate approval authority group could be formed from the affected state regulatory commissioners. Such a group would have to be backed by legislation, however. Otherwise, it is unlikely that the group's decision would be binding on the individual state commissions or siting authorities. A better solution may be to have federal legislation authorize the Federal Energy Regulatory Commission to approve multistate transmission facilities. FERC's authority could override the authority of individual state commissions and siting authorities for regionally planned projects.

EKPC is also concerned that state eminent-domain laws may not be effective for projects that ostensibly have no benefit to that particular state. EKPC believes that federal legislation should be enacted granting the right of eminent domain to utilities constructing transmission lines planned by RTOs and approved by FERC. If FERC can approve regional projects, and if federal law grants eminent domain to the constructors, there is little to stand in the way of implementation.

Where EKPC Stands

The list of concerns is long and the solutions to them are complex in some cases. Nevertheless, if these concerns can be alleviated and an ISO established whose benefits to EKPC's members outweigh the costs of belonging, then EKPC will join and feel confident in its future.■

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NOTES

1. The councils are self-policing organizations. The North American Electric Reliability Council contains 10 area councils throughout the United States, Canada, and Mexico. The East Central Area Reliability Council is an area council with member utilities in Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia.

2. Within their respective regions, RTOs coordinate the dispatch and transmission of power and oversee the process that establishes the price of electricity.

3. Since generators are normally operated at the lowest cost output, shifting load from one generator to another increases the cost of generation.

Public Power and the Hometown Utility

Public power distributors face a promising future if they concentrate on what they do best.

BY RALPH CAVANAGH

A few months ago, I came upon an implausible photograph that I would never have expected to find outside a history text. It showed a nondescript California street with a line of electric distribution poles marching off into the middle distance. Nothing remarkable there, but a few feet to the left of the line of poles was a parallel line of poles bearing a duplicate distribution wire. The second line was brand new, and it had been built by the Merced Irrigation District to serve long-time customers of the Pacific Gas & Electric Company. The targets of the raid were almost exclusively large commercial and industrial facilities.

Hundreds of miles to the north, utility customers in the state of Washington faced the prospect of more duplicate lines. The sponsor, Public Utility District No. 1 of Whatcom County, had for five decades maintained electric service for only one customer other than itself: a giant oil refinery. It proposed now to extend additional distribution facilities to two nearby industrial customers already served by Puget Sound Energy's grid and to more than 2,000 other customers within economic distance of the new lines.

In both instances, proponents justified the extension of duplicate facilities in the name of competition, cost savings, and customer choice. The rhetoric they used was that of the competitive values that have driven electric-industry restructuring over most of the past decade. Proponents argued that duplicate facilities would open the way for better and cheaper service. Moreover, according to the Whatcom Public Utility District, "the availability of competitive utilities is critical to attracting and retaining environmentally clean quality industries that provide jobs and economic growth."[1]

I do not doubt the sincerity of those views or the good intentions of the proponents. But others saw it differently. They saw publicly owned utilities in the act of cherry-picking choice prospects from a neighboring power grid, reducing the neighbor's capacity and motivation to maintain a robust distribution system for all its constituents, and adding unnecessarily to America's exploding population of 170 million utility poles.[2] This behavior invites comparisons to rapacious enterprises dominated by short-term shareholder interests. Yet those responsible are nonprofit institutions with a long history of local control and community service.

The duplicate-grid advocates are a small and unrepresentative sample of the public power community. There is little risk that the anomalies will become the rule, but careful scrutiny of this false path is important in illuminating the continuing rationale for public power in the face of industry restructuring. Duplicative distribution systems are hostile to public power's core traditions and values, and invocations of competitive models and virtues are helpful primarily to public power's adversaries.

A more compelling mission statement for public power starts with the image of America's hometown electricity company, committed to serving poor and rich alike, helping all customers use electricity more efficiently, and promoting cleaner power sources. The roll of honorable examples is already long and reaches every part of the nation. But even public power's finest have yet to execute urgently needed reforms in the structure of their electricity rates and revenues, which will ensure that promoting the public interest in efficient electricity use doesn't injure the credit rating of the hometown utility.

The Restructuring Challenge

Do we still need public power in a fully electrified nation, with privately owned companies seemingly able and eager to provide service for all? What is government doing providing a commodity service in a competitive marketplace, anyway?

For more than two decades, I have listened as some public power leaders answered these questions with the rhetoric of competition, drawing on one basic formula: "we're cheaper." This argument grounds public power's fundamental rationale in its capacity to deliver kilowatt-hours at less cost than those supplied by privately owned companies. Few would deny the importance of this performance measure, and public power has a generally strong record in holding down the price of electricity for its constituents. Yet this justification by itself leaves public agencies vulnerable to the juggernaut of electric-industry restructuring. Americans are used to relying on markets and for-profit competitors to minimize the cost of their commodities. We have limited tolerance for governmental entities as participants in competitive markets, and even less for the proposition that public ownership is essential for minimizing the costs of product delivery.

Public power's leadership takes understandable pride in a longstanding institutional commitment to low-cost electricity, but survival in the next century will demand a broader rationale. Fortunately, that rationale will not be hard to find.

The Case for Public Power

Electric-industry restructuring does not assume that all elements of this essential service are inherently competitive. Distinctions are routinely made between the generation and grid sectors. Most of the world still views the transmission grid as a "natural monopoly" in that costs are minimized and other public interests best served by having geographically defined grid franchises that operate under price regulation.[3] This means that public power need not and should not base its case on the rhetoric of competition; the most important of its functions are performed in regulated markets.

A few, to be sure, are offended by continuing price regulation of electricity distribution systems. The Cato Institute, for example, wants to release distribution service to competitive providers without any more price constraints.[4] Yet actual experience with alternatives to regulated grid monopolies hardly invites imitation.

Consider Georgia—not the Peachtree State, but the former Soviet republic. The electricity grid for the capital, Tbilisi, is in chronic disrepair. The affluent cope by paying entrepreneurs to install a second electric line, which provides enough power for one lamp and a television. Those not so fortunate are learning to cope with what the *New York Times* calls "a 19th century existence of kerosene-fueled space heaters and wood stoves as sources of warmth, hot water and light." According to a recent *Times* investigation, duplicate distribution lines for the well-to-do are now a "common part of the landscape here and in other suffering parts of the former Communist world."[5]

This unappealing model is unlikely to trump America's natural-monopoly rationale for distribution franchises any time soon. As a result, public power advocates need not feel defensive about any alleged incompatibility of public ownership with competitive values and markets. Public power can continue to focus instead on the public interests that are so palpably entwined with the monopoly elements of electric service.

In at least two significant respects, public interest offers an obvious role for public agencies: minimizing the environmental consequences of electricity generation and ensuring that access to this essential service is not allocated solely by ability to pay.

Environment and Equity

Taking the U.S. economy as a whole, electricity produces more than a third by weight of four major air pollutants. As a result, electricity generation is the largest single contributor to urban ozone, increases in greenhouse-gas concentrations, acid rain, and the obstruction of free-flowing rivers. And absent an enforceable duty to serve all customers, electricity grid operators often could strengthen their balance sheets by systematically avoiding low-income neighborhoods.

Electric distribution companies can make significant contributions to the public interest by mobilizing systemwide investment in energy efficiency, renewable energy, and energy services to low-income populations. Strong efforts have emerged from public power systems in Austin, Eugene, Los Angeles, Osage, Palo Alto, Sacramento, Salem, San Antonio, Santa Clara, Seattle, and Snohomish County. In California, public power utilities successfully supported legislation to establish a statewide usage-based charge on electricity to underwrite investments in technologies for saving energy, producing it from renewable sources, and reducing its costs for low-income households.[6]

One of the best illustrations of what public power has to offer in stewardship commitments is the Eugene Water & Electric Board. In 1998, a national survey concluded that EWEB was investing more in energy efficiency than the Southern Company, Entergy, Commonwealth Edison, and American Electric Power combined. And yet EWEB has only 73,000 customers, while the other four companies collectively serve more than 12 million accounts.[7] Today, EWEB is devoting 5 percent of its gross revenues to energy-efficiency improvements and is adding new renewable generation equal to 1 percent of total load each year.[8] This relatively small distribution company would be on any short list of the global leaders in sustainable energy development.

Retail Access

New opportunities are continuing to emerge for public power, some of which hark back to its origins. Public ownership advocates initially were concerned that many residential and rural customers would not generate large enough profit margins to interest investor-owned electricity providers. That same issue is resurfacing as retail electricity markets initially deliver disappointingly few options for small electricity users. Public agencies and cooperatives offer one way to aggregate the demand of those who cannot or will not choose a supplier, creating purchasing power comparable to that of the large users who are the focus of most marketers.

Given the high transaction costs of enrolling individual subscribers, however, aggregation looks promising only when combined with the equivalent of a franchise, in which those who do not choose an alternative supplier in a specified geographic area are assigned by default to a specified aggregator. Montana acknowledged as much in 1999 by enacting legislation that allows for default aggregation of much of the state's residential and small business sector. A nonprofit electricity-buying cooperative has been seeking permission from the state's public service commission to become the default aggregator.[9]

In a world of regulated monopoly functions with strong environmental and equity dimensions, there is no clear empirical basis for preferring private over public ownership; the two have coexisted productively in the North American electric industry for much of the last century. Neither system appears to have an inherent advantage, and neither can afford the luxury of complacency. Grid franchises are not eternal, and the possibility of new management should serve as a continuing caution to incumbents.

But if the strongest rationale for public power's survival lies in the equity and environmental dimensions of monopoly distribution service, public power itself is the principal loser when its own members act to subvert that justification. If distribution grids are redefined as competitive enterprises, inescapable and corrosive questions will follow about the appropriateness of including public agencies among the competitors.

A False Trail

> I doubt if we will find that any method of distribution will be invented that will supplant that which we are using; and if such be the case, we should rather welcome than fear new inventions, feeling that [electric distribution companies] are the most desirable purchasers of any inventions which may lessen the cost of electrical energy to our customers.[10]
>
> —Samuel Insull

Many still view Samuel Insull as the caricature of a predatory profiteer. But his century-old prophecy about the grid's resilience has been vindicated in two fundamental respects: distribution wires have proved a durable basis for monopoly franchises, whether public or private, and technological advances consistently have proved to be grid enhancements rather than grid replacements. Why, then, the sudden emergence of public power initiatives to bypass functioning distribution grids? The answers turn out to have nothing whatever to do with changes in grid technology, as the following examples indicate.

■ **Whatcom County**. Public Utility District No. 1 of Whatcom County, Washington, was formed by citizen vote in 1937 with the aim of replacing the county's investor-owned electric company. The project never came to fruition, however, and throughout the rest of the 20th century, the PUD's only customer, an oil refinery, enjoyed the benefits of the PUD's inexpensive federal hydropower. Whatcom never acquired any expertise in grid construction or maintenance; indeed, to this day it has no staff of its own to perform these functions.

But Whatcom's entitlement to cheap power did not escape the notice of nearby industrial customers, and over the past decade a few began threatening to install a wire to the PUD and sever their connection with Puget Sound Energy, the local distribution company. To avoid these revenue losses, Puget was forced repeatedly to provide special contracts on favorable terms for these large customers. In the latest iteration of this script, the PUD proposed early in 2000 to build new high voltage power lines and substations to serve two industrial plants owned by Georgia-Pacific and Bellingham Cold Storage.

One of two unhappy outcomes is almost certain. Either Puget will once again make a deal with the prospective defectors, potentially eroding the revenues available to support its grid, or a few duplicate wires will inflict the same damage without offering the vast majority of Puget's customers any competitive alternative. If the wires go in, Whatcom's purchases of inexpensive federal hydropower for its enlarged industrial clientele will leave less for allocation to the Northwest's residential and small-firm constituencies. In either case, a few large industrial plants will benefit at the expense of almost everyone else involved, and the undeserving winners' leverage will come courtesy of public power. For a movement born principally from a desire to serve small customers no one else wanted, either alternative is a radical departure from the founders' vision.

■ **California irrigation districts**. The Whatcom script is being rewritten on a larger scale in California's Central Valley. There the principals are irrigation districts—led by Modesto Irrigation District—which already have built duplicative but highly selective distribution systems to wrest some $20 million in revenues from the Pacific Gas & Electric Company. Only about 0.1 percent of those revenues represent service to residential customers.[11]

Modesto's plans are ambitious. The district proposes to extend a largely duplicative grid over 5,500 square miles (14,000 square kilometers), covering an eighth of PG&E's huge Northern California service territory. Modesto foresees no significant environmental impacts, "with the exception of aesthetic effects."[12] PG&E has responded in part by seeking regulatory permission to discount distribution services to large customers in the line of fire. At the same time, stakeholders concerned about reliability are pressing for significant new capital investments in the company's distribution system.[13] From the company's perspective, such investments already seem risky in the face of continuing uncertainties about the future of industry restructuring; an insecure distribution franchise worsens the problem.

Those with the most to lose are the millions of small PG&E customers who could never attract the wandering eye of an irrigation district. They have to live with a deteriorating hometown grid, without realistic hope of any alternative. Ironically, Modesto's case for further encroachments on the PG&E system is based in part upon contentions that PG&E's recent reliability performance is poor and getting worse.[14]

A backlash is imminent and predictable. For example, advocates for low-income households are sponsoring legislation in California to restrain the irrigation districts' duplicate grid extensions.[15] And the Modesto Irrigation District has signaled a willingness to open settlement talks with PG&E. This could revive an earlier long-term agreement simply to readjust the boundaries of their respective service territories, putting an end to redundant power lines.

These examples underscore a much broader point: public power should not continue to ground its existence, let alone its expansion, in the rhetoric of marketplace competition and comparative price advantage. The justifications offered for duplicative distribution are just the latest in a series of efforts to invoke these competitive values in support of public power initiatives. All such efforts play directly into the hands of private interests that yearn for access to public power's customer base, and incite the ideologues who oppose involvement of public agencies in any aspect of the electricity business. A much better and less hazardous strategy involves a return to public power's first principles.

A Secure Future

If public power overcomes its challenges, as I hope and expect, its historians are likely to view the debate over duplicate distribution as a momentary distraction. This squabble could easily fizzle without much damage to either the perpetrators or the movement collectively. States can establish durable distribution franchises and adjudicate boundary disputes while continuing to encourage robust competition among generators. And distribution companies can concentrate on what they ought to be doing best: providing reliable, universal service at the lowest possible environmental and economic cost.

To succeed, however, distribution companies will need to get much better at helping their customers get more work out of less electricity. Our collective electricity bill is less than 3 percent of the gross national product, and yet electricity generation contributes more than 30 percent of the nation's major air pollutants.[16] Electrical generation is among the principal causes of urban and regional smog, deadly fine particles in the atmosphere, acid rain, damaging nutrient loads to important water bodies, toxic mercury emissions, nitrogen saturation of sensitive forest ecosystems, regional haze, and greenhouse-gas emissions.[17]

Even that daunting list is incomplete, given, for example, electricity's role in the disposal of radioactive waste, the survival of endangered salmon fisheries, and the preservation of undammed rivers. And many of these problems are worsening as demand for electricity increases. The United States saw electricity generation almost double between 1973 and 1998, while petroleum use barely increased and natural gas consumption actually declined.[18]

Carbon dioxide emissions from electricity generation rose more than 15 percent from 1990 to 1998, outstripping growth rates in the rest of the economy and putting at severe risk the nation's treaty commitment, ratified by the Senate in 1992, to help stabilize greenhouse gas concentrations in the atmosphere.[19] Coal-fired plants accounted for almost 90 percent of the electricity sector's contribution.[20]

Regulatory pressures also are growing to establish tighter limits on emissions of nitrogen oxides, mercury, and sulfur dioxide, even as coal-based generation—the principal culprit—continues to surge in competitive wholesale markets. Almost all agree that the fastest and cheapest remedy lies in reducing electricity needs by promoting energy efficiency in all sectors. This creates a basic dilemma for public and private power alike, however, as long as the recovery of distribution costs depends on the volume of electricity moving over distribution wires.

Efficient Cures

There are two straightforward solutions. One, favored by many in the utility industry, is simply to charge customers a fixed amount for distribution service, regardless of their consumption. This would mean a radical shift in most current rate structures, however, resulting in a large group who would wind up paying more than they paid under the old system. Their collective unhappiness would deter most publicly accountable decision makers from adopting such a proposal.[21]

The better solution is to charge customers for distribution costs based on the amount of electricity they consume, and to adjust the charge regularly to correct for unexpected fluctuations in electricity use. In other words, if traffic over the wires exceeds or falls short of estimates made at the time rates are set, rates for the next year should be adjusted modestly to compensate. The recovery of distribution costs would then be independent of the total volume of electricity passing over the wires, although customers would still be charged on the basis of kilowatt-hour consumption. This is the model that the Oregon Public Utility Commission adopted in 1998 in response to a joint request from utility, governmental, consumer, and environmental parties.[22]

Some worry that continuing to recover distribution costs as part of volumetric charges will make additional consumption look more costly than it should.[23] But it is difficult to contend seriously today that recovering distribution costs in this manner risks suppressing socially beneficial growth in electricity use. If anything, we need to add more incentives for reducing consumption, given the environmental strains already catalogued and the abundant evidence that pervasive market barriers block energy savings that are much cheaper than additional energy production.[24] Certainly, we should not make a bad situation worse by reducing customers' rewards for conserving electricity, which is precisely what would happen if distributors relied exclusively or primarily on fixed charges to recover their costs.

By using volumetric distribution charges and regular, modest adjustments, public power can ensure that its energy efficiency successes do not undermine its financial health. With strong and continuing encouragement from the local distribution company, aggressive energy efficiency improvements can stabilize and then reduce electricity use. While electricity rates will go up slightly to restore the lost distribution revenue, communities' electricity bills will drop because their utilities will have helped them avoid buying kilowatt-hours that would have cost more than the efficiency improvements.

Utilities will distribute less electricity but will not suffer a loss of distribution revenue, while customers will benefit from avoiding the economic and environmental costs of unnecessary electricity generation. And public power need not worry that tougher efficiency standards for buildings and appliances will force cutbacks in the budgets that sustain reliable grids.

Unleashing public power in this

way could pay huge dividends for progress in energy efficiency. The potentially decisive contribution of the hometown utility lies in creating much greater local enthusiasm and understanding about efficiency opportunities. Utilities are widely trusted sources of information and quality control for customers otherwise disinclined to open their homes and factories to efficiency initiatives that they ordinarily would know nothing about. And modest charges on distribution service remain the best way to have all customers contribute to investments that reduce the entire system's environmental and economic costs.

While investor-owned systems can do all of this too, public power has a golden opportunity to demonstrate that it can more readily mobilize public interest and support, based on the "local control" values that figure so strongly in the movement's history.

At the same time, public power can do more to help customers minimize the environmental damage associated with electricity use. The Los Angeles Department of Water & Power and the Palo Alto Electric Utility, for example, offer their customers access to electricity from new sources of renewable energy generation, such as wind, solar, and geothermal power.[25]

Or consider the Bonneville Power Administration, which recently initiated a system of rigorous certification for renewable generation and dedicated part of the resulting power-sales revenues to a new and wholly independent Bonneville Environmental Foundation. The enthusiastic involvement of independent environmental groups and several of BPA's public-power customers ensured a successful launch of this venture in 1998. Former Senator Mark Hatfield chairs the foundation, which uses donations from sales of the environmentally preferred power to underwrite new fish restoration and renewable energy ventures. Snohomish Public Utility District, Emerald Public Utility District, Flathead Electric Cooperative, and Orcas Power and Light Company all deserve credit for their participation.[26]

Franchise Competition

Armed with a strong public-interest record, public power could open the way for a healthy and altogether legitimate form of competition for the distribution franchise itself. Distribution's natural monopoly character does not require a permanent incumbency. System managers should be exposed periodically to a formal challenge on the merits of their environmental, equity, and efficiency records. But the challenge should embrace the entire geographical franchise, not just those lucky enough to live near a distribution system boundary and electricity-intensive enough to make a duplicate connection practical.

The winners in franchise competitions should have the same duty to serve that the incumbents already owe to all within the contested territories, regardless of commercial clout. State legislatures are the proper place to establish the rules for such a contest. At regular intervals, let's give elements of both public and private power a chance to offer better distribution service for entire communities or regions, with the final decision driven by those same public-interest values that continue to underpin the franchise itself. This will help ensure that the hometown utility's enduring responsibilities remain in good hands, regardless of external changes in the increasingly competitive commodity markets for electric generation.■

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NOTES

1. Public Utility District No. 1 of Whatcom County, *The Power of Choice*, PUD position paper (2000), p. 17.

2. See James Salzman, "Beyond the Smokestack: Environmental Protection in the Service Industry," *UCLA Law Review* 47 (December 1999), pp. 411, 450.

3. A rather notorious exception is Washington State, which has no tradition of geographical franchises but does allow for regulatory approval of service territory agreements negotiated by distribution providers.

4. Peter Van Doren, *The Deregulation of the Electricity Industry: A Primer* (Washington, DC: Cato Institute, October 6, 1998).

5. Steve LaVine, "In Former Soviet Republic, Bribes Light the Night," *New York Times* (February 7, 1999).

6. California Public Utilities Code § 385.

7. J. Coifman, "Utility Deregulation a Bust for Energy Efficiency Programs, *Environmental Media Services Press Release* (October 1, 1998). On the other hand, Commonwealth Edison's subsequent appointment of CEO John Rowe virtually ensured an energy-efficiency renaissance there at least.

8. Interview with Randy Berggren, EWEB general manager (April 3, 2000). The energy efficiency commitment is at least five years old, while the renewable energy target was adopted by the EWEB board in 1999).

9. The statute, S. 406, was signed into law by Governor Racicot in April 1999; the Montana Electricity Buying Cooperative was incorporated soon afterward. The ultimate decision on default supplier status rests with the Montana Public Service Commission.

10. Samuel Insull, "Address before the Edison Association, September 14, 1897," in William E. Keilly, ed., *Central Station Electric*

Service (Chicago: Private Printing, 1915), p. 7.

11. Pacific Gas & Electric Co., "PG&E Customers Departed or about to Depart to Modesto ID and Merced ID," memorandum, (PG&E, March 10, 2000).

12. Modesto Irrigation District, *Draft Program Environmental Impact Report: M.I.D. Electrical Expansion Program* (Modesto, CA: MID, December 17, 1999), p. 2-1.

13. See, for example, letter from Senator Byron Sher to Richard Bilas, president, California Public Utilities Commission (December 9, 1999), identifying proposed reductions in major utility's distribution capital budget, and noting that "energy reliability is a vital issue for the high-technology companies and other constituents in my district," and that "I support a robust distribution infrastructure which incorporates innovative, environmentally sound activities such as energy efficiency improvements and other 'distributed' energy resources to reduce ratepayer costs and improve performance of distribution systems").

14. Memorandum from Chris Mayer, Modesto Irrigation District, to Ralph Cavanagh (April 14, 2000).

15. S.B. 1939 would restrict the capacity of irrigation districts to offer duplicative service and introduce more searching regulatory scrutiny of such efforts.

16. For a useful review of the downward trend in U.S. electricity costs since the early 1980s, see K. Smith, "Electricity Pricing Trends Challenge Conventional Wisdom on Retail Wheeling," *Electricity Journal* (April 1996), p. 84.

17. Letter to Congressman Edward J. Markey from Mary D. Nichols, assistant administrator for Air and Radiation, Environmental Protection Agency (March 28, 1997), p. 1.

18. U.S. Energy Information Administration, *Monthly Energy Review* (March 1999). Petroleum consumption increased by 5 percent from 1973 to 1998, while natural gas was down by 3 percent. Electricity generation totals are approximate, since EIA data for nonutility generation do not extend back to 1973.

19. The objective of the 1992 Framework Convention on Climate Change is "stabilization of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." See President William J. Clinton and Vice President Albert Gore Jr., *The Climate Change Action Plan* (October 1993) <http://www.gcrio.org/USCCAP/toc.html>.

20. U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, (1990-1998, Draft: February 2000); Daniel Lashof, Testimony before the Committee on Energy and Natural Resources, U.S. Senate (March 30, 2000).

21. See David Moskovitz, *Profits and Progress through Distributed Resources* (Washington, DC: National Association of Regulatory Utility Commissioners, February 2000), p. 22.

22. See Public Utility Commission of Oregon, Order No. 98-191 (May 5, 1998).

23. In their view, since distribution costs are independent of consumption in the short run, the charges that recover these costs should not vary with consumption either. The critics say that when fixed distribution costs are recovered by raising the costs of kilowatt-hours, customers are being overcharged for those kilowatt-hours and socially beneficial electricity use is being suppressed. Their preference is to recover the distribution costs as fixed monthly charges that do not vary with consumption. However, distribution costs are extremely sensitive to consumption over longer periods, with sustained growth periodically requiring costly equipment replacements to handle the higher volumes safely. This argues for making customers contribute more to distribution revenues as their electricity consumption grows.

24. For discussion of these barriers, which obstruct even overwhelmingly cost-effective savings, see, for example, Mark D. Levine et al., "Energy Efficiency Policy and Market Failures," and Ralph Cavanagh, "What Electricity Prices Can't Deliver," in *Annual Review of Energy and the Environment* (1995), pp. 519-25 and 535-55. For a recent empirical demonstration of the economic opportunities associated with utility and government intervention to overcome these barriers to cost-effective energy efficiency improvements, see RAND, "The Public Benefit of California's Investments in Energy Efficiency" (March 2000) <http://www.rand.org/publications/MR/MR1212.0>.

25. As explained in <http://www.greenla.com>, LADWP's product includes 100 percent renewable energy with 20 percent coming from new sources. Palo Alto launched its Green Pricing Program in April 2000, with 25 to 100 percent of the product from new renewable resources. Memorandum from Tom Kabat to Ralph Cavanagh (March 9, 2000).

26. See BEF website <http://www.BonEnvFdn.org>.

27. I very gratefully acknowledge the extensive and invaluable comments of Tom Anderson, Eric Heitz, Jim Lazar, Chris Mayer, Dennis McCarthy, Alan Richardson, and Jan Schori, several of whom disagree strongly with portions of the analysis.

Electrifying R&D

Technology for the 21st Century

Predicting the future is a hazardous business, and predicting the future of technology is more hazardous still. It's probably safe to say that the bulk of the technology that will be running the economy by midcentury hasn't even been invented yet. Nevertheless, we can spot trends that show us where technology is headed and, more important, we can lay down guidelines to help us exploit technologies as they arise.

Today's innovative electric technologies, such as combined-cycle power plants, solar photovoltaics, and wind power, for example, are the legacy of massive government and industry investments in research and development that began 25 years ago, says Tom Schneider, a former EPRI scientist and now a private energy consultant. Unfortunately, federal funds are drying up and industrial research is being fragmented into a series of state programs. As an alternative to this balkanization, Schneider recommends a national fund, collected from private industry, to support R&D and a national corporation with subsidiary institutes to manage the funds.

Congressman Rush Holt of New Jersey, on the other hand, is concerned that industry funding is also on the decline. He believes that the federal government should play a more active role in funding energy R&D.

Federal funding is shifting away from alternative energy sources such as solar and renewables, Holt says, and toward electricity transmission and storage. For instance, the Department of Energy's investment in superconductors, which can conduct electricity with virtually no energy loss, is showing a great deal of promise for improving the efficiency of generators and high-voltage transmission lines.

Holt sees increasing federal support for R&D as a powerful stimulus for social progress, physical health, and economic growth.

Kurt Yeager and Brent Barker of EPRI also believe R&D has a profound impact on the economy. Their solution is to sketch an R&D roadmap for completing electrification of the globe during the next half century. EPRI's roadmap—which was developed with the help of more than 150 organizations, is not so much a forecast as it is a vision of what the future could be like, the authors explain.

The roadmap identifies five goals society must work on during the next 25 years: eliminate reliability problems in power generation and transmission; activate the next-generation Internet, which offers services as well as products; make electricity the primary engine for economic development; solve the problem of carbon dioxide buildup in the atmosphere; and make sustainable global development a reality.

Yeager and Barker recognize this is a formidable challenge. Nonetheless, they believe the goals are achievable if we are willing to accelerate the pace of technological innovation.

Finally, Tom Schneider and Veronika Rabl of EPRI discuss energy technologies that will help us reach a sustainable economy. They see electrification as a means for developing nations to leapfrog over the energy-intensive development periods that the industrialized world had to suffer through. Developing nations can move directly from wood and kerosene to resource-conserving electric technologies that are just now coming into the market.

The mere existence of these advanced, highly efficient technologies does not ensure success, however, the authors warn. Worldwide acceptance will happen only with the support of governments and utilities focusing on customer service, market-driven pricing, and technology transfer.

The Editors

Decline, Balkanization, and Rebirth

Industry and government leadership need to foster new advances in electric technologies and reinvent the mechanism of research and development.

BY THOMAS R. SCHNEIDER

Jobs, national security, and the environment are all affected by the quality and reliability of the electricity infrastructure. While electricity represents less than 5 percent of the U.S. gross domestic product, the entire economy depends on affordable, reliable and secure electricity.

A century ago, rapid innovation in electric technologies was a major driver of the economy. New firms invented and improved on the electric motor, the light bulb, electrified transportation, and the generation and delivery of electricity. Today, those companies and their suppliers all appear to be mature, even stodgy, in comparison with the dot-com companies and the rapidly growing digital economy.

Yet substantial room remains for innovation in electricity and electro-technologies. The future offers a path to sustainable development through increasingly efficient generation and use of electricity, a path that will lead to continuing reductions in polluting emissions and in consumption of resources, even as prosperity increases. (See "Lighting the Path to Sustainability" in this issue of FORUM.) Such a future will be realized, however, only if today's trend of decreasing investment in research and development is reversed.

A Wired, Wired World

The firms of the digital economy are all inventing new uses for electricity. As the world moves rapidly towards connecting over a billion people through the Internet, electric technologies again sit at the center, or perhaps more appropriately serve as the foundation, of this revolution. A century ago, electricity was the innovation; today it is the enabler of innovation.

Electrification is not a historic event, rather it is an ongoing process, and today that process is being driven by computational speed and bandwidth, not motors and light bulbs. Underlying the dot-com revolution is electricity.

During the past 60 years, the electric power industry consisted of franchised, regional monopolies with a social contract to aid in the economic development of each monopoly's region. Today, that social contract goes beyond local economic development to encompass global prosperity, and it includes the mandate to preserve and protect the environment and create a sustainable future for humanity.[1]

Is there opportunity for further innovation in electricity-based technologies? When generators today can convert into electricity nearly 60 percent of the energy in fuel—nearly twice as efficiently as the average plant currently in use—can things improve further? New power plants combining combustion turbines with high-temperature fuel cells may take energy conversion efficiencies to 75 percent. Yes, there is room for improvement. These improvements may well lower the costs of electricity and further reduce dependence of the economy on fossil fuels.

On the consumers' side, even more room for improvements in efficiency exists as computer processor technology and power electronics allow more precise and controlled use of electricity. This marriage of brains and brawn increases efficiency and reduces wasted energy at the point of use.

Many of today's innovative new electric technologies are a legacy of the enormous investment in research and development by government, electric utilities, and the manufacturers of electric and electronic goods since the mid-1970s. Then, the world was declared to be running out of fossil fuels. Perhaps the most notable example is the massive investments made to convert coal into a cleaner burning, gaseous fuel—coal gasification. Other examples of technology investment during this period include the efforts to develop renewable sources of energy such as biomass, wind, solar photovoltaics, and many diverse innovations in energy efficiency at the point of use.

The oil crises of the 1970s also led to a renewed focus on the technology for the exploration and production of domestic natural gas, a commodity so scarce then that its use by utilities was banned in the United States in 1978. Today, because of new exploration and production technology, natural gas is abundant and prices are low. In addition, combined-cycle power plants—which were developed because this combined combustion-turbine steam cycle is critical to efficient use of coal gasifiers—are being built in record numbers. Only now, instead of being used to gasify coal, these plants are burning natural gas, currently a less expensive and far cleaner alternative with the lowest carbon emissions relative to all fossil fuels.

Today's innovative new electric technologies are a legacy of the enormous investment in research and development since the mid-1970s.

The future turned out to be very different from the forecasts and policies of the late 1970s. Yet the technology that flowed from the investment initiated then is today returning dividends in higher efficiency, lower cost electricity, and reduced emissions. Was this dumb luck? Perhaps, but it is certain that the nation and the world are reaping a return from electricity R&D.

Government energy R&D budgets today, however, have declined substantially, and utility industry funding and leadership in electricity R&D have declined even more dramatically since the start of restructuring of the electricity industry. The preferred approach to arresting this decline and restoring vigorous R&D funding is to resolve current regulatory ambiguity and adopt natural regulatory incentives for voluntary industry funding of electricity R&D for the public benefit. State utility commissions have provided these incentives in the past. Yet this route seems counter to current trends, and it leaves the decision process fragmented among the 50 states at a time when energy is, in fact, a national and global challenge.

Today, one often finds state restructuring legislation redirecting industry funds from collective industry research at a national level to state programs. Major examples include California, Massachusetts, and New York, where the redirected funds are managed by state agencies. In short, state-level restructuring is balkanizing electricity R&D by redirecting the funds for the national collective industry R&D to state programs. Federal legislation proposed by the current administration—S. 1047 and H.R. 1826—would create a federal fund, collected through a tax on electricity consumption, to match state monies, further exacerbating the current fragmentation.

If the administration's proposed legislation becomes law, the country will replace a strong collective R&D collaboration in public benefit research with small-scale programs sprinkled across 50 states. This shotgun approach will replace a needs-driven program with long-range goals targeted at real problems with a short-sighted focus on politically correct, hot topics.

Examples of the type of programs prevalent within these state-level efforts are premature demonstration of expensive "green" technologies and multiple demonstrations of energy efficiency technologies already being adopted through market forces, albeit more slowly than enthusiasts like. In addition, a massive increase in transaction costs will occur as the diverse new agencies and offices try to coordinate their efforts and avoid appearing to be duplicative, when in fact, duplication will be inevitable.

TABLE 1. Decline in Government Energy R&D

Select International Energy Agency Country	Decline in Energy R&D 1980-1995[2]
Japan	+20%
France	- 6%
Canada	-33%
Italy	-53%
USA	-58%
Germany	-85%
UK	-89%

False Economies

The well-documented decline in U.S. energy R&D and the resulting underinvestment need to be a focus of current policy debates. While investments have declined on a global basis, energy R&D has fallen even further in the United States than in other industrialized nations and in real dollars, in spite of the continued importance of energy infrastructure to the economy, national security, and the environment. (See Table 1.)

Yet the situation is even worse than these large-percent reductions suggest. Since 1973, an important component of U.S. energy R&D has been the voluntary public-benefit R&D of the electric utility industry through the collective mechanism of EPRI, formerly known as the Electric Power Research Institute. EPRI has been the world leader in managing and implementing electricity research for the public benefit, sponsoring the lion's share of the electric utility R&D in the United States. EPRI expenditures on R&D are roughly two-thirds of total research expenditures by all the electric utility industries.

In the early 1990s, total EPRI expenditures were nearly as great as the electricity-related R&D expenditures of the U.S. Department of Energy—about 70 percent of DOE's funding except for research on fusion technologies.[2]

DOE expenditures in electricity have been relatively stable over the last decade. Since 1994, however, EPRI revenues, and consequently electricity utility R&D, have been declining. In 1999, EPRI total revenues of about $340 million were roughly half of its 1994 levels, adjusted for inflation. At this rate, in a naïve linear extrapolation, EPRI revenues would drop to zero in 2002. Realistically, this decline shows that the utility-industry innovation engine in electricity R&D is in neglect. For the nation, the consequences are the loss of substantial public benefit.[3]

This decline in utility R&D is happening at the same time as blackouts are occurring in the western, midwestern, and eastern United States. Recently, emergency power reductions were necessary in the eastern and midwestern areas, and prices have spiked to $7.50 per kilowatt-hour—a 100-fold increase over baseline rates—in new electricity markets. These pressing problems are occurring against a background of a potential threat of global warming and growing energy demands in the developing world.

Changing Focus

In addition to the decline in R&D revenues, the very nature of EPRI, a nonprofit public benefit R&D organization, is changing. EPRI is now living in a business environment where significant competition has developed among previously cooperating member companies, including private utilities and public power providers. To remain viable in the current turbulent period, the timeframe for projects has been severely shortened, and EPRI has had to focus on delivering short-term solutions and technical services to its clients, previously referred to as members. Research, especially public-benefit research, is being downplayed and is disappearing from EPRI's portfolio. Rather than being a major source of public-benefit R&D funding, EPRI is competing with other providers of R&D for public funds. EPRI is moving to change its operating practices and is losing sight of the very nature of its original mission, a mission that is at least as important today as it was in 1972.[4]

These changes are a consequence of the opening of competition among electric power firms and the transition to competitive markets in electricity.[5] In response, EPRI unbundled its R&D program. Previously, the decision to fund EPRI was made at the highest levels in the electric power companies and was based upon a vision of the future and a commitment to a social contract with the regulators. Today, the decisions to fund EPRI are being made at significantly lower levels in these organizations based on near-term returns. Market forces are failing to maintain an essential longer-term investment in electricity R&D. There is no sign that federal restructuring legislation will create new incentives for private investments in this critical infrastructure.

In the July 30, 1999, issue of *Science* magazine, an issue devoted to energy, Robert M. Margolis and Daniel M. Kammen called for more collaboration in diverse energy R&D projects that would foster cooperation among industrialized and developing nations.[6] For the United States and other countries exploring deregulation of energy infrastructures, it is urgent to redress the declining collaboration within our own economies as a first step. The loss is not just the loss of funding of public benefit R&D reflected in the decline in the EPRI revenues; it's also the loss of industry leadership and subsequent loss of the detailed knowledge of problems. This collective knowledge and leadership are essential for managing the critical commons of our energy resources and infrastructures and their effects on our society and environment.

Bleak Prospects Ahead

Even as Congress considers restructuring the electric utilities industry, regulatory ambiguity continues. There's little hope that a comprehensive national electricity restructuring bill will emerge from Congress in this election year or that any such bill would effectively deal with the lost public-benefit R&D.

Indeed, the future of substantial R&D on public benefits, led and funded by industry, looks rather bleak. Meanwhile, state programs designed to shore up R&D for the public benefit continue to proliferate. The EPRI budget continues to shrink, and its programs are becoming more myopic. Although the National Association of Regulatory Utility Commissioners has endorsed the EPRI Technology Roadmap, which is a guide for electricity R&D for the next 50 years (see "A Roadmap for the 21st Century" in this issue of FORUM), no groundswell of support for funding this program has emerged.

Collective knowledge and leadership are essential for managing the critical commons of our energy resources and infrastructures

The Department of Energy has recognized the need for research on the reliability of the electric grid and has requested an increase in research directly related to the power grid in 2001. EPRI has successfully raised a supplemental $5 million to be spent over two years for an in-depth study of root causes of reliability problems in the U.S. grid.

These positive steps are too little too late, and they pale in light of the quirks of a marketplace where $400 million can be lost—and made—in an afternoon in a single market price spike. Electricity market functioning is still not understood, even by the experts. The volatility in these markets causes the wholesale price of electricity to fluctuate from less than 2 cents to more than $7 per kilowatt-hour. In addition to the issue of price, industry estimates are that $50 billion is lost to the economy each year through problems with the reliability and quality of power. The administration estimates that restructuring will save the nation $20 billion annually in lower electric rates. If current trends continue, deterioration of the infrastructure and further declines in R&D will be the result. The costs to the nation will be far higher than the expected savings from competition.

A Light in the Dark

The U.S. government has shown serious weakness in its agencies' energy R&D programs. Simply relinquishing energy R&D to the federal or the state governments is not the answer.[7] The best solution to the uncertainties of the times would be mechanisms to restore vigorous industry voluntary funding of public benefit electricity R&D. Today, this appears very unlikely. The current approach, reshaping EPRI to deliver near-term solutions and services to clients, is not sustaining the needed public and private benefit R&D of the electric power industry. Yet this is a result seen with clarity in hindsight. EPRI's decisions were made in good faith and with anticipation that market forces would sustain reasonable levels of electric utility R&D, or even result in increases.

The only hope for restoration of a vigorous, industry-led, national program is a *complete* rethinking of the R&D roles and responsibilities of companies in the electric power enterprise. Although such rethinking seems unlikely, how might a renewed, industry-led public benefit program be structured?

Market-driven and new for-profit elements would be spun off as true private enterprises with no ties to the nonprofits.

The roots of a solution lie in a creative proposal made by the economist Paul Romer in 1993.[8] According to this proposal, the industry would petition the government to create a national electricity R&D fund raised through a voluntary tax on electricity industry revenues. Creation of this tax would be voluntary, but once enacted it would apply to all participants in the marketplace for electricity and would solve the free-rider problem that has led to the unbundling of the EPRI program and the decline in funding and myopic nature of most of EPRI's current programs. Industry would work with government to set the levels of funding and the amount collected annually.

Romer proposed that, rather than a single entity such as EPRI, a family of research institutes could be created. The institutes would compete for the funds collected by the government from industry and provided to an industry-led board of a federally authorized nonprofit corporation to manage. Such a scheme might work.

Yet a variation on this model might be even better. The public-benefit institutes would work together to ensure their projects did not overlap. They would also work together to create a competitive environment based on the value and merit of the R&D and the needs of the industry, the consumer, and the public at large. A highly competitive allocation process would be created based on a portfolio of R&D that covers the full range of industry segments and issues. In this alternative, the focus of each institute would be on the collective needs of a particular segment of the industry—nuclear, fossil generation, renewables, transmission, distribution, system and market operations—and the use of electricity. The existing assets of the current nonprofit EPRI would be transferred to the new public-benefit organizations. To avoid the inappropriate use of monopoly power, the market-driven and new for-profit elements would be spun off as true private enterprises with no ties to the nonprofits.

This could lead to an efficient allocation of research dollars and could be an improvement over the current state of affairs in the restructured electricity R&D. An industry-led, self-organizing and managing board would oversee all of these new institutes. This approach would provide a competitive environment, with competition based on performance monitoring, soundness of scenario-based futures, and a formal portfolio analysis.[9]

In other words, a public-benefit corporation, or holding company, could be created, and a family of industry-segment-specific, nonprofit institutes or investment boards could be organized as subsidiaries. In general, these institutes would not actually perform the research; rather their role would be to define important areas of research, oversee and manage the course of research, and take responsibility for translating the research into application through demonstration and adoption programs funded by the early adopters or through other collective mechanisms.

To avoid inappropriate use of market power, these institutes would also be for the public rather than members' benefit and would not be allowed to compete with private sector firms. This is much like the function and policies of EPRI, in its early years, and its network of industry committees and contractors.

Close linkage in problem definition and portfolio design is key to filling the gap between basic, curiosity-driven research and the research private companies will fund for competitive advantage. In such a plan, the role of government in basic and exploratory research is well defined and essential. The government would continue to fund basic research—which would normally be in the public domain, available to all parties—as well as those R&D activities that are too risky for even collective private sector programs and those undertakings that address essential national security concerns. Individual, private-firm R&D would continue to be driven by market forces, which are bottom-line oriented and often driven by the need to find quick, economical solutions to short-term problems. Collective industry-led public benefit R&D would fill the gap between research that is best funded by government and the R&D funded by private firms seeking profits.

The executive board of the nonprofit, public-benefit corporation would base its decisions on common and collective needs. The allocation of funds would be based on both significant public interest and value to the consumer and the collective industry. The board would likewise set the rules for overall budgets and relative funding responsibilities. A formula for funding would be based on national and industry collective needs with a 20 to 50-year time horizon. Examples of the type of roadmap needed to guide this effort include the current EPRI Electricity Technology Roadmap and the older R&D Goals Report that the industry itself created to guide the formation of EPRI.

Challenge

The proposed independent, public benefit corporation for addressing the decline in public-benefit electricity R&D lets government do what it does well, collect revenues, and lets the private sector do what it is accomplished at doing, making decisions on allocation of resources for economic growth and prosperity. Examples of government oversight include Federal Energy Regulatory Commission oversight of gas research, government support of the semiconductor manufacturing consortium SEMATECH,[10] and the Internal Revenue Service's review authority over public-benefit nonprofit corporations.

Is this proposal so radical? Can it possibly work in the real world? I believe the answer is yes. There is a long history of self-managed, common pool resources, from town commons to Swiss grazing pastures to Japanese fisheries.[11] Within the U.S. energy industry, both EPRI and the Gas Research Institute were successful and had a return rate of 3 to 10 times the investment made by industry and consumers, before they redirected their focus and experienced a decline in funding.

No human endeavor can ever be perfect, but the approach proposed here could surely be superior to what is now occurring. Further, it would not replace current market-driven collaborations; rather, it would supplement them and fill the gap between government-supported basic research and the private sector's funding for profit. Eventually this concept could be applied globally as the world moves toward a sustainable future.

The challenge today is to the executive leadership of the new and evolving electricity enterprise. In electricity R&D, change is not just inevitable, it is necessary. From the leaders in industry, government, and regulatory bodies, will someone have the gumption to step up to this challenge and lead the revolution in funding and managing collective research?■

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NOTES

1. Thomas R. Schneider, *Electricity and Society*, Electric Power Research Institute Report No. BR-105484 (Palo Alto, CA: EPRI, 1994). In this novel power plant, the fuel cell works as a topping cycle and rejects heat to the combustion turbine bottoming cycle.

2. Victor S. Rezendes, "Electric Utility Restructuring: Implications for Electricity R&D," United States General Accounting Office, summarized in testimony before the Subcommittee on Energy and Environment, House Committee on Science (Washington, DC, March 31, 1998).

3. Robert A. Bell and Thomas R. Schneider, "Balkanization and the Future of Electricity R&D," *Electricity Journal* (July 1999), p. 87.

4. The Articles of Incorporation of the Electric Power Research Institute, Inc., March 21, 1972.

5. Robert A. Bell and Wayne Seden, "Utility Restructuring and the Transformation of Industry-Sponsored R&D," *Electricity Journal* (December 1998), p. 32.

6. Robert Margolis and Daniel Kammen, "Underinvestment: The Energy Technology and R&D Challenge," *Science* 285(5427) (July 30, 1999), pp 690-92.

7. Chauncey Starr, "Sustaining the Human Environment: The Next Two Hundred Years," in *Technological Trajectories and the Human Environment* (Washington, DC: National Academy Press, 1997), p. 185.

8. Paul Romer, "Implementing a National Technology Strategy with Self-Organizing Industry Investment Boards," in *Brookings Papers: Microeconomics* 2l (1993), p. 345.

9. Peter Schwartz, *The Art of the Long View* (New York: Doubleday, April 1996); Philip A. Roussel, Kamal N. Saad, and Tamara J. Erikson, *Third Generation R&D* (Boston: Harvard Business School Publishing, April 1991).

10. SEMATECH is a consortium of 11 semiconductor manufacturing companies whose collective R&D is matched by federal appropriations. See William J. Spencer, "Technology Teamwork: The SEMATECH Story," *FORUM for Applied Research and Public Policy* 11 (3) (Fall 1996), pp. 49-53.

11. Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge, UK: Cambridge University Press, 1990).

A Roadmap for the 21st Century

Electric utility leaders have developed a roadmap to guide research and development for the next 50 years.

BY KURT E. YEAGER AND BRENT BARKER

Electricity is more than energy. It is the prime mover for productivity, wages, and jobs throughout the world. Since Edison's day, its influence has been so pervasive that the National Academy of Engineering voted the "vast networks of electrification" as the number-one engineering achievement of the 20th century—ahead of automobiles, broadcasting, telecommunications, computers, and even health care in terms of its impact on quality of life.

Its impact, however, will not be relegated to the stasis of history. We anticipate an even greater, transformative role for electricity in the 21st century as the value of electricity shifts progressively from a bulk power commodity to the precision and intelligence capability of energy and information-bearing "smart" electrons powering the digital economy.

Roadmap to the Future

The Electric Power Research Institute has begun exploring the full breadth of this potential through a visioning and research-and-development planning process that we call the Electricity Technology Roadmap. Given the fundamental importance of electricity to the quality of life, EPRI launched the Roadmap initiative with the basic societal concerns of the 21st century in mind.

Through a series of workshops and meetings in 1998 and 1999, the ideas and insights of individual stakeholders from more than 150 organizations, including utilities, industry, government, academia, and community and environmental organizations, were gathered and synthesized in a 1999 interim report. The report is organized around five key destinations that the stakeholders believe must be reached by society over the next 25 years, along with their assessment of the technology and the R&D priorities that should be pursued to reach these destinations.

As such, the Roadmap is helping to forge a comprehensive vision for increasing electricity's value to society and translating it into a set of performance goals with the technology innovation pathways to achieve them. The summary report includes a call to action for greater R&D, specifically for public and private institutions to increase their support of collaborative, electricity-related R&D funding by at least 150 percent over the next 10 years. The R&D will be used to transform the electricity infrastructure, create new services, enhance economic productivity through electricity-based innovation, and open a new pathway to environmental sustainability.

The Roadmap looks forward 50 years, but it is intended not so much as a forecast of the future as a vision of future potential. It is described in terms of stretch goals the stakeholder participants believe are achievable through the acceleration of science and technology. More specifically, these participants assert that innovation, made possible by and through electricity, has the potential to increase global economic productivity, energy efficiency, emissions reduction, agricultural yield, and fresh water availability by 2 percent or better each year over at least the next half century. This rate of achievement, described in the

Roadmap as the "2-percent solution," is consistent with the rate of progress in many of the developed countries during the 20th century, and it is viewed as a necessary step in putting the world on a confident path to a sustainable future.

Global expansion at this pace, however, is not inevitable. There are at least two critical hurdles. First comes the challenge of extending the benefits of electrification worldwide during a time when global population will grow to 10 billion people, with 90 percent of this growth occurring in today's poorest nations. Second will be the difficulty of mobilizing the will, political consensus, and sustained resources to accelerate electricity-related innovation in areas critically and chronically underfunded.

The participants believe that the aspirations of the developing world cannot and should not be denied, and they recognize the essential need for an electricity and communications infrastructure upon which to grow a more resource-efficient economy. This need has been captured in the Roadmap by its call for universal electrification by 2050, with at least 1,000 kilowatt-hours available per person per year to meet the most basic needs.

As minimal as that level sounds, it is still substantially more aggressive and ambitious than the most optimistic projections in mainstream energy forecasts today. It means bringing electricity to more than 5 billion new users over the next 50 years and adding as much as 10,000 gigawatts of global electricity capacity. To fall short of this goal is to condemn a significant portion of the world to poverty and hopelessness and the increasingly serious social and environmental disruption that ensues.

R&D Requirements

The Roadmap focuses on reaching five essential and interdependent destinations. Specifically, it calls for accelerating research investments to ensure we have the tools in hand to begin to:

- **Meet** the escalating U.S. power reliability challenge by 2003. Power reliability is straining under competitive pressures while the technologies needed are delayed because of lack of financial incentives and R&D. The potential for large-scale outage is considered greater than at any time since the great Northeast blackout 35 years ago. The grid must be upgraded and transformed into the continental equivalent of an integrated circuit.
- **Provide** customer-managed services—not just products—through the next-generation Internet by 2005. The changing appetites for power quality and quantity in a digital economy will require the creation of a new mega-infrastructure of electricity and communication that can provide intelligent services tailored by customers to their individual needs and preferences.
- **Enhance** electricity's role as an engine for economic productivity by 2010. Microminiature electronic sensors coupled with increasingly powerful microprocessor control, and new electrotechnologies using the full electromagnetic spectrum, promise to revolutionize the efficiency of manufacturing and operations. Electricity-based innovation—from lasers to plasmas—represents our best hope of boosting the U.S. productivity growth rate enough to generate sufficient wealth to support the escalating needs of an aging population.
- **Resolve** the buildup of carbon dioxide in the atmosphere by 2015. Our global climate strategy must include the accelerated development of a broad portfolio of clean-energy technologies. Technology breakthroughs are needed in every fuel source—fossil, renewable, and nuclear.
- **Manage** global sustainability issues by 2025. We will need the tools in hand within 25 years for decoupling essential future economic growth from resource consumption and environmental impacts. Electrification, which affords continuous improvements in technical and resource efficiency, will be at the heart of the sustainability drive of the 21st century.

Table 1 shows a preliminary estimate of the R&D funding needed during the next 10 years to ensure the highest probability of reaching these destinations. The total U.S. funding required for this science and technology package—exclusive of the needs for the global sustainability destination—is estimated to be $4.6 billion per year above current levels. This represents an increase of approximately 2 percent above current U.S. R&D expenditures for all fields of science and technology. Less than half the needed R&D is now underway, and significant portions of the programmatic needs are currently unfunded.

Estimating the science and technology requirements for the global sustainability destination is particularly difficult at this point. Current research funding levels in this area are not well defined, largely because the relevant work is being performed throughout the world in an unstructured manner via a host of diverse projects and under a wide variety of topical titles. The total funding requirements to achieve the technology needed for sustainability in the 21st century will certainly be in the multibillion-dollar-per-year level over the next 50-100 years.

Neither government nor indus-

TABLE 1. 10-Year Funding Outlook ($mill/yr)

Destination	Current Funding	Additional Funding Needs	Total Funding Needed
Power System Vulnerability	400	600	1,000
Customer-Managed Service Networks	400	500	900
Boosting Economic Productivity	700	1,500	2,200
Energy/Carbon Challenge	1,600	2,000	3,600
Global Sustainability Challenge	N/A	TBD	TBD
Total	$3,100	$4,600	$7,700

try can fulfill the Roadmap's vision alone. The Roadmap participants identified a need for a major increase in electricity-related R&D investment at a time when there are many competing needs for both public and private funds. Policymaker involvement is therefore seen as an important catalyst for Roadmap implementation. As a first step, new financial incentives will be needed for participation in public/private collaborative R&D to share the costs and risks of strategic technology development. Such incentives could include tax credits for research, innovation, capital investment, production, and environmental improvement; enhanced intellectual property protection; market stimulation and procurement policies; and streamlined regulatory processes to facilitate needed innovation.

The Roadmap calls for reversing the 20-year decline in global energy R&D and refocusing the portfolio of energy-related research work to meet pressing goals related to the larger issues of economic growth and environmental protection. With accelerated R&D support, for example, industrial processes in the 21st century can be revolutionized by the growing role of new electrotechnologies—including lasers, microwaves, and electron beams for materials processing—as well as electrochemical synthesis and electroseparations for chemical processing.

Similarly, manufacturing can be revolutionized by a host of emerging technologies, including nanotechnology, biotechnology, high-temperature superconductivity, and the blending of advanced sensors with information technology to create adaptive, intelligent systems and processes. Future industrial facilities exploiting these advanced electrotechnologies could then be operated in new ways to simultaneously optimize productivity, energy use, materials consumption, and plant emissions.

Justification for supporting this level of R&D can be made on many levels, from individual power companies seeking opportunities for growth, to entire industries pursuing business opportunities through convergence with other industries, to public institutions seeking faster productivity growth while mitigating the environmental impact of economic growth.

In a recent editorial, Philip Abelson, editor emeritus of *Science*, offered insight on the nature and scale of these particular proposals:

> In total, the [Roadmap] proposals call for a rapid increase in annual U.S. R&D expenditures from $3.1 billion to $7.7 billion. In comparison to the nation's gross domestic product, this sum is tiny. The suggestions of these stakeholders are many and constructive. They include R&D to decrease the cost of renewable power, the development of hydrogen fuel cells that generate competitive electricity; safe and cheaper nuclear power; and electronic control of the supply, transmission and delivery of reliable electricity. As a means for preparing for a drastically different future, the proposed program is worthy of serious consideration.[1]

What Can R&D Deliver?

A number of leaders and scholars are expressing concern about the decline in energy R&D and are calling for a reversal of global trends. In varying degrees, they are also calling for some form of public/private collaboration to focus the necessary resources and to coordinate the programs for maximum leverage.

But what is the carrot? What is the payoff that would justify such a large, long-term investment? The Roadmap provides at least a glimpse of the potential payoff in the next 25 to 50 years. Even with our limited vision at this preliminary stage, it is clear that sufficient and well-focused R&D could be one of the soundest investments made by society in the new century. Consider a few examples.

As framed in the Roadmap, R&D promises efficiency gains throughout the entire energy chain, from energy-conversion efficiency, to power delivery, to the variety of machines, appliances, and networks that constitute the diversity of energy end use. The Roadmap's goal is to double the efficiency of the entire energy chain by 2050 through advanced electrification while cutting energy-related pollution in half.

Looking at just one end of the chain, advanced combustion turbines are pushing the energy conversion efficiency from the historic 35-percent range into the 50 to 60-percent range, and tomorrow's fuel cells combined with gas turbines should be able to lift the conversion efficiencies into the 70-percent range. Even more dramatic efficiency gains are in store for power delivery through superconductivity for example, and in a variety of end uses, ranging from heat pumps to electric vehicles.

Moreover, building upon some fundamental technologies—ranging from micro-miniaturization to adaptive materials to digital devices—that will underpin all future economic activity, the Roadmap's goal is to achieve the technological means to double productivity growth rates by 2020.

Using the unique attributes of electrons to carry energy and information for greater efficiency and precision, productivity can be improved continuously through technical innovation. Gigahertz computer processors, for example, have just come on the market with the ability to move a billion electron-bits of data every second.

As the century progresses, the slow decoupling of economic growth and natural resource consumption can and will be speeded up by the interconnection of business and industrial processes on a common digital network. We are at the beginning of this era and cannot yet foresee exactly how it will unfold. It seems clear, however, that the integration of electricity and communications into a new mega-infrastructure will provide the webs connecting these interdependent human activities.

The Roadmap departs from most mainstream energy forecasts, such as those put forth by the World Energy Council, in terms of technology advancement and natural resource consumption. The pace of technological change is assumed to be much faster in the Roadmap as a result of accelerated technical innovation and global electrification. The upshot is that primary energy requirements in 2050 can be reduced by more than 25 percent below what otherwise would be needed for the same level of economic growth.

Finally, even transportation will not be immune to dramatic change. The traditional automobile could be made much more efficient and fuel-flexible by moving from internal-combustion propulsion to electric drive. The century-long technological constraints on electric vehicles appear to be coming to an end with the prospect of low-cost fuel cells tugging at the entrepreneurial instincts of the world's automobile manufacturers.

Encouraged by the likely success of internal-combustion and fuel-cell hybrids, the Roadmap calls for at least 50-percent electrification of land transportation by 2050. The implications for petroleum-based infrastructure and global fuel resources and security are quite large. There is even the distinct possibility that some of these vehicles will become mobile, distributed power sources in the next 25 to 50 years. Just imagine driving home and using your automobile to supply the power needs of your house.

Productivity Imperative

The United States shares with many other developed countries the quandaries of generally slow productivity growth, workforce and wage stagnation, growing economic disparity, rising environmental expense, and the prospects of soaring costs to meet the needs of an aging population. These economic challenges will place increasing pressure on technology innovation to create the productivity advances and wealth needed to address these issues. Technology can meet these challenges, but only if it advances on a broad front and at a pace that is sufficiently vigorous and continuous to stay ahead of accelerating social and environmental problems.

During the third quarter of the 20th century, real wages per job nearly doubled in the United States as a result of technology-based productivity growth rates, while the fraction of the population employed in the workforce remained about the same. In the fourth quarter of the century, the picture changed. Productivity growth stagnated in most parts of the economy and real wages remained flat, although the number of low-end jobs grew significantly and the fraction of the population in the workforce doubled. The United States grew in terms of gross domestic product during both quarter centuries but for very different reasons.

The fraction of the population employed in the workforce is reaching saturation at around 50 percent. U.S. economic expansion in the past decade has become more dependent upon shorter-term, expedient pathways such as reducing the budget deficit and corporate restructuring for efficiency. While this has produced some significant short-term economic gains, this trend will not be sustainable unless the atypical productivity growth now seen in narrow slices of the economy, such as information technology, can be more broadly realized.

Looking to the coming decades, the opportunities for significant workforce expansion are also limited. Today, workers in their prime working years make up a greater proportion of the U.S. population than ever before, and very little further workforce growth is anticipated in the coming decades. After 2010, the proportion of workers to elderly people will shrink rapidly as the nation's average age increases. This means that real economic growth must depend once again upon fundamental improvements in productivity, with global competition driving the productivity imperative faster and harder.

In short, the economic focus in the coming decades must be on building economic muscle, not just reducing fat. The alternative will be an increasing economic burden on working-age people.

We are left with an uncomfortable choice in supporting the aging baby boomers as they enter retirement years. In the simplest terms, we can ultimately either double the tax rate on those left in the labor force, or we can grow the economy by increasing their productivity. We will again need to find ways to increase productivity growth rates across the board, as we did in the 1950s and 1960s.

There is at least hope in the recent productivity gains that information technology has injected into the economy, but reliance upon information technology industries alone to carry us through seems precarious. On a broader scale, R&D is the soundest way of ensuring that we have the resources to support an aging population. Failure to do so will predictably result in intergenerational conflict and a declining quality of life for all.

Clean Energy Imperative

The United Nations Framework Convention on Climate Change recommends that the global average atmospheric concentration of carbon dioxide be capped by 2100 at no more than twice the level that existed at the dawn of the Industrial Age. Efficient electrification—using a diverse array of energy sources such as fuel cells, solar photovoltaics, wind, and nuclear power—is the only practical means to accomplish this in a world of 10 billion people.

The goal set by the Roadmap participants is to bring at least a basic level of electricity access to 100 million more people every year for the next 50 years, more than tripling the rate of electrification over the past 25 years. This means that even with expected improvements in efficiency, the world will likely need some 10,000 gigawatts of new generating capacity by 2050, three times today's global capacity. While substantial, this total generation is the horsepower equivalent of less than five years of current global automobile production and would cost less on an annual basis than the world spends on cigarettes.

Because more and more of this new generating capacity will need to be non-carbon-dioxide polluting, most of these power plants will have to be very different from those that exist today. Changing from a global system where more than 85 percent of the energy used releases carbon dioxide, to a system where ultimately very little carbon dioxide is released, requires fundamental changes in technology and major investments in capital equipment turnover or replacement.

Anticipated incremental advances in today's technologies will be inadequate to meet the global energy performance specifications of the future. A robust portfolio of advanced power generation options—fossil, renewable, and nuclear—will be essential to meeting these growth requirements, both domestically and globally.

Some of the technology breakthroughs needed to provide 10,000 gigawatts of capacity include:

- **Improving** high-temperature materials and coatings and integrating design advances to enable natural gas-fired, combined-cycle plants to operate at 70 percent thermal efficiency within the next 10 to 20 years, and simplified clean-coal conversion technologies to operate at 60 percent efficiency within the same timeframe.
- **Achieving** a fivefold improvement in the cost, performance, and reliability of solar photovoltaic power within 20 years and scaling up the development and application of other new forms of renewable energy, including wind and geothermal.
- **Promoting** advanced, high-efficiency nuclear power generation. This must be coupled with sufficient engineering advances in safety, waste handling, and proliferation-control capabilities to ensure confident public support for the nuclear option.
- **Developing** refining technologies to improve the efficiency of fossil fuel and biomass use, coupled with physical and biological technologies to remove carbon dioxide from power plants or from the atmosphere.
- **Improving** the performance, cost, and interconnectivity of small, dispersed generation plants, both stationary and mobile, including microturbines and fuel cells.
- **Creating** energy storage technologies—superconducting magnets, flywheels, advanced batteries, and capacitors—that are broadly adaptable and inexpensive.

Electronic Superhighway

Advancements in productivity, resource efficiency, and pollution-free energy presuppose the urgent transformation of the existing electricity delivery system into a superhighway for electronic commerce for the 21st century. This is not a given. The North American electricity delivery system has not kept pace with the escalating demands of competition or with the exacting requirements of a rapidly expanding digital economy. The chronic lack of incentives for investment in infrastructure technology in general, and electric power in particular, has begun to take its toll.

Outage frequency, for example, doubled in the two years following the regulatory changes of Federal Energy Regulatory Commission orders 888 and 889, which established the rules for open access of transmission lines and resulted in greater demand being placed on existing lines. Knowledgeable observers think that North America is closer to the edge in terms of frequency and duration of severe power outages than at any time in the last 35 years. The potential for major blackouts is growing and puts at risk the expected economic benefits of utility restructuring.

A number of companies and corporations—including electric utilities, the North American Reliability Council, and the Institute of Electrical and Electronics Engineers—have asked the Electric Power Research Institute to lead a comprehensive assessment of the reliability of the North American power delivery system to assess the risks, identify the locations of greatest vulnerability, and recommend the most cost-effective solutions.

The first order of business is to keep the lights on. The second is to use existing technology to upgrade the power system to handle the new volume and patterns of traffic created by electricity competition. The third is to begin the process of transformation of the entire power grid into the equivalent of a digital integrated circuit, able to switch at the speed of light while retaining stability in all parts of the system.

The power electronics and other tools to do this are 20 years behind end-use microcircuitry but are now becoming available. The research goals are to drive down the capital costs, saturate the entire delivery system with low-cost diagnostic sensors and real-time control to create the equivalent of a nervous system for the grid, and to develop the wide-area management system needed for continental-scale integration and control. This is a tall order, but it is an essential one for realizing the ambitious destinations illuminated in the Roadmap.

The final step is to use the new mega-infrastructure of electricity and communications to establish a new superhighway for electronic commerce that will also enhance productivity. Just as the patchwork of roads forming the U.S. highway system during the first half of the 20th century was augmented during the second half by a continental-scale Interstate system, the electronic superhighway will bring unprecedented speed, directness, and interconnectivity to all sectors of the economy. Encompassing and in several dimensions surpassing the information Internet, this new superhighway will become the backbone of the U.S. and global economies, a digital platform upon which electricity-based innovation can expand.

Such an information superhighway is the prerequisite for meeting the following aggressive goals of the Roadmap from 2010 to 2050:

- **Doubling** the rate of decline in the amount of energy needed to produce a dollar of gross domestic product from its historic rate of 1 percent per year to 2 percent per year.
- **Increasing** the efficiency of the entire energy chain from roughly 5 percent today to 10 percent.
- **Tripling** the rate of decline in carbon emissions by the global energy system from the long-standing historic rate of 0.3 percent per year to 1.0 percent per year.
- **Reducing** industrial waste streams to near zero, while minimizing the need for virgin resource use.
- **Doubling** the growth rate of global economic productivity by 2020.

Solving the Trilemma

Universal electrification of the global energy system offers a solution for resolving what promises to be the defining issue of the 21st century: the "trilemma" posed by population, poverty, and pollution. With its ability to use energy and information-bearing smart electrons for continuous gains in efficiency and productivity year after year, electrification becomes the best, and quite possibly the only, means for decoupling economic growth from resource consumption.

Electricity is the equal-opportunity medium for energy sources of all types. It is, for example, the only practical means for using renewable energy on a global scale, and it is the best means for creating a smooth transition through fossil-fuels to the anticipated clean hydrogen fuels of the 22nd century.

Providing access to electricity to the 2 billion people in the world currently without, as well as to the 3 to 4 billion yet to be born into these impoverished conditions, is an ambitious but necessary and achievable goal. Around 1,000 kilowatt-hours per person per year is the threshold separating the bare essentials of life from the amenities, including education, environmental concern and protection, and intergenerational investment.

It is in our own enlightened self-interest to ensure that this course is taken during the next 50 years. Right now, the technology is not there to bring this about. It is too inefficient, too expensive, and too polluting. Incremental improvements will help, but given the population surge that is seeking greater economic opportunity, it will be too little, too late. We need to accelerate the pace of technological innovation—not slow it down with short-term, misguided policies—if we are to solve the formidable global challenges before us.

This is the ultimate payoff for R&D in the energy-related areas of technology. Adding $5 billion to the ongoing U.S. research budget is small compared to the anticipated global market of $100 billion to $150 billion per year in energy-conversion technology alone. For just a fraction of the capital cost, the electricity infrastructure could be greatly improved. It could be made to be cleaner, smarter, less expensive, and more adaptable to the diverse needs of different cultures, saving money, lives, and the environment in the process.

As a nation and as the global leader, the United States must recommit to the future. Historically, innovation has been the backbone of U.S. economic progress and world leadership. Today, we are reaping the harvest of past investment in R&D while doing far too little to ensure the future.■

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NOTE

1. Philip Abelson, "Future Supplies of Electricity," *Science* 287 (February 11, 2000), p. 971.

Investing in a Bright Future

In a fragmented electric utility market, the federal government will need to lend a hand for research and development.

BY RUSH HOLT

Affordable energy is the lifeblood of modern society. Without it, the network of transportation, agriculture, health care, manufacturing, and commerce deemed essential by many of the world's inhabitants would not be possible. The environment, national security, and jobs are all affected by the reliability of the nation's electric power grid.

In today's deregulated and highly competitive business environment, the energy industry must continue to invest in fundamental research and development if it wants to maintain and enhance its productivity.

Faced with an uncertain future, however, private investors may lose sight of their traditional role in R&D. The federal government can therefore be a valuable partner in helping industry find new ways to respond to growing consumer demand for electricity.

Decline in Energy Funding

Founded in 1972 by a consortium of public and private utilities, the Electric Power Research Institute has provided a public benefit to the electric utility industry through its R&D programs in production, transmission, distribution, and use of electricity. U.S. electric utilities established EPRI as a nonprofit membership corporation to manage a national research program on behalf of its funders, the industry, and society. In forming one of the first industrywide research consortia, electric utilities pioneered the concept of pooling their resources for maximum benefit.

Although individual utilities have continued to conduct their own research, EPRI has far and away been the mainstay of industry research. Yet, some might argue, restructuring of the energy marketplace has caused a decline in funding from the private sector and therefore a decline in the public benefit of R&D. Industry funds have been redirected away from collective industry research on issues such as material science technology and its application to improved transmission capacity. Today, the electric industry is struggling to survive in a competitive environment, and industry-wide funding for R&D is suffering as a result. EPRI's funding in 1998, for example, declined 10 percent. This trend toward decreased funding for fundamental R&D and the increasing concern of state and local utilities about their role in a deregulated environment have resulted in a fragmented approach to vital projects. For example, smaller state and local utility organizations have fewer resources to invest in research and will have significantly reduced efficiency in developing solutions to common problems relating to transmission capacity and reliability across larger regions.

The decline in industry funding means the federal government will need to take a more active role in funding R&D projects in the electric utility industry, which is vital for continued economic prosperity as well as national security.

Federal Aid

While investment in collaborative R&D efforts by public and private members of the utilities industry has declined, the federal government has provided significant increases in funding through the U.S. Department of Energy for research projects in the electricity industry. These research efforts will ensure the efficient and reliable delivery of electric services in competitive, restructured electric markets.

For fiscal year 2001, DOE has proposed a $48 million budget, or nearly a 25 percent increase over the fiscal year 2000 budget in overall spending on R&D of electric energy systems.[1] In previous years, funds were spent on research into alternative sources of energy such as solar and renewable energy sources. The new budget calls for exploring technical advances in electricity transmission and storage to enhance the efficiency and reliability of the nation's electrical grid.

A top priority of the 2001 budget is research on high-temperature superconductivity. Superconductors have the ability to conduct electricity without the loss of energy. When current flows in an ordinary conductor, for example copper wire, some energy is lost. In a light bulb or electric heater, the electrical resistance creates light and heat. In metals such as copper and aluminum, electricity is conducted as outer energy level electrons migrate as individuals from one atom to another. These atoms form a vibrating lattice within the metal conductor; the warmer the metal the more it vibrates. As the electrons begin moving through the maze, they collide with tiny impurities or imperfections in the lattice. When the electrons bump into these obstacles, they fly off in all directions and lose energy in the form of heat.

Inside a superconductor the behavior of electrons is vastly different. The impurities and lattice are still there, but the movement of the superconducting electrons through the obstacle course is quite different. As the superconducting electrons travel through the conductor they pass unobstructed through the complex lattice. Because they bump into nothing and create no friction, they can transmit electricity with no appreciable loss in the current and no loss of energy.[2] This can greatly increase the efficiency of generators and heavy electrical machinery and dramatically increase the carrying capacity of high-voltage transmission lines.

In 1999, we saw the first industrial applications of high-temperature superconducting cables to transmit electricity to the Southwire Company's headquarters in Carrollton, Georgia, to power three manufacturing plants. These cables added about 15 megawatts to the capacity of this commercial grid system. DOE's fiscal year 2001 budget proposal included $32 million for the High Temperature Superconductivity program that will emphasize strategic research, providing the fundamental knowledge base for advances in this program.

In addition to research on high-temperature superconductivity, DOE has proposed $11 million for research on increasing the reliability of transmission on the existing grid. This funding will support the development of advanced power electronic controls capable of responding to critical changes in electrical demand. These systems are needed to ensure reliable delivery of electric service by the nation's transmission and distribution systems. DOE has also proposed $5 million in funding for energy storage for fiscal year 2001. [3] Development of energy storage technologies has the potential to reduce the high cost of power outages, improve power quality, and enhance technology choices in a competitive utility environment.

In his April 1999 testimony before the Senate Subcommittee on Energy and Water Development Appropriations, Assistant Secretary for Energy Efficiency and Renewable Energy Dan W. Reicher explained that efficient energy storage is critical for service reliability and for the success of distributed power generation. Energy storage will play an increasingly crucial role in combining multiple inputs of varying power quality and matching output to a changing load. The program will initiate the transmission power quality study and explore advanced storage technology concepts.

Basic Needs, Basic Research

The transition to competitive, restructured electric markets requires the development of advanced technologies to ensure the efficient and reliable delivery of electric power services to consumers.

Growing consumer demand for electricity is placing increased stress on the nation's transmission and distribution systems. Overcoming regulatory, technical, and institutional barriers to the transmission of power will relieve stress on the nation's electric transmission systems. The development of lower-cost, high-performance power electronic controllers with energy storage systems as part of the transition to instantaneous control of electric systems will provide improved power quality and will add operational capacity within the existing transmission and distribution infrastructure. The development of high-temperature superconducting power equipment will significantly reduce losses in generation, delivery, and end use of electricity and will relieve constraints on power delivery systems, particularly in urban areas with very high-capacity transmission and distribution cables.

But more needs to be done. Just as the federal government has a responsibility to invest in basic medical research to ensure the health of present and future generations, it also has a responsibility to invest now in basic energy research to ensure both our immediate and long-term economic and environmental health. If our nation is to remain competitive in the global marketplace, we must continue to adequately fund efforts in R&D.

I am pleased to be an original sponsor of the Federal Research Investment Act (H.R. 3161). This bill is a bipartisan proposal to double the amount of the federal government's investment in civilian R&D. It calls for raising the percentage of the total federal budget spent on research activities from the current 2.11 percent to 2.6 percent, with a recommended funding level of nearly $68 billion by fiscal year 2010.

As a scientist, I know that today's research is at the threshold of even further major scientific advancement that can dramatically improve the quality of life for the American people. Through federal support of scientific research, we can continue to drive a powerful engine of social progress, physical health, and economic growth.■

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NOTES

1. U.S. Office of Management and Budget, *The Budget of the United States Government Fiscal Year 2001* (Washington, DC: U.S. Government Printing Office, 2000).

2. Robert W. Dull and H. Richard Kerchner, *A Teacher's Guide to Superconductivity for High School Students* (Oak Ridge National Laboratory, September 1994).

3. U.S. Department of Energy, Office of Chief Financial Officer, *FY2001 Budget Request to Congress Budget Highlights: Strength Through Science* (Washington, DC: U.S. Government Printing Office, February 2000).

Lighting the Path to Sustainability

New, innovative electric technologies can be the key to a sustainable future for developed and developing nations alike.

BY THOMAS R. SCHNEIDER AND VERONIKA A. RABL

The last part of the 19th century was a period of dynamic growth and rapid economic development. The discovery of practical electrical generators, motors, lighting, and electrified transportation helped fuel this economic acceleration. This first wave of electrification was largely complete by 1940. The next 50 years witnessed a second period of electrification built on a diverse range of electric technologies.[1]

Today, many wonder if the world can sustain continued population growth and economic development. Recent and ongoing analysis points toward a third wave of electrification as a sound and sane path toward sustainability in terms of social and economic progress as well as preservation of the human environment.

A century ago, electricity itself was a radical innovation. Today, electricity is a fundamental enabler of technical innovation and a driver of social and economic progress. Electricity is also the medium for the revolution in information technology. The marriage of electrical and electronic technology should permit developing countries to leapfrog in their economic and social development and minimize environmental impacts.

In this context, electricity and electrification are not the objective but rather an integral element of technological innovation, economic development, and social progress. The environmental benefit results from the natural course of technological progress. In short, continued economic competition increases efficiency and reduces the resources consumed to produce a unit of wealth. Indeed, in the process, humankind's inventiveness emerges as the ultimate renewable resource.[2]

Identifying and following this path requires system-level thinking on the part of governments, the energy industry, and private companies participating in the economic development of our increasingly global society. Understanding the connection between electricity and society's progress is vital.[3] The impact of innovation on past and future development and environmental quality and the opportunities that these advances place before the world are often obscured by concerns over emissions at individual power plants.

Having the vision to look at the world economies as systems—indeed, as industrial ecological systems—will lead to a different course of action than that produced by analyzing individual subsystems. Treating the human environment as an ecological system will create the path to sustainablity.

A Global Context

The appropriate roles and paths for electrification vary somewhat depending on a nation's position along the economic development continuum. For developed nations, electrification is a continuation of a natural evolutionary path of upgrading existing technological infrastructure. The goal of these nations is a sustainable long-term balance of their standard of living with conservation of the Earth's resources.

For developing nations, electrification offers a more revolutionary opportunity: a means to leapfrog from their current condition directly to an advanced technological state that contributes positively to advancing both their economic wellbeing and environmental sustainability. For these nations, the opportunity involves bypassing some of the interim states of less-sustainable industrialization. This means that the use of conventional technologies, which might be easier to acquire, is far more costly over the long term in economic and ecological terms and can be avoided by adopting advanced electric technologies. Initial costs of such technologies may or may not be higher.

Electricity and an improved quality of life have been closely linked since the initial electric inventions of Westinghouse and Edison. Offering unprecedented benefits—such as precision, control, and cleanliness—electric tools and appliances quickly dominated alternatives in the marketplace, even at higher initial prices. For example, compared with its predecessors, electric lighting is phenomenally energy-efficient as well as clean, odorless, and highly controllable by the user. Modern improvements in electric lighting technology also continue to increase the energy efficiency advantage. The increase in efficiency of electric lighting today versus 1890 is more than 50-fold—with most of that occurring in the last few decades.

Shortly after its introduction, electric lighting extended the day, making possible many activities and pastimes that were previously impractical. Meanwhile, electric trolleys and trains extended space by allowing many people to move out of crowded inner cities. Electric transit continues to reduce pollution in comparison with other forms of transportation.

Electric motors have created major productivity benefits through increased freedom of movement organization of the production process, and reduction of on-site pollution. The addition of ever-improving controls for the speed of motors facilitates further precision, automation, and energy savings.

The resulting productivity gains have fostered economic growth while reducing the energy inputs to production. In developed countries such as the United States, overall energy intensity per dollar of gross national product has declined steadily for decades, at the same time that electricity's share of energy use has been increasing.

Nations with the highest electricity generating capacity tend to have the highest gross domestic product per capita. With the exception of some of the former Soviet countries, where economic policies historically emphasized increasing industrial capacity without achieving corresponding growth in GDP, these results suggest a strong link between electricity use and prosperity.

When the complete fuel cycle from resource extraction to waste disposal is considered, electricity is the environmentally superior energy form for a vast array of applications, from heating and cooling to making steel. Major gains now appearing in electricity generation will further reduce energy resource use and magnify the environmental benefits of more electric end uses. At the same time, emerging electric technologies will draw increasingly on electricity's inherent capabilities to further expand their applications and increase their efficiency.

Electrifying the Third World

Nowhere is the promise of electricity greater than in the poorest and least developed countries of the world. Historically, with industrialization, energy intensity has first increased as the infrastructure is developed and then declined continuously as economies of scale and innovation produced efficiencies. Countries that developed later tended to be more energy-efficient in this process—that is, their energy-intensity peaks were lower and their ultimate energy intensities were lower as well.

This appears to be a natural result of two phenomena. The first is continuing innovation in energy production and use, which provided the later-developing countries with efficiency advantages not available to earlier-developing countries. The second factor is more rapid market diffusion of the new technologies

What determines how fast new technologies are adopted? The rate of diffusion of a new approach tends to be driven by the economic advantage of the new process and the technology it replaces. For the country developing at a later time, the gap between the old technology and the new tends to be larger. Hence, the benefit is more significant and the payback faster. Consequently, adoption is more readily justified and diffusion is faster.

In today's developing nations, the lack of an extensive industrial base and electric power infrastructure requires a similar major investment but also offers an even greater opportunity to leapfrog to highly advanced, more-efficient, and environmentally sound new electric technologies. This technological leap could in turn stimulate the economic growth needed to improve living conditions in the face of expected population increases. In fact, electricity appears to be the only energy form that can simultaneously meet the global environmental and economic imperatives of the future.

As the introduction of electric

lighting did in the currently developed world, the wider use of electric lighting in the developing world can expand the available time for work, education, and leisure. By leapfrogging 100 years, from oil and kerosene lamps and wood fires directly to electric light, major reductions in energy use can be accomplished. Simultaneously, indoor air quality and protection of the natural environment can be improved.

Compared with a candle's output of about 0.15 lumens per watt, a standard incandescent light bulb provides about 12 lumens per watt. This marks an 80-fold increase in efficiency. The new compact fluorescent lighting technology increases this efficiency to 56 lumens per watt, an additional improvement of nearly fivefold.[4]

By using electricity from a small photovoltaic array or by burning kerosene or oil in a small-engine generator instead of a lamp, similar dramatic efficiency improvements can be attained. The quality of the lighting is also greatly improved. This quality improvement is in turn associated with gains in labor productivity and human health.

The introduction of widespread electric lighting represented a vital change in Western society, but it will be even more so in much of today's developing world. Indeed, when electric lighting was introduced in the West, refined fuels—rather than wood or other native fuels—were already being used more extensively for lighting than is the case today in some developing regions. The potential leapfrog in that part of the world is therefore not just from the industrial 1880s to today's standard lighting, but an even more dramatic leap from a preindustrial, sometimes primitive, agricultural social structure to today's advanced technological capability.

In these poorest regions, the next priority after lighting may be an electronic means for education and communications at the level of the community or village. Here education via direct broadcast satellite in the native language can communicate knowledge about sanitation and more modern health and farming practices.

Similarly, the creation and dissemination of simple designs for more effective fuel-burning cook stoves offer a major opportunity for improving indoor air quality.[5] Consider, for instance, that in some developing countries, the family's search for firewood represents a major and growing use of time and is worsening with population growth and increasing deforestation.[6] The increasing scarcity of firewood also leads to use of other fuels. The knowledge of how to build and use more-efficient stoves, which could still use native fuels, will dramatically reduce the amount of wood burned and the hours of labor spent gathering wood.

Emerging Technologies

The new electric end-use technologies now appearing and under development are generally of two types. The first is evolutionary—that is, incremental efficiency improvements to existing types of electric equipment. The second type is revolutionary—that is, brand-new technologies that meet new needs or completely supplant existing technologies. Both types are relevant to developed as well as developing nations.

There is further opportunity to improve the energy efficiency—and thus reduce the pollutant emissions—of today's electric technologies, and progress is continually being made in such incremental, evolutionary improvements. However, even greater gains are being made through development of new electric technologies to replace, rather than improve on, existing ones. Such beneficial electrification opportunities, if pursued with the same vigor as the more evolutionary efficiency opportunities, could double energy savings while cutting carbon dioxide and other emissions in half.

■ **High-efficiency electric heat pumps** provide all-season heating and cooling of homes and commercial buildings while eliminating fire dangers and local emissions. Heat pumps now on the market offer the highest efficiency in use of energy resources compared to other approaches on direct fuel combustion. The heat pump delivers the lowest-available consumption or use of energy resources and consequently the lowest emissions. When the total system of electricity generation delivery and use in heat pumps is compared with the best available gas furnace, the electric heat pump wins by a small margin. If the comparison is made based on best available electric generation efficiencies of 60 percent, the heat pump beats gas furnaces by a factor of two. New ground-source and solar-assisted heat-pump technologies—which supplement electric energy input with low grade heat from the ground or solar collectors—achieve even higher efficiencies, above the 200 percent mark. Along with continued improvements in component efficiency and gains in the efficiency of electricity generation, the energy efficiency of the heat pump is certain to continue to improve, and this advantage of electrification of space heating will gain further over direct fuel combustion.

■ **Advanced electric motors and adjustable-speed motor drives**, now widely available, offer major savings in energy use and cost. The enormous efficiency advantage of adjustable speed drives was uncovered in a study of power plant motor use in the early 1980s. It was discovered that conventional design practice specified fan and pump motors for maximum operating flows of air or pressurized water. Over the course of a year, or a day, these maximum operating conditions would occur only part of the time. For the rest of the time, when reduced flows in the process streams are needed, throttling vanes and valves are used. This dissipates the energy input to the motor.

Replacing these standard design practices permits the control of the process flows by varying the fan, pump, or compressor's energy use directly and eliminating the unnecessary dissipation of energy through throttling. Typical savings are 30 to 40 percent of the energy that previously was delivered by the electric motor and dissipated rather than doing useful work. In the early 1980s, the necessary electronic controls for the adjustable or variable speed motor were expensive and bulky, yet payback times well under a year have often been achieved through retrofits.

New power electronics are lowering the price and size of retrofit and adjustable drives, and more rapid diffusion of this technology is occurring in a range of applications from power plant forced-air fan drives to the new horizontal clothes washers. Adjustable-speed drives alone are forecast to save some 15 billion kilowatt-hours in the next 15 years, reducing carbon dioxide emissions by over 10 million tons. Sulfur dioxide and nitrogen-oxygen emissions will also be reduced.

■ **Electric arc furnaces** offer many advantages over traditional coke-fired blast furnaces and the basic oxygen furnace for producing steel. Using scrap steel, the arc furnace reduces electricity use to a small fraction of the primary fuel required by the traditional process. Synergism between increased recycling, increased availability of steel and iron scrap, and improved scrap melting and refining to higher quality products creates the advantage. This innovation now dominates U.S. steel making and cuts out the need to mine the ore and shortcuts the resources needed to go from mine mouth to steel. The new ore mine is the scrap pile, and old cars are the new resource.

When compared with the standard oxygen furnace, even using electricity generated by older coal-fired power plants without scrubbers—which have a marginal efficiency of about 27 percent and a heat rate of 12,500 billion kilowatt-hours—the electric arc furnace still consumes only about 60 percent as much primary energy. The electric arc furnace also demonstrates clear environmental advantages. This furnace generally releases lower emissions and produces a carbon-dioxide-equivalent global warming effect of only about 40 percent of that for the oxygen process.

The electric arc furnace also increases siting flexibility. Indeed, because it is smaller and less environmentally destructive, it can be located closer to the manufacturer that consumes its products, reducing transportation and energy costs further. Overall cost are reduced and economics improved, and yet these mini-mills can produce a variety of high-quality specialty steels. Because of these advantages, U.S. steel production with electric arc furnaces continues to grow despite an overall downward trend in total domestic steel production.

■ **Freeze concentration** is an example of an ultra-high-efficiency electric technology for process industries. Using half the source energy of conventional gas-fired evaporation, electric freeze concentration can be used for many products, including concentrated milk or juices. Conventional separation or concentration processes work by boiling off the volatile components in foods, which is typically water. Freeze concentration removes the water at its freezing point instead of the boiling point. In most cases, and in all cases where water is the primary fluid being removed, achieving concentration through boiling incurs a higher energy penalty. Emissions at the process site are reduced to nearly nothing, and total emissions including at the power plant are a fraction of those of the gas-fired alternative.

■ **Infrared industrial ovens** can be used for drying and curing a variety of coatings on products ranging from beverage cans to cars. Conventional technology raises the temperature of the entire product to the drying temperature when only the surface and the immediate substrate need to reach the drying or curing temperature to successfully dry or cure the surface. Far less energy is used in this process, because only a small fraction of the necessary conventional heat energy is used.

In drying and curing for auto paint refinishing, for example, the electricity used in the infrared process represents less than half the total source energy of a gas convection oven. Major classes of pollutant emissions—including those at power plants and on-site—are also correspondingly lower with the infrared technology. Infrared is faster, uses less space, and is more controllable than the gas oven, and it eliminates most of the emissions at the factory site.

■ **Electric flashbake ovens** use halogen lamps for cooking, combining the speed of microwave ovens with the cooking characteristics of conventional ovens. This combination optimizes simultaneous rates of interior cooking and exterior browning of foods. Compared to a commercial wood-fired oven, the flashbake oven uses only about a sixth as much energy and creates about the same fraction of total carbon-dioxide-equivalent emissions.

■ **Microwave noodle drying** is another innovative electric technology applicable in many developing countries. The conventional drying method uses an oil-fired three-stage steam-drying oven, while the microwave method replaces only the most energy-intensive stage and otherwise uses the conventional method. Even with this limited use, however, energy requirements and carbon-dioxide-equivalent emissions are reduced by more than 50 percent.

■ **Electric vehicles** are just entering the market as advanced prototypes. Major manufacturers are likely to introduce hybrid electrified vehicles this year in several markets, and competitive pressure should lead to rapid improvement and wider use in the United States and throughout the world.

Electric vehicles appear to offer many advantages, both to society and to the user. Electric vehicles use far less source energy than a comparable gasoline-powered car, and they dramatically reduce most pollutant emissions. Electric vehicles will also offer users the convenience of in-home refueling, reduced noise, lower maintenance requirements, and a longer life, all with adequate range and comparable acceleration performance.

■ **Cool-storage technology** permits high-efficiency space cooling and dehumidification without the high-peak-period demands for power usually associated with air-conditioning. The efficiency advantage comes from operating the refrigeration or chillers at night when outside ambient temperatures are typically significantly lower, often lowering the refrigeration energy required by as much as 50 percent.[7] This also shifts the power plant energy consumption to nighttime periods when more-efficient power plants are online and available. The needed "coolth" is stored for use during peak demand in water, ice, more-sophisticated materials, or some combination of all three.

The combined benefit can be substantial, depending on local climate and generation mix. The user can also take advantage of lower rates offered during off-peak periods—typically nights and weekends—when demand for electricity is lower. Consequently, the electric utility will experience less demand on its system during times when electricity use is normally the highest. Coupled with advanced air-handling techniques that can utilize sophisticated learning algorithms based on actual monitoring and model of the building and adjustable-speed fans and blowers, cool storage can be particularly useful in improving occupant comfort at minimum cost in humid climates.

■ **Public water supply and wastewater treatment** can benefit from many new electric technologies in terms of cost and effectiveness. Some of these technologies include high-efficiency motors with electronic, adjustable-speed drives. These more precisely match the electric energy input into the motor with the needs for pumping energy and eliminating throttling losses. Other techniques include membrane filtration, electron-beam replacement for chlorine, electro-acoustic sludge dewatering and microwave sludge drying, ozonation, and ultraviolet disinfection to replace chlorination.

All make use of new technologies for separation and also replace chlorination. Both are desirable changes in the sanitary wastewater treatment.

In addition to energy efficiency, cost-competitiveness, and emissions reduction—all-important benefits to society and its electric utilities—these technologies often provide other benefits that may be even more important to the user. In the industrial sector, for example, these benefits generally involve making the user's process more effective through increased productivity and product quality, greater precision, reduced space requirements, and improved safety, noise, and thermal impacts. These user benefits will ultimately drive the adoption of these advanced electric technologies.

Revolution in Generation

The economic and environmental advantages of all end-use electric technologies will be raised dramatically by the fast-rising tide of high-efficiency generation. Further improvements are near. The combined-cycle power plant should achieve efficiencies of perhaps 65-68 percent. New innovative power plant concepts, combining combustion turbines with high-temperature fuel cells, may take energy conversion efficiencies to 72 to 75 percent. Yes, there is room for improvement. These improvements will lower the costs of electricity and further reduce dependence of global economies on fossil fuels.

The conversion efficiency improvements extend the life of fossil fuel resources by nearly 250 percent. These improvements in efficiency go hand-in-hand with point-of-use efficiency improvements. Together they create an economic driver for continued global electrification. A seemingly historic event that occurred a century ago is actually an ongoing process and offers a technological path to sustainability of the human environment.

Along with photovoltaics and fuel cells, high-efficiency gas-turbine generators are also being scaled down to sizes that can be situated close to facilities needing electricity, which improves energy efficiency and reduces emissions still more. This will offer tremendous advantages to developing countries in particular, where both generation and delivery infrastructure is strained by the pace of development and increasing power demands.

Making It Happen

The mere availability of advanced, high efficiency, end-use technologies is not enough to bring about large-scale global benefits. Strong policy support by governments and electricity providers is also essential. Governments and utilities must see electrification in terms of its relevance to broader economic and environmental goals rather than only as an option for individual end users. In that broader, societal context, it becomes clear that a comprehensive delivery system is necessary. That delivery system for large-scale electrification has at least three crucial elements that governments and utilities worldwide must recognize and support: customer service, fair and market-driven costing and pricing, and technology transfer.

■ **Customer service**. Effective customer service is vital to facilitating the acceptance and adoption of advanced electric technologies. Particularly in the industrial and commercial sectors, many electric utility customers need help in identifying appropriate electric technologies and their benefits. Assistance in implementing these new technologies is also widely needed. There are substantial opportunities for added revenue for utilities that seek ways to be more valuable to their customers by providing new products and services.

Many new customer-service activities and products are likely to be seen in the coming decade. These range from technical information and assistance to financial services, from entertainment to security services.

■ **Costing and pricing**. Electric utility costs have historically been analyzed and managed only for broad classes of customers or for enterprises as a whole. This approach will give way to a far more detailed analysis and understanding of the costs of specific services at specific times and locations.

Two types of rates are in general use. Time-of-day rates where there are typically two different rates—one for peak periods and a second for low-demand, off-peak periods—are found in some utility rate schedules even for residential customers.

Consumers of large quantities of electricity often see a charge proportional to their peak demand during a month—that is, the demand charge—and the charge for the energy consumed during that month. These rates do not place great demands on metering technology and have been around for many decades. Current computer processors allow sophisticated metering, and variations on these simple rates closely track actual prices for electricity. The demand for delivery equipment can be expected to rise with ongoing deregulation.

With more detailed information on the relationship between service and cost, better pricing structures become possible, and market distortions are reduced. Even where social policy dictates selective below-cost pricing—for instance, in providing electricity at reduced rates to farms or low-income households—the impacts of different price levels on total revenue can be determined. Such information is also needed for time-of-use and real-time pricing plans. In addition, detailed knowledge of costs of service facilitates strategic pricing to address objectives such as revenue, emissions control, and economic growth.

For example, conventional incentive programs can be focused on cost-subsidized customer groups to adopt new electric technologies and practices that can increase efficient use of electricity. In electricity supply-limited regions, where economic growth is a vital concern, this approach can be used to make more power available to important full-cost electricity customers whose usage can improve the utility's revenue as well as the region's economic health.

■ **Technology transfer.** The process of transferring new electric technologies and practices from their developers to the ultimate users is essential and must include such diverse elements as identification of the high-potential technologies as they emerge, investment in accelerated development and demonstration of these technologies, development of expertise in the effective application of these technologies, and systems engineering of the entire adoption process from invention to use.

Wired World

The expanding worldwide use of electric technology, including many emerging innovations in power generation and end uses, will greatly reduce energy resource use, cut costs, increase competitiveness, and allow enhanced environmental protection.[8] These same innovations will also help promote national economic strength. At the same time, power electronics and improved electronic communications will offer greater customer choices in electric services.

The many new end-use technologies and their specific applications will succeed because they will provide customers with the kinds of value they want: lower costs, greater comfort and convenience, controllability, and enhanced safety, speed, and productivity.

These many advantages of modern electrification are applicable in the world's vast developing areas as well as in the more developed nations. Through accelerated electrification, developing nations have the opportunity to leapfrog from more primitive and traditional energy sources to the most modern and efficient technologies. This can lead to major improvements in economic strength and living standards, in part because the developing countries are relatively unencumbered by extensive and outdated infrastructure investments in less efficient technologies. In short, many of them are starting from scratch and proceeding directly to the most modern technologies.

Importantly, the developed nations will also benefit from these new electric generation and end-use technologies. Indeed, these technologies will provide a clear path to the rapidly changing and highly competitive future while offering a means of achieving a sustainable, long-term standard of living on planet Earth.■

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NOTES

1 Sam H. Schurr et al., *Electricity in the American Economy: Agent of Technological Progress* (Westport, CT: Greenwood Press, 1990).

2 Jack M. Hollander and Thomas R. Schneider, "Future Energy Innovation Grows from Today's R&D," in *FORUM for Applied Research and Public Policy* 12(1) (1997), pp. 145-148.

3. Thomas R. Schneider, *Electricity and Society,* Electric Power Research Institute Report No. BR-105484 (1995).

4. Lindsay Audin et al., *Lighting Technology Atlas* (Boulder, CO: E-Source, Inc., 1994).

5. Daniel M. Kammen, "From Energy Efficiency to Social Utility: Lessons from Cookstove Design, Dissemination, and Use," in J. Goldemberg and T.B. Johansson, eds., *Energy as an Instrument for Socio-Economic Development* (New York: United Nations Development Programme, 1995).

6. Ndey-Isatou Njie, "Energy's Role in Deforestation and Land Degradation," in Goldemberg and Johansson, eds., *Energy as an Instrument for Socio-Economic Development.*

7. Veronika A. Rabl, "Thermal Storage: A Win-Win Technology," in *Proceedings: 1992 Electric Thermal Storage (ETS) and Thermal Energy Storage (TES) Conference,* Report TR-103729 (Electric Power Research Institute, September 1994).

8. Clark W. Gellings, "Electrotechnology Cleans Up," *IEEE Spectrum* (February 1996).

Electric Utility Terms

Italicized terms in the following definitions are defined elsewhere in the glossary.

Aggregation—the joining together of groups of small customers, typically residential or commercial, to leverage buying power to get better prices.

Allowances (also called *emissions credits*)—units of air emissions, such as tons of sulfur dioxide emitted by a coal-fired power plant, that are brought and sold in an *emissions trading* market. Trading in emissions credits allows utilities a flexible, cost-effective way to achieve air quality goals.

Avoided cost—the price utilities pay to nonutilities for *cogenerated* power, which is equivalent to the utilities' cost if the utilities had produced the power themselves

Banking—storing *emissions credits*, either by overcomplying with environmental regulations to earn excess credits or by purchasing credits for later use or sale (see *emissions trading*).

Bilateral trading market—a market in which *generators* sell electricity directly to *distributors*, *power marketers*, or consumers (see *ISO market*).

Capacity—the maximum amount of power produced by a power plant or the approved maximum output of a power plant.

Cap-and-trade—a type of air *emissions trading* program in which a cap, or limit, is placed on the total amount of emissions that may be released to ensure a net reduction in pollution. Trading of *emissions credits* is allowed among emitters to improve the cost effectiveness of the program.

Carbon tax—a tax imposed on business and industry for the amount of carbon emissions (for example, carbon dioxide, carbon monoxide, or methane) they release into the air.

Cogeneration—*generation* technology that produces both electricity and useful heat or steam.

Cogenerator—a company that produces both electriciy and useful heat or steam.

Combined cycle—*generation* technology that captures waste heat from a power plant and uses it to drive a second power plant to produce additional electricity.

Competitive transition charge—a charge assessed on electricity consumers to help utilities pay for *stranded costs*.

Consumer-owned utility—a locally owned, nonprofit electric utility, such as a *cooperative*, a *municipal utility*, or a *public utility district*.

Cooperative—a private, nonprofit electric utility owned by consumers.

Cost-based rate—the price the consumer pays for a unit of electricity, based on a utility's costs for *generation*, *transmission*, and *distribution* rather than on market forces (see *market-based rate*).

Cost of service—a system for establishing energy rates based on a utility's costs for *generation*, *transmission*, and *distribution* plus a small profit. Cost of service rates are regulated (see *cost-based rate*).

Cost shifting—establishing a *transmission* charge within an *RTO* that is the average charge of all utilities within the RTO. Under a cost-shifting approach, the transmission costs of all participating utilities shift toward the average (see *locational marginal cost pricing* and *zonal pricing*).

Default full-service contract (also called *standard-offer contract*)—a contract for the purchase of electricity between a local *distributor* and retail customers who do not choose a supplier. A regulator establishes the price of the electricity.

Demand-side management—the use of management tools, such as energy conservation programs or incentives for reducing demand, that lower the demand for power during certain times of the day or that shift the demand to times when demand is lower.

Deregulation—the process of removing restrictions and regulations from an industry to allow it to become a more competitive industry. In the electric utility industry, deregulation removes the monopoly franchise for the local utility, allowing other firms to compete for the business while offering utilities greater business flexibility (see also *restructuring*).

Direct service industry—an industrial plant that buys electricity directly from a government agency rather than from a utility company.

Distributed generation—small-scale sources of power, such as wind turbines, combustion turbines, diesel generators, fuel cells, and solar panels, that can be easily established on or nearby a consumer's site to meet a specific consumer's energy needs. Distributed generation reduces or eliminates the need of a company to buy power transmitted long distances from a central power plant and can help reduce the need for additional transmission and distribution lines for delivering electricity.

Distribution—the delivery of electricity to homes and businesses. Distribution typically occurs at a voltage of 69 kilovolts or lower.

Distributor—a company that buys wholesale power from a supplier then sells and delivers it to consumers.

Electrification—the process of providing electrical service to a region that previously lacked such service.

Emissions credits (also called *allowances*)—units of air emissions, such as tons of sulfur dioxide emitted by a coal-fired power plant, that are bought and sold in an *emissions trading* market. Trading in emissions credits allows utilities a flexible, cost-effective way to achieve air quality goals.

Emissions trading—the buying and selling of *emissions credits* or *allowances* in a market. Emissions trading allows companies a flexible approach to meeting environmental compliance goals while ensuring a net overall reduction in pollution.

End-user—a customer who buys electricity for consumption, not for resale.

Energy service provider—a company that buys power and other services from a supplier and sells them to *end-users*.

Generation—the production of electricity.

Generator—a company that produces or generates electricity for sale. Also a piece of equipment that generates electricity.

Grid—the network of *transmission* lines that serves a region.

Independent system operator (ISO)—an entity or organization that facilitates the sale and *transmission* of electricity but that is not a *generator* or owner of a transmission system.

ISO market—a market in which *generators* bid on the price and amount of electricity they wish to sell and an ISO facilitates the sale and ensures that the power is delivered to the buyer (see *bilateral trading market*).

Investor-owned utility (IOU)—an electric utility company owned by stockholders (see *public utility*).

Kilowatt-hour—the amount of energy expended by one kilowatt (1.34 horsepower) in one hour (for example, the amount of energy used by ten 100-watt lightbulbs burning for an hour).

Line derating—reduction of *capacity* due to weather, maintenance, or other factors.

Load—the amount of power required to meet consumer needs.

Locational marginal cost pricing—a system for determining *transmission* prices, based on the marginal cost of *generation* at any point on the transmission *grid* see *zonal pricing*).

Market-based rate—the price the consumer pays for a unit of electricity, determined by market forces rather than the *costs of service*.

Market power—the ability to set prices above those that would exist in a truly competitive environment.

Megawatt—one million watts or 1,341 horsepower.

Municipal utility—a nonprofit utility owned by a municipality.

Natural monopoly—a market structure in which the economies or natural constraints are such that it is economical for only one company to provide a product.

Open access—allowing electricity buyers and sellers to use *transmission* lines that belong to neither.

Outage—the period during which a power plant or *transmission* line is out of service. Also the time during which a consumer is not served with power because of an equipment failure.

Peak load—the maximum demand for electricity during a particular period of time.

Pooling—the coordination of energy supply by two or more utilities to more economically meet their combined *load*.

Power marketer—a nongenerating company that buys and sells power.

Price to compare (also called *shopping credit*)—the default price, or the price at which a utility will sell electricity in the absence of competition.

Public power—the not-for-profit segment of the electric utility industry that is owned by communities or government agencies.

Public utility—an *investor-owned* utility company that operates in a regulated, monopolistic market rather than a competitive market.

Public utility commission—a state regulatory commission set up to oversee *public utilities*.

Public utility district—a government corporation established by voters to provide electricity to consumers within the district.

Qualified facility—a *cogenerato*r or renewable power producer that sells power to a utility, as provided under section 201 of the Public Utility Regulatory Policies Act of 1978, which was enacted to encourage nonutilites to cogenerate power (see *avoided cost*).

Rate pancaking—multiple access charges incurred when *wheeling* electricity across multiple *transmission* systems.

Regional transmission organization (RTO)—an institution that coordinates the dispatch of power within a region and oversees a bidding process to establish a fair price for all buyers and sellers within the market.

Renewable resources—natural energy sources, such as biomass, landfill gas, water, wind, and solar, that are continually regenerated.

Restructuring—changes in laws governing the operation of the electric utility industry to convert it from a monopolistic to a competitive industry (see also *deregulation*).

Shopping credit (also called *price to compare*)—the default price, or the price at which a utility will sell electricity in the absence of competition.

Standard-offer contract (also called *default full-service contract*)—a contract for the purchase of electricity between a local *distributor* and retail customers who do not choose a supplier. A regulator establishes the price of the electricity.

Standard-offer price—the price of electricity for retail customers who do not choose an alternative supplier (see *standard-offer contract*).

Stranded costs—prior investments that a utility undertook when it had a monopoly but that it may not be able to recoup in a competitive market.

Thermal efficiency—the ratio of the energy output of a technology to its energy input.

Transaction costs—nonproduction costs, such as locating buyers and sellers and negotiating contracts, that a utility incurs in a market.

Transmission—the process of moving electricity through transmission lines.

Unbundling—the separation of *generation*, *transmission*, and *distribution* into different companies.

Vertically integrated—*generation*, *transmission*, and *distribution* provided by a single company.

Wheeling—*ttheransmission* of electricity from a buyer to a seller across transmission lines that are not owned by either.

Zonal pricing—a *transmission* pricing system that sets a single price within a large geographic region, or zone, based on the assumption that the cost of transmission for all companies within the zone is roughly equivalent. In a zonal pricing system, an *RTO's* territory is divided into several zones. Customers within a particular zone can buy power from other zones within the RTO at the same rate charged by all the utilities within the customers' zone (see *locational marginal cost pricing*).