POLICY report

Goldwater Institute

No. 232 | July 21, 2009

Opening the Grid: How to Recharge Arizona's Electricity System for the 21st Century

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EXECUTIVE SUMMARY

Arizona's heavily regulated, monopolistic electricity industry is ill-equipped to meet the state's growing demand for energy. Nor is it well-suited to contain the higher costs that are likely to result from renewable energy mandates. Only by moving Arizona's electricity industry closer to the ideal of an open and competitive market can the ingenuity of entrepreneurs be engaged to meet the increasing demand for electricity—the lifeblood of Arizona's economy.

Despite California's electricity debacle, this report will show that restructuring can be done right. Economists and regulatory reformers have learned from California's mistakes. Texas, Pennsylvania and Britain have recently restructured their electricity industries to achieve remarkable improvements in both conventional and renewable generation capacity. The competitive electricity market in Texas, for example, has increased generation capacity by 35 percent from 1998 to 2006. Moreover, many customers have been willing to pay a premium for electricity generated from renewable sources. As a result, Texas's renewable generation capacity has increased by 390 percent in the last eight years. In Britain, restructuring has lowered rates 30 percent.

Successful restructuring, however, requires unbundling existing monopolies in electrical generation, transmission and sales to prevent the exercise of market power by incumbent utilities. In other words, existing utilities will likely be required to sell some of their existing generation and distribution capacity in order for a competitive market to get its bearings. The experiences of Texas, Pennsylvania and Britain indicate that this is the only way for a heavily regulated, vertically integrated, monopolistic electricity industry to transition into one based on competition among multiple providers of unbundled services.

Accordingly, this report recommends eliminating regulation that shuts out new electrical companies and replacing monopoly regulation with competition in two key areas: wholesale electricity markets and retail markets. Achievement of wholesale market competition will require that the largest utilities divest some of their generation plants into independent generation firms. A related reform would be to relax regulatory restrictions on new power generators to sell into that market. The second area of reform proposed in this report is in retail electricity markets. Retail service providers would purchase electricity in wholesale markets and compete with one another to make innovative electricity service offerings that would attract customers.

This unbundling and restructuring could bring Arizona the improvements in cost and capacity that Texas, Pennsylvania, Britain and others already enjoy.

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Introduction

Despite Arizona's mounting energy demands, the state's energy sector is increasingly being geared toward high-cost electricity generation, with a significant portion of generation capacity reserved for export to other states.

Arizona is facing a stark economic reality when it comes to electrical generation and distribution. Arizona's consumption of electrical power has been growing at about three times the rate of the United States as a whole.[1] This trend, although blunted by the current economic environment, is likely to continue. And yet, much of Arizona's generation capacity is subject to long-term contracts requiring utilities to export the energy to other states.[2] Moreover, Arizona's new capacity derives primarily from recently built natural gas-powered generators that produce electricity at a cost nearly double that of coal, nuclear or hydroelectric.[3] At the same time, the Arizona Corporation Commission (ACC) has imposed renewable energy mandates that will force many producers to generate electricity from even more costly sources. In short, despite Arizona's mounting energy demands, the state's energy sector is increasingly being geared toward high-cost electricity generation, with a significant portion of generation capacity reserved for export to other states. As a result, recent data shows an uptick in Arizona's electricity rates.[4]

The convergence of rising demand and limited capacity, however, need not consign Arizona to skyrocketing energy costs. In the last decade, Texas, Pennsylvania and Britain have successfully opened their electricity generation and retailing markets. In Texas, competitive retail markets have increased generation capacity by 35 percent and blunted the costs associated with renewable energy mandates. Pennsylvanians' above-average electrical rates are now well below the national average.

Unfortunately, Arizona has yet to restructure its electricity system, which essentially operates the same way that it has for nearly 100 years. That is not for a lack of trying. In 1996, Arizona formed the framework for restructuring with passage of its Retail Electric Competition Rule.[5] This rule provided for a phase-in of both wholesale and retail market competition that would allow consumers to choose between their existing power provider and new retail service providers.

The 1996 Competition Rule would have unbundled (or disintegrated) utilities and replaced them with multiple companies operating at each stage of the production process.[6] Between 2002 and 2004, however, Arizona's restructuring process encountered significant setbacks. In 2002, the ACC staff advised the Commission that, "The wholesale market was not currently workably competitive; therefore, reliance on that market will not result in just and reasonable rates."[7] Also in 2002, an ACC administrative law judge delayed divestiture of generation assets until July 1, 2004 under the rationale that divested generation plants would have too much power to influence prices to the detriment of consumers.[8] Then, in January 2004, the Arizona Court of Appeals ruled in *Phelps Dodge Corp. v. Arizona Electric Power Coop.*,[9] that the Competition Rule wrongly delegated to the market the ACC's constitutional duty to set "just and reasonable rates." This decision, although not from the highest court in the state, effectively terminated Arizona's restructuring effort.

As we will discuss in more detail later, there are a number of reasons to believe that fear and politics—not good public policy or legal reasoning—best explain the demise of Arizona's initial effort at restructuring. After all, both the ALJ and Court of Appeals' decisions in *Phelps Dodge* were made against the backdrop of the spectacular failure of California's deregulatory effort. Regardless of the independent merits of Arizona's restructuring plan, this historical context quite likely had some effect on the ACC, the ALJ and the courts.

The key for Arizona is to transform an industry composed of large, regulated monopolies into one based on open entry and multiple providers that can freely transmit and adjust to price signals. To determine the best path for reform, we draw from the recent successes in Texas, Pennsylvania and Britain. In each of these markets, while ownership of existing transmission facilities, i.e. the transmission lines, has been maintained as a regulated monopoly, there is open competition in the generation of electricity and in the retailing of electricity. This has enabled the crucial communication of price signals that incentivize the efficient use of electricity by consumers and the efficient allocation of resources for electricity generation by producers. In view of the success of competitive reform in Texas, Pennsylvania and Britain, this report recommends similarly untangling Arizona's inefficient and unsustainable regulatory web. If followed, our recommendation will allow the industry to function competitively and efficiently—with the kind of innovation in electricity generation and distribution that free markets promise.

The Benefits of Restructuring

There have been a number of studies on the impact of restructuring on producers and consumers. Paul Joskow, Ph.D. Alfred P. Sloan Foundation and MIT, examines the impact of restructuring on prices for residential customers and industrial customers, using state-level data for the period 1970-2003.[10] He controls for the effects of factors that might vary across states, such as fossil fuel prices, the presence of nuclear power plants and the availability of hydro power. He measures two aspects of restructuring: (1) the percentage of power generated by non-regulated firms in a state and (2) whether the state has introduced retail competition. Joskow finds a strong, statistically significant impact of both aspects of restructuring on prices. Specifically, the higher the percentage of power produced by non-regulated generators in a state, the lower the prices paid by residential and industrial customers. And, the introduction of retail competition in a state is associated with lower prices for residential and industrial customers.

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Catherine Wolfram summarizes results from several studies of the impact of re-

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structuring on the operation of generation plants.[11] She reports that plants in states that have restructured use fewer workers per MW generated and have lower non-fuel expenses per MW compared to plants in states that have not restructured. James Bushnell, Research Director, University of California Energy Institute, Berkeley and Wolfram investigate whether plants divested to merchant generators perform differently after divestiture in states that restructured.[12] They find that, on average, plant heat rates have fallen after divestiture, indicating improved efficiency of plant operations.

Electricity restructuring has also provided strong incentives for investment in new generation facilities. States that have deregulated their wholesale electricity markets have experienced significant new investment in generation capacity. Over the eight-year period from 1998 to 2006, Pennsylvania's generation capacity grew by 22.8 percent, rising from 36,556 MW of summer capacity to 45,005 MW, an increase of almost 8,500 MW.[13] Electricity capacity growth has also been robust in Texas. Between 1998 and 2006, capacity grew from 74,571 to 100,754 MW, an overall growth of 35 percent. In New York, another deregulated state, capacity rose from 34,980 MW in 1998 to 39,550 in 2006, an increase of 13 percent in a state whose economy has been lagging.

Other jurisdictions across the world have also restructured their electricity systems including Alberta, Australia, Chile, New Zealand and the United Kingdom. Each of these restructured jurisdictions has shown significant increases in electricity capacity since 1998.[14] From 1998 to 2004, electricity generating capacity in Alberta's restructured electricity market rose from 8,631 MW to 11,732 MW, an increase of 3,101 MW, or nearly 36 percent. Electricity restructuring took place in most of Australia in the late 1990s. Australian capacity rose from 38,252 MW in 1998 to 48,468 MW in 2004, a more than 26 percent increase. Electricity markets in Chile were restructured in 1986. Electricity capacity in 1998 was 7,544 MW, rising to 12,192 MW in 2006, an increase of 62 percent. Similar to Australia, New Zealand's electricity markets were restructured in the late 1990s. Electricity generation capacity in New Zealand grew from 7,899 MW in 1998 to 8,860 MW in 2006. This represents an increase of 12.2 percent. Given New Zealand's relatively slow economic growth, this again shows that restructured electricity markets have robust incentives to induce entry into electricity generation. Approximately 89 percent of the population in the United Kingdom (in England and Wales) gained restructured electricity service in 1990. Capacity rose 8,548 MW, starting at 70,158 MW in 1998, and reaching 78,706 MW in 2004, an increase of 12.2 percent.

Arizona's Electricity System

Introduction to Vertical Levels of Production

To understand electricity markets, one must understand the levels and types of production. In Arizona, much of the electricity system is vertically integrated, meaning that utilities own each level of the system from generation to distribution and retail delivery. The system begins at generation facilities that can be located in a variety of places and generate power from a variety of sources. For example, at generation facilities such as Palo Verde and Red Hawk, west of Phoenix, Glen

Canyon Dam, in northern Arizona, and Four Corners in New Mexico, coal, natural gas, nuclear and water power are all used to create electricity.

Once the electricity is generated, utilities send it along transmission lines to where consumers can use it. In Arizona, transmission lines take power from the distant reaches of the state and bring it to load centers, primarily in Phoenix and Tucson. Transmission lines also bring power into the state from New Mexico and Nevada, and export it to Southern California.

Once power is taken by transmission lines to load centers it is sent to final consumers through distribution lines. Distribution lines run through residential and industrial areas.

In addition, under current technological limitations, electricity must be supplied through an electricity grid. Electricity, for example, cannot yet be feasibly transmitted by microwave. As a result, there are physical difficulties in managing electricity supply and demand. For example, presently it is very difficult to store large quantities of electricity for significant periods of time. Additionally, large quantities of electricity sloshing around from one storage point in the grid to another can cause components to overheat and burn out. As a result, because electricity moves at close to the speed of light, this means that there must be an almost immediate use for any electricity that is generated at about the same time that it is generated. In other words, in any particular grid, the supply of power must almost exactly equal the demand for power at any particular moment. To ensure this condition, electricity grids must engage in "system operation." System operation involves the control of electricity dispatch, as well as the control of backup systems for times when the electricity system runs short of power.

Physical Aspects of Arizona's System

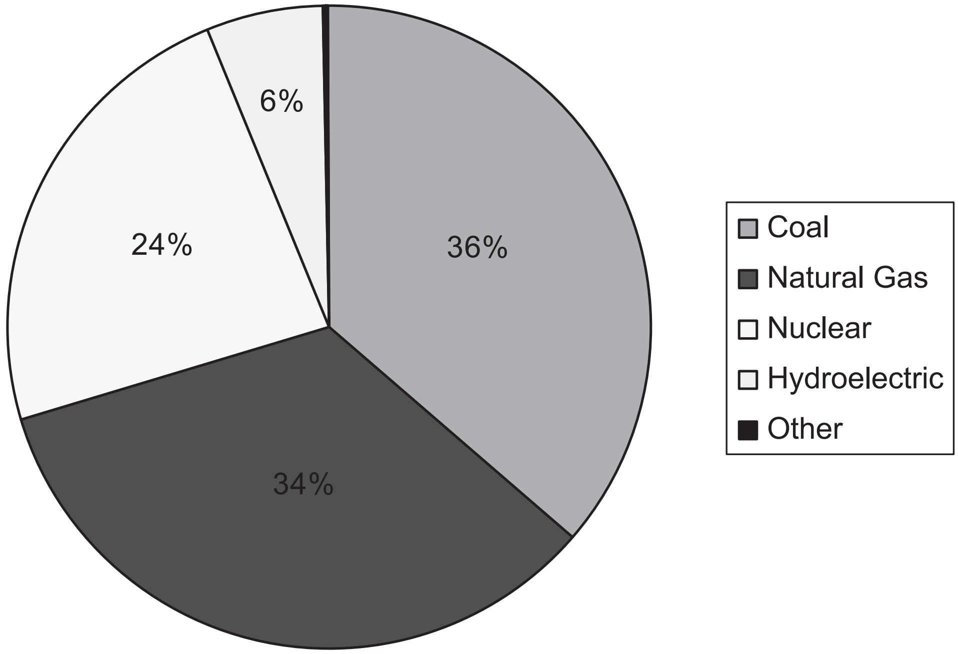
Arizona is served by three vertically integrated utilities, federal power generators, and a host of smaller generation and distribution operations. The three large utilities are investor-owned utilities: Arizona Public Service (APS) and Tucson Electric Power (TEP), which are regulated by the Arizona Corporation Commission (ACC); and, Salt River Project (SRP), a government-owned power provider.[15]

In 2002 and 2003, several merchant power producers, including the Harquahala Generating Project and Sempra Energy Resources, began operating new natural gas generation plants that added significant capacity to the industry. Apart from the entry of these merchant power producers, the basic structure of the industry has changed little in the last 10 years.

Although the price for natural gas is on average three- to five- times higher than coal prices, natural gas plants require less capital investment and are not subject to the expensive pollution control systems required for most coal-fired plants.

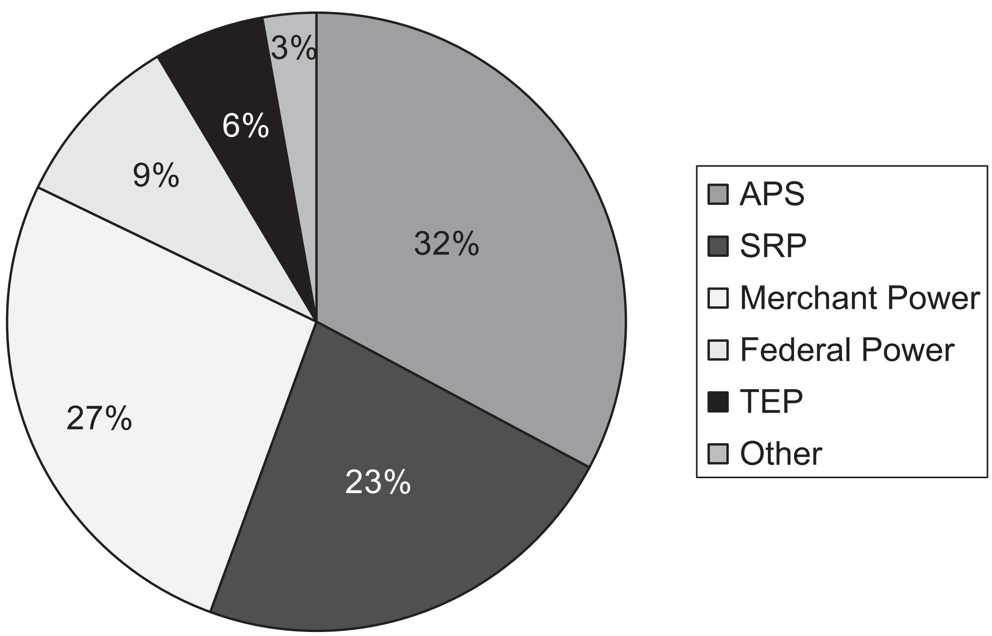
Figure 1 shows electricity generation for 2007 by fuel type. Coal, natural gas, and nuclear-powered generators produce over 90 percent of power in Arizona, with coal making up the largest share. Almost all of the new generation capacity added in the last 20 years is fueled by natural gas, which is now the second largest component. This follows the national trend—most of the new generation capacity built in the U.S. in the last 20 years is fueled by natural gas. Although the price for natural gas is, on average three- to five- times higher than coal prices on a thermal equivalency basis, natural gas plants require less capital investment and are not subject to the expensive pollution control systems required for most coal-fired plants.[16]

Figure 1: Source of Electricity Generated in Arizona, 2007



Source: http://www.eia.doe.gov/cneaf/electricity/epm/table1_1.html

Figure 2: Utility Share of Generation Capacity, 2005



Source: http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html; 2005 is the most recent year for which Energy Information Administration data is available for capacities of individual firms.

Figure 2 shows ownership of generation plants by type of owner. APS and SRP are the two largest power producers in Arizona, collectively holding over half of the state's generation capacity. The biggest change in generation during the last 10 years is the construction of a large amount of natural gas-fired plants by merchant power producers. These producers now operate 26.5 percent of Arizona's generation capacity.

Generation plants and load centers are connected by a transmission grid that crisscrosses the state. Transmission in Arizona is part of the Western Interconnection, the alternating current power grid that covers the Western U.S., Western Canada, and part of Baja California in Mexico. Power is imported into Arizona during some peak demand periods (principally, hot summer days) from generators across the Western Interconnection. During lower demand days, Arizona exports power. On balance, Arizona is a net exporter of electric power, with about 27 percent of electric power produced in Arizona shipped out of state. The bulk of power exports go to Southern California.

Electricity consumption is broken out by sector in Figure 3. The residential and commercial sectors are the largest consumers, with industrial a distant third.

Electrical Regulation in Arizona

For most of the 20th century, the electricity industry was typified by vertically integrated utilities that provided generation, transmission and distribution

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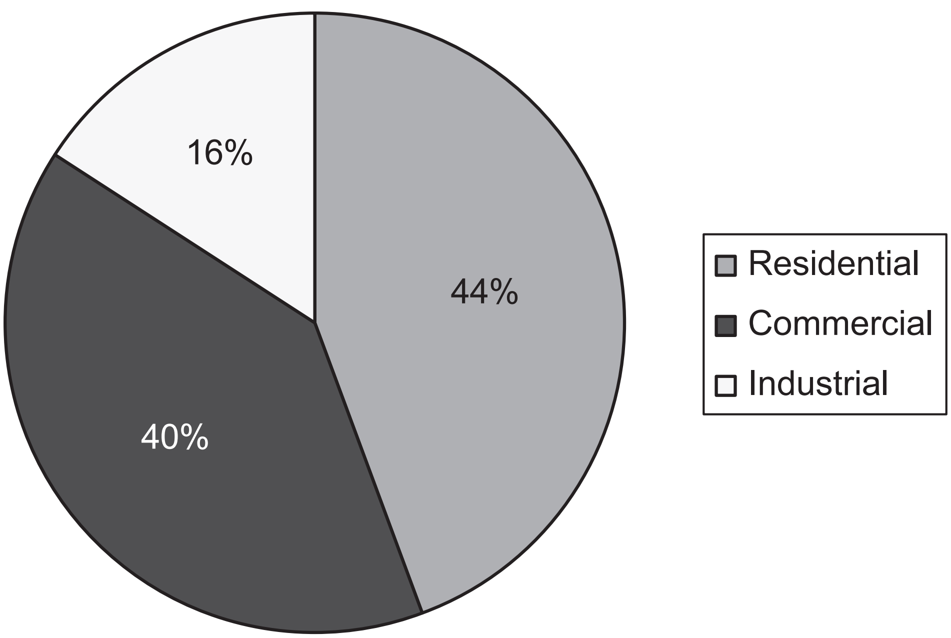
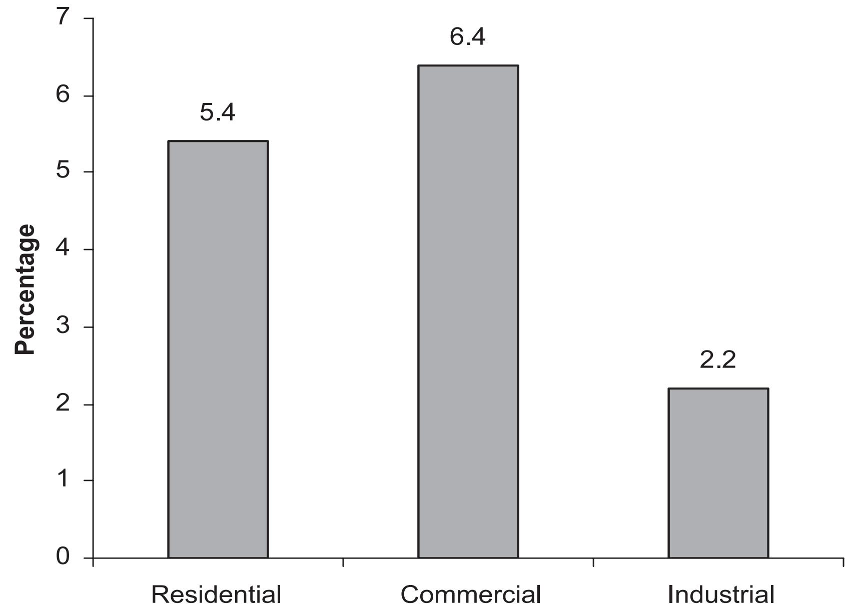
Figure 3: Share of Megawatt Hours in Arizona by Sector, 2007



Source: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html, authors' calculation

Figure 4: Annual Growth Rate in Consumption by Sector



Source: http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html, authors' calculation

While having a single firm might be the lowest-cost option for organizing electricity production and distribution, a potential problem of monopoly pricing emerges.

of power. These were investor-owned utilities that were tightly regulated on both the prices they could charge for electricity and the investments they could make. Other utilities are government entities that either specialize in one or two segments of the industry (e.g., the U.S. Bureau of Reclamation's Hoover Dam generation and transmission operations) or operate as a vertically integrated utility (e.g., SRP). Both were protected by law from competitive market entry.

The economic rationale for both regulation and state ownership has typically been natural monopoly. A natural monopoly occurs when the total cost of production is lower when a single firm serves the market than when multiple firms serve the market. To be sure, there are economies of scale in electricity generation, particularly for coal-fired and nuclear generation plants. The high costs of building transmission lines, coupled with line losses from long-distance transmission, initially limited movement of electricity over long distances. When transmission facilities were constructed, scale economies meant that it was more efficient to build a single high-voltage line rather than multiple low-voltage lines. For distribution, assuming current technological limitations, it usually makes sense to have a single local distribution grid rather than duplicating costs by setting up multiple lines to connect to competing generators.

While having a single firm might be the lowest-cost option for organizing electricity production and distribution, a potential problem of monopoly pricing emerges. Some economists have argued that an unregulated monopoly electricity provider would have a profit incentive to set a high price and produce too little power, creating economic inefficiency in the process.[17] Accordingly, in the 1910s many states began regulating utility prices and investment decisions and preventing entry of competing electricity providers.[18] The regulatory role envisioned for government is explicit in the Arizona State Constitution. Article 15, Section 3 of the constitution states in part:

> The Corporation Commission shall have full power to, and shall, prescribe just and reasonable classifications to be used and just and reasonable rates and charges to be made and collected, by public service corporations within the State for service rendered therein, …

Under a regulated system such as Arizona's, regulated utilities make filings to a government commission for rates based on their costs. The government commission examines those filings and decides what rates can be considered "just and reasonable." Rates are generally made for the entire package of electricity services, from generation and transmission to system operation and distribution.

The Challenges Facing Arizona's System

The electricity industry in Arizona faces substantial challenges, primarily due to three interdependent developments. The first is the growing demand for electricity that comes with population growth. Arizona has been one of the fastest growing states in the U.S. for decades, with annual population growth in the 3 to 4 percent range, and it is projected to continue to be one of the fastest-growing states in the country. The U.S. Census Bureau projects that Arizona's population will grow from its current 6.5 million to 10 million in 20 years.[19] This population growth is clearly an important driver for increases in electricity consumption. If electricity usage grows at the same rate as population (a likely underestimate, given past experience), then the state will consume about 40 million more megawatt hours in 20 years than it does now. This represents more than a 50 percent increase in electricity consumption, requiring billions of dollars of new investment in generation plants, transmission lines and distribution facilities. However, the growth rate for electricity consumption has been even higher than the population growth rate. This is true for the last three decades of the 1900s, as well as for 2000-2006, when population grew at an annual 2.9 percent while electricity consumption grew 3.4 percent annually.

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Two main factors appear to be behind rising per-capita electricity consumption. First, real rates for electric power declined for most of the past three decades. Lower rates stimulate demand for electricity. It is just since 2004 that real rates have been rising in Arizona. Second, real income per capita has been rising for most of the past three decades. As incomes have risen, consumers have purchased more electricity-using gadgets and larger homes, with greater heating and cooling requirements. It is reasonable to predict that this trend will continue as the bounty of technology expands. Therefore, population growth is, at best, only a floor for growth in electricity demand and there is every reason to believe that demand will continue to outpace population growth.

A second challenge relates to generation from fossil fuels. Currently, about 70 percent of Arizona's electricity production is from fossil fuels, with most of the rest from hydro and nuclear. Large amounts of

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new generation capacity will be required to meet projected demand growth. Natural gas would be a "natural" fuel source for new generation plants, given its relatively low greenhouse gas emissions and low capital costs, and most new generation plants built in Arizona in the last 20 years are natural gas-fueled. But the marginal cost of natural gas is high and natural gas prices in the Southwest may well rise over time as demand for this fuel rises.

Scrubbed coal is currently the lowest-cost type of generation. Average total cost for a new scrubbed coal plant is estimated to be $50 per MWh.[20] However, coal generation yields the largest greenhouse gas emissions—about one ton of CO_2 emitted per MWh generated from coal. Carbon dioxide emissions are likely to be limited by a cap and trade program and emission permits will be costly to obtain. An estimate of the long-term equilibrium price for CO_2 is $40 per ton.[21] This would increase the average cost of generation from scrubbed coal to $90/MWh.[22]

We, therefore, wish to emphasize that due to increased environmental regulation and increased demand, the cost of generation from fossil fuel in Arizona is likely to rise over time.

The third challenge for the electricity sector in Arizona relates to renewable energy. The ACC has mandated a renewable energy portfolio standard for Arizona. Electric utilities will be required to generate 15 percent of their energy from renewable resources by 2025. Hydroelectric power currently accounts for only 6.5 percent of total production. Despite Arizona having the highest solar radiation per square meter of any state, there is very little solar generation capacity in Arizona. Meeting the ACC's renewable energy mandates thus requires more than doubling the existing capacity of renewable energy in less than 20 years. Moreover, beginning in 2011, 30 percent of total renewable power must be from distributed generation, i.e. generation by independent parties "behind the grid," such as consumer-owned and maintained residential solar panel systems. The challenge in meeting these aggressive renewable goals comes from the high cost of generation from renewable facilities.[23]

Arizona's existing electricity regulation system is ill-equipped to meet these interrelated challenges. Under the current system, regulated utilities would need to be making most of the investments in generation and infrastructure required for growing demand. And these utilities will need to charge rates high enough to allow them to cover the costs of these investments. Yet regulators are already showing signs of resisting the rate increases required for these investments.[24] In contrast, market-based systems have a very successful track record of stimulating large increases in generation capacity at lower costs.

Rate of Return Regulation

Theory of Regulation

For most of its existence, the electricity industry has been heavily regulated under a model that protects existing market players from new competition while also regulating the prices of their goods and services to what regulators consider a "just and reasonable" rate. The basic assumption of this regulatory model is that the free market would otherwise generate natural monopolies in electrical generation and distribution, which would then use their market power to abuse consumers and stifle economic growth. A related assumption is that regulators are better able to determine a "just and reasonable" rate for electricity than are market processes.

The "natural monopoly" theory underpinning rate of return regulation implies that one firm can supply the relevant market at a lower cost than two or more firms. Thus, competition results in one firm driving the other firms out of business and establishing a monopoly, to the detriment of consumers. Whatever merit this theory had in the generation of electricity has been eliminated by technological and policy changes over the last 30 years, as we will discuss.

Flaws in Rate of Return Regulation

Rate of return regulation has several serious flaws. The first is that it limits the incentives of firms to innovate and reduce costs. In competitive markets, firms have to meet customers' needs for better and cheaper products and services. In the regulatory setting, however, firms must simply get the relevant regulatory agency to agree that their costs are prudent. In particular, regulated firms are under only a limited obligation to engage in innovative activities.

Second, experience across the country has shown that consumer interests are not well represented in regulatory commissions. The problem is that while any particular consumer may have only a few dollars at stake, a regulated firm may have millions of dollars at risk. Therefore, while it pays no particular consumer to have representation in front of a commission, it certainly does pay for the regulated firm to do so. Thus, regulators are often more exposed to the regulated firms' point of view than the consumer's point of view.[25]

Third, the price of electricity in wholesale power markets varies widely from day-to-day and hour-to-hour. In a regulated setting, however, most retail electricity consumers pay a fixed rate that does not vary across hours or days. Even "time of day" pricing is not sufficiently flexible to ensure price signals from the wholesale market are efficiently received by consumers. These fixed retail rates mean that the prices individual consumers pay bear little or no relation to the marginal cost of providing power at any given time of day. Moreover, because retail prices do not fluctuate, consumers are given no incentive to change their consumption as the marginal cost of producing electricity changes. The consequences of this disconnect go beyond inefficient energy consumption; resulting investment in generation and transmission capacity can also be inefficient, affecting power market operation for many years to come. This disconnect has also suppressed the implementation of technologies that engage customers in making active consumption choices, even though communication technologies that facilitate these choices have become increasingly affordable and user-friendly.

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The Debacle of Stranded Costs

The poor incentives faced by electricity generators have led to the "stranded costs" problem. The term "stranded costs" refers to investments in generation plants and electricity infrastructures for an incumbent utility, which may become redundant in a competitive environment. Consider a utility that made what turned out to be

The natural monopoly basis for regulation or state ownership has weakened over time as both demand and technology have changed.

poor investments in a large generation plant. In a competitive market, when cost overruns occur, the costs are borne by stockholders. But in regulated markets, when these cost overruns occur, they are typically borne by consumers.[26]

Estimates of stranded costs in the United States vary anywhere from $50 billion to $200 billion. What is clear is that ratepayers have spent a great deal of time and money paying off bad investments. In regulated states, these costs are imbedded in the rate base. In restructured states, consumers pay what is generally referred to as a "competitive transition charge" or "CTC" to pay off these charges.[27] But in a competitive market, those charges, once paid, are never incurred again. The cost of bad investment will thereafter be born by the stockholders of the electrical utility, which will strongly incentivize more efficient investments in capacity and distribution. And this means that it is reasonable to expect that rates in a competitive market will eventually be less than they otherwise would have been under a regulated system.

The New Approach to Restructuring

The natural monopoly basis for regulation or state ownership has weakened over time as both demand and technology have changed. The demand for electricity has grown dramatically as population and income have grown. Per-capita electricity consumption in the U.S. is 20 times higher now than it was 75 years ago. Two changes in technology are important. The major change in generation has been the emergence of natural gas-fired generation plants. These plants can operate efficiently at a scale of 150-200 megawatts (MW), whereas coal and nuclear plants typically require a scale of 600 or more MW. Almost all of the new generation capacity built in the U.S. in the last 20 years is fueled by natural gas. Transmission has also improved, permitting lower line losses and longer shipments of power. Arizona is part of the Western Interconnect, the transmission grid that covers the Western U.S. and Western Canada. Sophisticated computer systems that control grid operations allow power users (e.g., a local distribution company) to acquire power from distant generators. Generators can and do transport power 1,000 miles over the Western Interconnect.

These changes in demand and technology have shifted the economic fundamentals of the electricity industry. The combination of higher demand and reduced scale for efficient generation implies that power generation is no longer a natural monopoly (if it ever was). In most parts of the U.S., demand is now large enough to permit multiple competing generation providers to supply wholesale power.[28] Moreover, expansion and improvement of the transmission grid have increased the geographic scope of electricity trading, permitting regional wholesale markets to develop and operate.

Today, we have an electricity system that is naturally competitive at some levels and monopolistic at other levels. The wide array of generating sources makes it clear that generation is naturally competitive. In addition, it is clear that the retailing of electricity—shaping power into products that consumers desire—is also naturally competitive. On the other hand, because of economies of scale, it appears in most circumstances that transmission is a natural monopoly in most areas. Similar analysis holds for distribution services. Finally, system operation, because it requires balancing across an entire electrical grid, is also a naturally monopolistic enterprise.

Therefore, the restructuring approach calls for creating competition in the generation and retailing of electricity. Given current technological limitations for transmission, distribution and system operation, however, some degree of continued regulation is still appropriate, despite the weaknesses of that approach.

The Lessons Learned from Restructuring

There are a variety of benefits that come with competitively structured industries: incentives for efficient production, incentives for innovations that improve the production process or provide new products and services, and the information provided by prices that can signal where profitable investments can be made. Decentralized competition almost always works as an effective coordination mechanism that efficiently transforms resources into the products and services that consumers want, without a significant government role. The benefits that competition creates can be brought into the electricity sector in Arizona. But not without first considering what went wrong in California.

Restructuring Done Wrong: California

In 1998, California opened electricity generation to competition via a restructuring of the procurement process. Incumbent regulated utilities divested many of their generation plants to private firms as part of the restructuring. Retail prices were frozen during a transition period, and provisions were made for utilities to recover stranded costs. A daily auction market, the California Power Exchange, was created for trading wholesale electricity to be delivered the next day. California established a system operator, the California ISO, to operate the network and administer the Power Exchange.

From April 1998 through April 2000, the average wholesale price on the Power Exchange was $33/MWh. While there was evidence that generation providers exercised market power at some times, the California wholesale market appeared to operate in a workably competitive fashion during its first two years of operation.[29]

The situation changed dramatically in the summer and fall of 2000. California historically relied on imported power for 20- to 25 percent of its electricity needs. Low availability of hydro power in the Pacific Northwest left less power available for importing into California. During late summer 2000, hourly imports averaged 3,600 MWh, versus 6,800 MWh in late summer 1999—a drop of approximately 47 percent. This large drop in power imports meant that generators had to rely more than usual on high-cost peaking plants to meet demand. These peaking plants typically use natural gas, and natural gas prices had increased significantly in 2000. Wholesale electricity prices in California skyrocketed to an average of $141/MWh during summer and fall 2000, with prices in some hours reaching $750. In addition to high wholesale prices, there were power shortages in some areas and distributors responded by imposing rolling blackouts across their service territories. While relatively high prices may be expected in a competitive market when producers incur high costs to meet high demand,

The restructuring approach calls for creating competition in the generation and retailing of electricity.

The combination of limited excess generation capacity, reduced power imports, no long-term contracts and no demand-side price-response made the California Power Exchange vulnerable to market power manipulation by generation firms.

the evidence suggests that California's high prices were mainly due to California generators exercising market power during peak demand periods.

This exercise of market power was greatly facilitated by the poor design of California's restructured electricity markets. The combination of limited excess generation capacity, reduced power imports, no long-term contracts and no demand-side price-response made the California Power Exchange vulnerable to market power manipulation by generation firms. For example, by withholding some generation from the wholesale market during a peak demand period, a generation firm could push up the wholesale price and earn greater profit on the generation they did sell. This tactic was tempting to suppliers because, even after deregulation, California did not allow consumers enough freedom to hedge pricing or purchase electricity from alternative sources to ensure that such behavior would be sufficiently punished by the loss of business or competitive entry. In other words, even after deregulation, California's regulatory system still skewed the economic game of supply and demand in favor of suppliers and against consumers.

Estimates of the extent to which market power contributed to high prices in California vary. One well-known study estimated that 59 percent of the increased expenditures in summer 2000 were due to market power exercised by generation firms.[30] This estimate is probably on the high side, since it is very difficult to accurately estimate generation costs over short time periods, and because it ignores the impact of factors such as start-up costs that must be incurred each time a generation unit is turned on.[31] Nevertheless, it seems clear that market power contributed to the California crisis.

With retail electricity rates frozen through 2000, the utilities lost millions of dollars per day buying power at high wholesale prices and selling at the lower fixed retail rates. In early 2001, with the utilities nearly bankrupt and no longer creditworthy, the state of California stepped in and negotiated new supply contracts for the utilities and California abandoned its experiment with electricity restructuring.

The California electricity crisis raised serious concerns about the viability of competitive electricity markets. Concerns were particularly acute in Arizona, given the intense media coverage of the California crisis in Arizona and the fact that Arizona was in the process of restructuring its electricity industry. While these concerns are certainly understandable, our view is that the failure of restructuring was due not to inherent weaknesses of competitive electricity markets but, rather, to flaws in California's restructuring process.

Two problems with California's restructuring plan stand out.[32] The first was a near-prohibition on long-term contracting between generation suppliers and utilities. Almost all wholesale power in California was required to be traded on the day-ahead Power Exchange spot market. In other wholesale markets, the vast majority of power is exchanged via long-term forward contracts. Long-term contracts reduce uncertainty for both suppliers and purchasers (such as distribution utilities). Having a large portion of power committed to long-term contracts has the beneficial side effect of limiting opportunities and incentives for generation firms to exercise market power in a spot market, because in such circumstances any potential for exercising market power is greatly reduced.

From the California experience we learn that restructuring should have allowed, rather than restricted, the use of forward contracts. Restructuring in some states has facilitated forward contracting by allowing buy-back forward contracts (sometimes called vesting contracts) in which divested generation plants sell a fixed amount of power per year for several years back to the utility at a rate set by the regulator.

The second problem was a lack of price response from buyers. Retail competition had not taken hold at the time of the crisis. Residential customers had been guaranteed price cuts from incumbent distributors whether they shopped around or not, and retail competitors had to compete against frozen rates. So, while in theory the market was open to retail competition, there was not much competition for residential customers and not much real-time pricing. As a consequence, generators were able to push up wholesale prices without reducing the total quantity demanded from buyers. Some form of retail competition needs to be phased in at the outset of restructuring so that at least some buyers (e.g., large industrial customers) can respond to wholesale price fluctuations. The lessons learned from California are well-illustrated by the successful restructuring of the electricity markets in Britain, Pennsylvania and Texas.

Restructuring Done Right: Britain, Pennsylvania, Texas

England and Wales—One of the first examples of electricity restructuring was the 1990 privatization of the electricity industry in England and Wales. This was the final phase of a privatization program for state-run enterprises launched by British Prime Minister Margaret Thatcher. Thatcher's policies were based on the view that private ownership and the profit motive provided much better incentives to achieve efficiency and innovation than government ownership. The British electricity restructuring followed the basic architecture of competitive electricity markets as outlined in the preceding section. The restructuring included formation of two private generation companies from the state-owned generation organization and creation of a power pool. The pool was a centralized wholesale market into which generation firms and power importers supplied power, and local distributors and large industrial buyers made bids to purchase power. Initially, retail choice was restricted to large customers. Eight years after restructuring, residential customers became eligible for retail choice.

Several changes in the organization and regulation of the industry were made after 1990. For example, additional divestitures of power plants were ordered for the two generation firms because of market power problems in the pool. In addition, the pool was abolished in 2001 and replaced by private markets for bilateral trades and a centralized market for the period immediately before the relevant electricity is generated. The overall impact of this restructuring appears to have been quite positive. By 2005, real electricity prices had fallen about 30 percent and industry profits remained healthy.[33]

A number of states and regions in the U.S. began restructuring their electricity industries following the British

The lessons learned from California are well-illustrated by the successful restructuring of the electricity markets in Britain, Pennsylvania and Texas.

restructuring. The early movers in the U.S. tended to be states and regions with relatively high electricity rates, such as California, New York, New England and Pennsylvania. Restructuring was seen as a way to increase efficiency, attract power imports from low-cost states, encourage new investment in generation and ultimately reduce prices for customers.

Pennsylvania—Electricity restructuring was phased in beginning in July 1998. In contrast to California, no divestitures of generation plants were ordered, as the state utility commission judged that there would not be significant market power problems upon restructuring. Retail prices were frozen during a transition period (for customers who did not choose an alternative retail supplier), and provisions were made for utilities to recover stranded costs, as in California.

Restructuring was seen as a way to increase efficiency, attract power imports from low-cost states, encourage new investment in generation and ultimately reduce prices for customers.

Pennsylvania did not establish its own system operator. In the eastern part of the state, system resources were managed by the PJM Interconnect. Utilities coordinated their own systems in the western part of the state. Starting in 2003, PJM began to expand across the Mid-Atlantic states. Today, PJM takes in all or part of New Jersey, Delaware, Pennsylvania, Maryland, the District of Columbia, Virginia, West Virginia, Ohio, and the area around Chicago in Illinois.

During 2000-2001, natural gas prices rose in Pennsylvania, just as they did in California. However, Pennsylvania did not enter into a crisis. Pennsylvania was more reliant on coal and less reliant on hydro and natural gas than California. In addition, Pennsylvania had more excess generation capacity and better access to imported power than California. Wholesale prices rose in 2000 and 2001 in Pennsylvania, but not nearly as much as in California. In part this was because Pennsylvania, unlike California, permitted long-term contracts between producers and consumers.

Retail prices charged by incumbent utilities were lowered and capped during the period of stranded cost recovery. These regulated retail prices were set to equal the sum of transmission, distribution, generation and competitive transition cost (for stranded cost recovery) charges. Consumers choosing a retail supplier other than their incumbent distributor were given shopping credits set administratively by the state utility commission. The shopping credits were set above the original generation cost component of retail prices. This provided "headroom" that permitted new retailers to earn a modest profit. However, as wholesale prices rose in 2000-2001, the shopping credits were not adjusted, and most of the new retailers exited the market.

Thus, the state of Pennsylvania attempted to set up a system where retail competition could occur and stranded costs were paid off. Unfortunately, the system did not account for the very real possibility that underlying commodity prices would fluctuate. Thus, the system of retail price controls that was implemented during the period of stranded cost recovery killed off retail competition in Pennsylvania's restructured electricity markets. The lesson from this experience is that prices must be allowed to adjust. Fortunately, most of the retail price controls have since expired, and all of them are set to expire by December 31, 2010.[34] As a result, with price signals more accurately reflecting underlying costs, retail competition is once again developing in Pennsylvania.

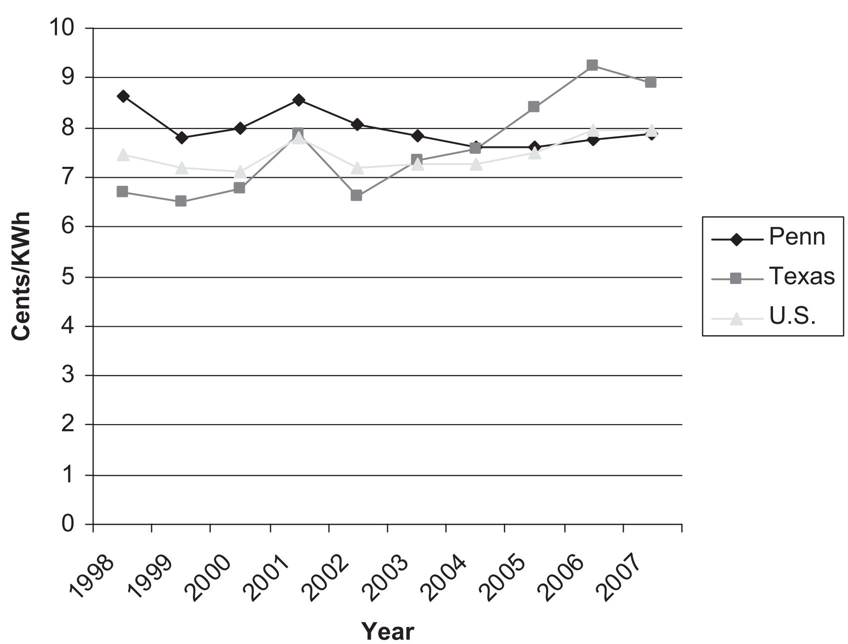
Table 1: Average Retail Prices in Pennsylvania, Texas and U.S.*

Year	Penn	Texas	U.S.
1998	8.64	6.70	7.44
1999	7.79	6.52	7.17
2000	7.99	6.78	7.11
2001	8.54	7.87	7.78
2002	8.06	6.62	7.20
2003	7.84	7.33	7.27
2004	7.62	7.57	7.25
2005	7.62	8.42	7.50
2006	7.75	9.23	7.94
2007	7.87	8.91	7.93

* Prices in cents/KWh in constant 2002 dollars. Data from Energy Information Adm: http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html

Table 1 shows average retail prices (adjusted for inflation) in Pennsylvania, Texas and for the U.S. since 1998. Retail prices in Pennsylvania were well above the U.S. average at the outset of restructuring in 1998. Over the last 10 years, inflation-adjusted retail prices have fallen in Pennsylvania, while U.S. average prices have increased slightly. By 2007, the retail price for Pennsylvania was below the U.S. average retail price.

Figure 5: Rate Stability after Restructuring



One of the keys to successful retail competition is how pricing by incumbent distributors is regulated by the state commission during the transmission to retail competition.

Texas—Texas began restructuring its electricity system in 1995 with passage of the Public Utility Regulatory Act, which was aimed at facilitating wholesale market competition. The following year, the state utility commission authorized Electric Reliability Council of Texas (ERCOT) to operate as a non-profit ISO for a territory that covers much of the state. One thing that is unique about Texas is that ERCOT manages an electricity network that lies entirely within the state and is not interconnected with the electricity grids that serve the eastern and the western U.S. The fact that the ERCOT network lies within state boundaries allows the state utility commission to have jurisdiction over retail and wholesale markets and the transmission network. In contrast, in a state like Pennsylvania, which is served by an RTO that crosses state boundaries, the state utility commission has jurisdiction over retail distribution, but jurisdiction over transmission and the wholesale market is by the Federal Energy Regulatory Commission (FERC).

In 1999, the Texas Legislature passed Senate Bill 7, which gave the ERCOT ISO the responsibility to develop the markets and business processes for implementation of retail electric competition. This bill opened the retail market to new firms called retail electricity providers (REPs). REPs are firms that market and sell electric service to end-use customers. In any implementation of retail competition, REPs will compete with an incumbent utility that operates the local distribution network. Customers will have the option of staying with their incumbent distributor, or switching to a REP. One of the keys to successful retail competition is how pricing by incumbent distributors is regulated by the state commission during the transmission to retail competition. Texas established a "price-to-beat" (PTB) mechanism that set a fixed, regulated rate for each incumbent utility during the transition to full retail competition. The PTB rate established a price floor for an incumbent utility that remained in effect during a specified transition period.

At the start of 2002, a "fuel factor" was introduced that permitted the PTB to be adjusted for changes in fuel (e.g., natural gas) prices. This addressed the kind of financial problems for utilities that arose in California when wholesale prices rose sharply due to higher fuel prices but regulated retail prices remained frozen. This also addressed the problem that arose in Pennsylvania when new retail service providers were squeezed out of the market when fuel prices (and wholesale electricity prices) rose but the regulated rates for incumbent distributors were not changed.

The PTB mechanism permitted retail competition to emerge in Texas. By February 2003, 7 percent of residential customers were served by non-affiliated REPs, 11 percent of small nonresidential customers by non-affiliated REPs and 50 percent of large nonresidential customers by non-affiliated REPs.[35]

Table 1 displays (inflation-adjusted) retail prices for Texas during restructuring. Real retail prices have risen over time and have increased relative to average U.S. prices. Two main factors appear to be driving higher wholesale and retail prices in Texas. First, Texas has experienced rapid economic growth in recent years. Rising demand for electricity pushed up wholesale prices as relatively high-cost generation plants were dispatched to meet demand. The second factor was rising natural gas prices that drove up the price of generation. But the wholesale market is working as it should. Unlike other states, the Texas system encourages fuel conservation when fuel costs are high, and encourages more consumption when fuel prices are low, exactly as economic theory states is appropriate. This is in contrast to other states that failed to pass on immediate fuel price increases in the 2005-2008 period. Instead, these states have delayed payment of these costs for future years, hampering capital investment in electricity generation exactly at the time when such investment is needed.

Relatively high wholesale prices have stimulated significant new generation investment in Texas. As noted earlier, Texas increased its generation capacity by 35 percent from 1998 to 2006. Second, most of the added generation capacity has been either natural gas or wind turbine; these are both relatively high-cost sources of generation.[36] The Texas legislature enacted an aggressive renewable energy portfolio standard, and Texas has added significant amounts of wind turbine generation capacity in the last eight years.[37]

The Emergent Economic Consensus

After years of studying electricity restructuring, and in view of the experiences of California, Britain, Texas and Pennsylvania, economists have now largely agreed on the key elements that are needed for restructuring to work effectively. The basic architecture for competitive electricity markets would include the following elements:[38]

1. Vertical disintegration of utilities — electricity services are unbundled and sold separately rather than being offered only as a bundled package. This permits competitive segments (wholesale power generation, retail/marketing services) to be separated from segments that continue to be regulated (transmission, distribution, system operations). This unbundling can be done through divestiture of utility business units and/or functional separation of utility business units (e.g., via firewalls that separate the operations of units within a utility).

2. Creation of an organization to support network operations and transmission management and investment. The network should encompass a geographic area that includes at least the majority of generation plants that serve the main load centers. This organization (typically either an Independent System Operator (ISO) or Regional Transmission Organization (RTO)) has responsibility to manage network operations, schedule generation to meet demand, and maintain frequency and voltage so that the lights stay on.

3. Creation of a wholesale spot market and development of institutions to provide ancillary services, such as voltage regulation. The spot markets and ancillary services must operate in a way that balances power injections and withdrawals in real time. Restructuring should be done in a way that minimizes opportunities for generators to exercise market power in the wholesale market. This can be done by a careful generation divestiture plan and, if necessary, through the use of market rules

After years of studying electricity restructuring, and in view of the experiences of California, Britain, Texas and Pennsylvania, economists have now largely agreed on the key elements that are needed for restructuring to work effectively.

(e.g., on wholesale market bidding) aimed at mitigating market power.

4. The ISO or RTO would set up a system that allows wholesale suppliers and buyers to move power across the grid. This system would include provisions for pricing and allocating transmission capacity when transmission is congested.

5. Allowing free entry into the generation sector to increase supply and competition in the wholesale market for electricity.

6. Engaging in horizontal divestiture in electricity generation to prevent the exercise of market power in the sale of generation. We note that, in general, market power that is gained through efficiency is not illegal, and economic theory does not teach that it should be discouraged. In this instance, however, were restructuring to take place without such divestiture, firms could gain market power. The source of this market power, however, would not be firms' economic efficiency, but rather from gains made possible by the prior anti-competitive regulation that restructuring aims to replace.

7. Allowing free entry of retail service providers who can compete for customers against incumbent local distributors. These retail service providers would purchase power from wholesale suppliers (or, perhaps generate their own power) and deliver power over regulated transmission and distribution networks. Consumers would be able to choose their retail provider, who would compete by offering a variety of services.

8. Allowing Real Time (or Dynamic) Pricing. As discussed above, current electricity meters used in regulatory regimes do not allow for real time pricing. Such meters do, however, exist and can be used in restructured markets.

All of the aforementioned elements of restructuring are important for achieving an effective, market-based system for the electric industry. We wish to highlight one particular aspect of restructuring: innovations in real-time metering technology. This technology has substantial implications for the types of retail products and services that load-serving entities (such as distribution companies) can offer to their customers. In particular, advanced metering innovations reduce the cost of offering real-time pricing. It allows for pricing where the price paid by retail customers is a direct function of the wholesale price of power at the relevant date and time.

Dynamic retail pricing enables customers to shift demand away from peak periods with high prices, and/or to reduce their overall use.

Dynamic retail pricing enables customers to shift demand away from peak periods with high prices, and/or to reduce their overall use. This economizing incentive, aligning benefits to consumers and costs to producers, is the source of the conservation benefits of dynamic pricing. The primary effects are felt directly by the consumers who choose to curtail or shift use. But an indirect effect creates even more value—the reduction in peak demand lowers wholesale prices for all other consumers of all power in that hour. Even if customers cannot shift away from peak, their prices can be lower and more stable because of the decisions of others to shift. Thus, dynamic retail pricing can help bring market supply and market demand into balance at lower and less volatile prices.

While many policy prescriptions for restructuring have been implemented, no state has yet enacted a widespread system of real-time pricing. As discussed earlier, real time pricing implies that customers bear wholesale electricity prices more directly, and therefore will be more likely to shift demand away from hours with high wholesale prices.[39]

Unfortunately, real-time pricing cannot be imposed immediately because consumers need the proper type of meter. The typical analog watt-hour meter that most utilities employ in their customers' homes and offices predates the increased power and sophistication of semiconductor technologies, and it also predates the development of digital data tape recording technologies in the 1950s. The utility uses this meter to measure the amount of energy that a consumer uses, but the meter is not sophisticated enough to provide time-specific information about current flow, even though semiconductor technologies make such metering feasible and inexpensive.

Currently, several states, including Pennsylvania and Texas, are moving toward widespread installation of modern "smart" meters for consumers of electricity. For example, PECO, a large electricity distributor in the Philadelphia area, has asked the Pennsylvania Utility Commission to approve a voluntary residential real-time pricing program.[40] Participating customers would have access to a website where they would find the information needed to make decisions about how and when they use energy. Customers would be able view the hourly price of energy and their actual energy use. PECO would upgrade meters with additional software to provide more automated meter readings for customers who agree to participate for 12 months.

Putting Arizona Back on the Path to Restructuring

Unfortunately, despite the gains that are possible, Arizona's electricity industry has not been restructured. In 1996, Arizona embarked on a path toward restructuring and substantial deregulation of its electricity sector. At the time, electricity restructuring was proceeding in many parts of the U.S. and in several other countries. As of 1997, legislatures or regulatory commissions in 40 states had begun to deregulate their electricity markets; Arizona was one of them.[41] The restructuring movement followed two crucial pro-competitive federal policy changes.

While many policy prescriptions for restructuring have been implemented, no state has yet enacted a widespread system of real time pricing.

First, in 1978 Congress passed the Public Utility Regulatory Policies Act (PURPA). This Act created a market for non-utility electric power producers by forcing electric utilities to buy power from these producers at the "avoided cost" rate. Avoided cost is the cost the utility would incur were it to generate or purchase power from another source. The requirement that utilities purchase power from outside sources encouraged construction of relatively small power generators. These new generators were typically owned by independent firms rather than by regulated utilities. Much of this new generation was in the form of small, renewable energy generation plants (e.g., wind turbines) or cogeneration plants, which produce electric power and steam. Federal policy thus encouraged cogeneration on the theory that it harnesses thermal energy (in the form of usable steam) that would be wasted if electricity alone was produced.

The significance of PURPA went beyond its impact on new generation construction. After PURPA went into effect it became clear that it was feasible to operate an electricity network in which multiple, independently owned and operated generation plants could inject power into the grid and have this power delivered to customers. PURPA, therefore, illustrated the feasibility of active and competitive wholesale power markets. Moreover, the experience with PURPA also points to a key defect of monopoly regulation by state agencies. What might appear to be wasteful duplication of generation investment by independent firms in the absence of regulation may, in the longer term, be revealed to be a valuable process in which the market discovers more efficient ways of doing things.[42]

Arizona's initial attempt at restructuring, the 1996 Competition Rule, would have unbundled electricity generation, distribution and retail sale.

Second, the Federal Energy Policy Act of 1992 required utilities to open their transmission systems to wholesale power producers at nondiscriminatory rates. Prior to this Act, an independent power producer faced large barriers to entry. Most power customers were served by utilities that had little incentive to purchase power from independent power producers. In addition, utilities owned the transmission network that an entrant would need to ship its power to other customers. Utilities did not have incentives to sell transmission services to independent power producers, because doing so would reduce their sales and, therefore, their regulated profits. After passage of this Act, merchant power producers constructed new generation plants in many parts of the U.S. and were able to move power across the grid.

Against this backdrop, the ACC formed the framework for restructuring in Arizona with passage of its *Retail Electric Competition Rule* in 1996.[43] This rule provided for a phase-in of both wholesale and retail market competition over a six-year period. Utilities were to file with the commission new rates for unbundled services (that is, separate prices for generation, transmission, distribution, and metering and billing). Consumers would be able to choose between using their existing power provider and obtaining service from new retail service providers.

Arizona's initial attempt at restructuring, the 1996 Competition Rule, would have unbundled electricity generation, distribution and retail sale. At the wholesale (top) stage, independent power producers (IPPs) would generate and sell electricity to distribution companies and retail service providers. The physical movement of power would take place over a still-regulated transmission grid. The transmission grid would be operated by an independent entity such as a Regional Transmission Organization (RTO). Retailers and distribution companies would resell power and provide additional services to end-use customers in a retail marketplace. Physical movement of power associated with the retail market would occur over the distribution network.

Implementation details of the 1996 Competition Rules were subsequently fleshed out in a series of ACC and Arizona legislative decisions.[44] In order to ensure competitive wholesale markets for electricity, generation assets of APS and TEP were to be spun off into separate generation companies that would compete with merchant power companies as IPPs. The former APS and TEP facilities would no longer be subject to rate-of-return regulation, and would gain profits (or incur losses) solely on the basis of the prices their products received in the market.

The ACC agreed that APS and TEP would be compensated for "stranded costs" associated with their generation divestitures. Consumer payments for electricity were to include competitive transition charges (CTCs) that would finance "stranded cost" payments to utilities. Implementation plans also called for consumer education programs during the transition to retail choice and provisions for consumer protection.

As mentioned earlier, Arizona's restructuring process encountered significant setbacks. These roadblocks to restructuring, however, came amid California's failed attempts at deregulation and had little to do with the merits of Arizona's proposed electricity restructuring.

For example, an ACC administrative law judge delayed divestiture of generation assets until July 1, 2004, fearing that the divested generation plants would have "market power"—the ability to influence prices and the supply of electricity without competitive restraint to the detriment of consumers—and that once divested, the ACC would no longer have jurisdiction over the plants and would not be able to protect Arizona consumers from market power abuses.[45]

The judge's rationale for delaying the divestiture reforms needed for competitive entry into Arizona's electricity market, however, was dubious as a matter of basic economics. If the judge believed that the owners of divested generation plants would have had significant power to manipulate the wholesale price of electricity, then the judge could simply have made additional divestitures a condition of restructuring.

Similarly, the reasoning behind the Arizona Court of Appeals' decision to strike down competitive market-based pricing for electricity is fundamentally problematic. In *Phelps Dodge Corp. v. Arizona Electric Power Coop.*—a case brought by established electricity players against the 1996 Competition Rules—the court agreed with the plaintiff's argument that the ACC violated Article 15, Sections 3 and 14, of the Arizona Constitution by improperly "delegating to the competitive marketplace the Commission's duty to set just and reasonable rates" based on the fair value of a utility's infrastructure investments. In essence, the Court of Appeals ruled that the Arizona Constitution mandated that the ACC employ some version of rate-of-return regulation, in which the regulated firm is permitted to charge prices that cover its operating costs and provide its investors with what state officials deem a fair return on their financial investments.[46]

The Court rejected the ACC's reliance on competitively established market rates as failing to meet the threshold of a "fair and reasonable" rate that takes all relevant interests into account. But it is widely accepted that prices in a competitive market do just that. Indeed, this is precisely the approach the Federal Energy Regulatory Commission (FERC) takes in its oversight of competitive wholesale interstate electricity markets.[47]

As mentioned earlier, Arizona's restructuring process encountered significant setbacks. These roadblocks to restructuring, however, came amid California's failed attempts at deregulation and had little to do with merits of Arizona's proposed electricity restructuring.

The Appeals Court's assertion that competitively established market rates can be "unreasonably" high or low presumes that there is an ideal price for electricity that can be ascertained independently from the expressed preferences of all market players in a competitive market. But, in reality, there is no such ideal price. Indeed, in a well operating market, the market price is the ideal price. It was, therefore, illogical for the Court of Appeals to interpret the Arizona State Constitution as charging the ACC with the impossible task of chasing down an idealized "fair and reasonable" electricity price, distinct from that which is generated in a competitive market.

In its basic outline, the plan for restructuring Arizona's electricity industry in the late 1990s and early 2000s was similar to electricity restructuring that successfully went into effect in a number of states and regions in the U.S. and overseas.

Additionally, although the Court of Appeals' decision repeatedly cited to the Arizona Supreme Court's decision in *U.S. West Communications v. Arizona Corp. Comm'n.* 201 Ariz. 242 (2001), the Court ignored the key foundational reasoning of that case. In *U.S. West,* the Arizona Supreme Court ruled that when a competitive market has emerged in a regulated industry—in that case, telecommunications—allowing markets to set prices is perfectly consistent with the ACC's constitutional obligation to prescribe fair and reasonable rates. The Court specifically emphasized:

> We still believe that when a monopoly exists, the rate-of-return method is proper. Today, however, we must consider our case law interpreting the constitution against a backdrop of competition. In such a climate, there is no reason to rigidly link the fair value determination to the establishment of rates. We agree that our previous cases establishing fair value as the exclusive rate base are inappropriate for application in a competitive environment.[48]

This reasoning applies equally well to electricity markets, and stands starkly against the Court of Appeals' decision in *Phelps Dodge Corp.* If anything, the holding of *U.S. West* implies that so long as a restructuring effort generates a genuinely competitive market, the rate regulation role for the ACC under the Arizona Constitution is not one of rigidly setting rates based on "fair value," but rather one of monitoring the market to ensure that it remains sufficiently competitive to justify departing from the traditional rate-of-return method of determining rates. Again, this is exactly the role FERC takes in interstate wholesale electricity markets.

Despite the clearly flawed reasoning that derailed restructuring, the inescapable fact is that electricity restructuring in Arizona has been on hold since the 2004 Appeals Court decision. Our view is that this delay in restructuring has been a missed opportunity for Arizona. In its basic outline, the plan for restructuring Arizona's electricity industry in the late 1990s and early 2000s was similar to electricity restructuring that successfully went into effect in a number of states and regions in the U.S. and overseas. The following recommendations build on restructuring plans previously developed for Arizona as well as on recent developments in the state's generation and transmission sectors. In short, we believe that electricity restructuring offers Arizona the best prospects for meeting its growing electricity demand. Both the ACC and the Legislature can and should revive restructuring in Arizona.

Recommendations for Arizona

Our policy recommendations provide a vision of how a restructured electricity sector would work in Arizona and describe key steps in the transition away from utility regulation. Before describing our recommendations, we point out that some real progress toward a market-based system has already been made. Arizona embarked on a restructuring process in the mid 1990s, as did a number of Western states. While overall deregulation of electric utilities stalled in Arizona around 2004, a number of significant changes were made that make the transition to a market-based system easier to accomplish than it otherwise would be. These changes include: the unbundling of electricity services, entry of new merchant power generators, expansion in the volume of wholesale power trading, improved access to the power grid for merchant power generators, and a proposal for a new RTO.

Unbundling

We recommend that consumer electricity bills in Arizona be broken out into separate charges for transmission, generation, distribution and system operations. In this way, consumers can see the cost of each element of the electricity production chain. Further, consumers will be able to respond to price competition in the generation of power by observing the prices that they are offered and choosing the generator that offers the lowest price. Unbundling should be associated with at least some vertical dis-integration of incumbent utilities. In the next sub-section we recommend sufficient divestiture of generation plants from utilities to ensure a competitive wholesale market.

If a utility retains ownership of some generation facilities, which were acquired during a time of anti-competitive regulation, then the rates charged by the utility should remain regulated to prevent excessive pricing, and the utility should be required to place a "ring fence" around the non-regulated parts of its business, so as to prevent costs from competitive, non-regulated activities to be counted in its regulated rate base.

Wholesale Electricity Competition

Price controls on wholesale electricity should be entirely lifted. Under restructuring, electricity will sell for whatever price it reaches in the wholesale market. In addition, generators will no longer have their costs guaranteed by the ACC. Instead, they will get to keep the profits that they make and will be responsible for the losses that they incur.

The development of a competitive wholesale electricity market is a key component of a restructured electricity sector. While there has been significant expansion of merchant power generation capacity, APS, SRP and TEP still own and operate a substantial share of generation in Arizona. The ideal restructuring reform would involve unbundling all three utilities because in the absence of substantial divestiture of generation by these utilities, there would be insufficient competition in the wholesale market to ensure efficiency and low prices for buyers. However, the ACC only has jurisdiction over APS and TEP. This means the legislature would need to take action regarding the unbundling of SRP's electrical generation activities because SRP is not governed by the ACC. Of course, any such legislative action could also direct the ACC to including APS and

We recommend that consumer electricity bills in Arizona be broken out into separate charges for transmission, generation, distribution and system operations. In this way, consumers can see the cost of each element of the electricity production chain.

TEP in restructuring efforts. Obviously, there are a number of political hurdles to such action. And in the event that all three major utilities cannot be divested of generation due to political considerations, we still recommend restructuring so long as divestiture of at least some of the generation plants by regulated utilities is attainable, with the aim of forming several new, independent power generation firms.[49] These new firms would then compete with existing merchant power generators and any other firms (e.g., public power producers) selling power into the grid. Such divestiture is justifiable from a free market perspective because the current scale of APS, SRP and TEP can be attributed largely to anti-competitive government regulation and, in the case of SRP, favorable regulatory and tax treatment.

Our recommendation is to operate the wholesale market with no price cap, no automatic bid mitigation, and no separate capacity market.

The wholesale market would operate mainly through decentralized trading via bilateral contracts. These trades can be coordinated through private exchanges. In fact, wholesale electricity has been traded in Arizona on private exchanges for many years. For example, the New York Mercantile Exchange (NYMEX) began trading electricity on five regional markets in May 1996; one of these NYMEX markets calls for electricity to be delivered at the Palo-Verde switchyard in Arizona (PV). This kind of decentralized model allows traders to buy and sell spot contracts and forward contracts, as well as a variety of financial instruments (puts, calls, swaps, etc.) to hedge against risk.

This decentralized trading model follows the approach used in the Texas wholesale market, and is in contrast to the use of a centralized market run by the ISO, like the old Power Exchange in California or the "Pool" in England and Wales. A centralized power exchange is potentially vulnerable to manipulation by generation firms attempting to exercise market power.

Concerns about high wholesale prices in restructured markets have led policymakers to impose wholesale price caps and/or automatic mitigation procedures that limit wholesale price markups in markets served by the New York ISO, New England ISO and the PJM. However, such price restrictions remove some of the profit incentive required for generation investment that would meet peak demand. This, in turn, has led policymakers to establish so-called capacity markets as a way to stimulate investment. For example, the New York ISO and the New England ISO each operates capacity markets as vehicles to induce more generation investment. However, the ability of capacity markets to deliver on the objective of providing an efficient amount of generation capacity at low cost depends a great deal on details of their design. The capacity markets of NYISO have been criticized for providing insufficient incentives for investment during peak periods.[50] Indeed, capacity markets appear more suited to direct additional payments to incumbent generators rather than to induce the construction of desirable generation.

Our recommendation is to operate the wholesale market with no price cap, no automatic bid mitigation, and no separate capacity market. This is the approach used in Texas's ERCOT. The result is that wholesale prices may be temporarily quite high during peak periods, higher than in other restructured markets, but these high prices provide good incentives for generation investment. As noted earlier, Texas has expanded generation capacity significantly since implementing restructuring, even in the absence of capacity markets. This approach may yield greater short-run wholesale price volatility than a policy with more wholesale price restrictions,[51] but it has the advantage of providing clear incentives for generation investment.

System Operation and Transmission

A decentralized system of market exchange is an efficient, effective method for trading most goods. However, because of some special features of electricity, it is difficult to completely decentralize wholesale electricity trading as can be done for many other types of commodities. Because of the physical nature of how electricity flows over a network, and the limitations of current technologies, it is vital to have a central coordination of power flows over the network. This coordination function is fulfilled by a system operator, who must coordinate power injections and withdrawals over the network on a continual basis so as to maintain the frequency within a certain narrow band of tolerance. Systems operations in restructured markets are handled by an Independent System Operator (ISO) or Regional Transmission Organization (RTO).[52]

The formation of a new ISO or RTO is a daunting proposition, involving complex technical issues of network management and potentially conflicting interests of stakeholders. Fortunately, Arizona is already well along a path leading to formation of an RTO. During the 1990s, utilities and merchant power producers began to recognize the need for greater coordination of power flows across the network in the Southwest U.S. The search for a way to manage power flows across the network led to the formation of WestConnect, an organization of transmission owners in the western grid. WestConnect was organized to coordinate power flows and transmission planning across an area that encompasses Arizona, most of New Mexico, and parts of other southwestern states. A petition was filed in 2001 seeking FERC approval of WestConnect as an RTO. However, the petition was withdrawn in 2002. Since then, WestConnect has operated as a collaborative organization that facilitates wholesale market trading and coordinates transmission planning, rather than as a formal RTO.

Our recommendation is to develop WestConnect into an RTO charged with managing network operation across its territory, supporting wholesale power trading and responsibility for transmission planning and expansion. WestConnect would thus be a vital component of a restructured electricity industry. Most parts of WestConnect's 2001 RTO proposal should be maintained. These include:

- Wholesale traders report their bilateral trades to the RTO for scheduling purposes.
- Operation of balancing markets to match supply and demand for power and to manage inter- and intra-zonal congestion.
- Operation of ancillary markets (such as markets for services like spinning reserves) that are needed for reliable electric service.
- A governing board for which directors are prohibited from having either a financial interest in or a business relationship with the utilities (or other transmission owners). Governance would also be facilitated by a Stakeholder Advisory Committee with representatives from various stakeholder groups.

Our recommendation is to develop WestConnect into an RTO charged with managing network operation across its territory, supporting wholesale power trading and responsibility for transmission planning and expansion.

Retail competition allows providers to compete on the price and type of service offered to retail customers.

One key aspect of WestConnect's RTO proposal should be modified to better serve a restructured industry. We recommend a non-profit RTO that would have an objective of operating the electricity system in a way that maximizes the total gains from trade available to all electricity industry participants. A key challenge for the RTO will be to develop policies consistent with this goal. A for-profit RTO, as the 2001 proposal called for, may have the advantage of a clear objective, against which proposed transmission fees and new transmission investments can evaluated. But historical experience with deregulation of other networked utilities suggests that a for-profit RTO is likely to operate at cross-purposes with effective wholesale and retail competition and advancement of consumer welfare. For example, a for-profit RTO, insulated from competition by regulations precluding free entry into the business of network management, may decide against expanding the capacity of a constrained transmission link if the expansion would yield reduced transmission payments, even when the expansion would yield more producer and consumer benefits than it would cost.

Finally, to account for advances in network management technologies, which may render the centralized RTO model obsolete or inefficient, reforms should: a) provide for a sunset review process requiring periodic demonstration by proponents of RTO network management that a centralized RTO remains necessary to achieve a competitive and efficient electricity market; and b) ensure that there are no regulatory impediments preventing electricity generators from directly furnishing energy to consumers, if the electricity transmission and consumption occurs "off-the-grid" and, therefore, does not risk the stability of transmission or supply on the grid.

Retail Competition

Another goal of restructuring is to eliminate the monopoly local distribution companies hold on retailing. Retail competition allows providers to compete on the price and type of service offered to retail customers. Consumers are able to choose their electricity provider, just as they are currently able to select their long-distance phone carrier. Retail competition offers a number of significant benefits. However, retail competition has failed to take hold in some states that have restructured, largely because of how it was implemented. Following are recommendations on retail competition that take into account the experience of other states.

Currently in Arizona most end-use consumers purchase their electricity from regulated utilities, public power providers or electric cooperatives. Very few consumers can choose their electricity provider. We propose to open the retail electricity sector in Arizona to competition among electric service providers (ESPs). An ESP would purchase power from generators, sell electric power to the end-use customer and provide customer service. If an ESP owns local distribution facilities, then the firm would use its local distribution to deliver power to those of its customers who are linked to its distribution network. If an ESP does not own local distribution, then it would pay regulated rates to the owner of local distribution for network access.

A move from regulated monopoly electricity service to retail electric competition is a significant change for customers, and many customers may be hesitant to switch from their incumbent distributor. But for competition to emerge, customers must be convinced to change their habits and to start behaving as consumers in a competitive market. Additionally, business expectations must be allowed time to adjust to the fundamental changes that will be made in the state's energy sector. For this reason, it will be important to have a limited transition period during which retail competition can be phased in and consumer expectations can adjust to the opportunities presented by such competition. Several things should be happening during the transition period:

- We recommend launching a customer information campaign that educates customers about the transition timetable and their options under retail choice.
- To prevent incumbent distributors from wielding the market power they have accrued through anticompetitive regulation, a regulated retail rate for incumbent distributors should be established during a temporary transition phase. The Arizona Retail Electric Competition rules describe this as the Standard Offer Service rate. This rate will essentially serve as a price floor for incumbent distributors during the transition; competing retailers could attract customers away from an incumbent by offering a rate below the standard offer.
- If retail competition fails to emerge in a service territory, then the standard offer rate will also serve as a price ceiling, protecting customers from monopoly pricing. This is consistent with free market principles due to the fact that incumbent distributors may be presumed to owe their monopoly position to anticompetitive regulation.

The standard offer service rate should be determined by the ACC and should include several components:

- Wholesale cost of purchasing electricity;
- Transmission and distribution charges;
- Metering charges and other customer charges; and
- Retail margin, to provide incentive for ESPs to enter.

The way in which the standard offer rate is set, and then adjusted over time, is critical for the emergence of retail competition. When Rhode Island and Massachusetts introduced retail choice in the late 1990s, standard offer rates were set low relative to the unit costs for an ESP and, therefore, little entry occurred and retail competition failed to emerge. In Pennsylvania there was significant entry of ESPs following deregulation. However, as discussed previously, the standard offer rates in Pennsylvania were not adjusted as natural gas prices, and hence wholesale electricity prices, increased. As a result, profit margins for ESPs disappeared and most ESPs exited the market by 2001.

The transition to full retail competition should be long enough so that strong wholesale competition has emerged by the end of the transition.

Clearly, standard offer rates should be set to reflect local market conditions, and should be adjusted over time as fuel prices and wholesale prices change. For example, if a large percentage of wholesale power trading is tied up with pre-existing long term contracts, then ESPs may have difficulty purchasing power from generators. The transition to full retail competition should be long enough so that strong wholesale competition has emerged by the end of the transition.

One of the goals of retail competition is to increase the range of choices open to customers. Two aspects of this are

The retail competition program in Texas has dramatically expanded renewable energy options for customers, from both new retail entrants and from incumbent distributors.

particularly important. The first is that retail competition may bring new options for purchasing renewable energy for customers. The retail competition program in Texas has dramatically expanded renewable energy options for customers, from both new retail entrants and from incumbent distributors. Renewable generation capacity has increased by 390 percent in Texas in the last eight years.[53] Many customers have been willing to purchase electricity generated from renewable sources, even when they must pay a premium for renewable electricity. A second aspect is that retail competition may bring new pricing options and service innovations for customers. New retail entrants may bring options such as more sophisticated metering that allows for real-time pricing, and that would provide customers with incentives to better manage their daily patterns of consumption. There are large potential efficiency gains for the industry associated with shifting power generation from peak hours to off-peak hours.

Real time pricing

We believe that to complete the restructuring package, Arizona should move toward giving as many customers as possible the option of real time pricing. Opening the retail market to competition among ESPs is one way to encourage real time pricing, since this kind of pricing is one way for an ESP to differentiate its service offerings from those of competitors. The experience with retail competition in Pennsylvania bears this out. Large industrial customers should have the greatest incentive to adopt the sophisticated meters required for real time pricing, since these customers have large potential gains from shifting production to off-peak days and times with low prices. We would expect smaller industrial and residential customers to adopt real-time pricing gradually over time, as these customers become more familiar with metering technology and with the service offerings from ESPs. However, it is important to note that there can be significant benefits from real-time pricing in terms of lower overall capital costs and lower average retail prices, even if only a fraction of customers purchase via real-time pricing plans.[54]

Real-time pricing may also be an effective way to price electric power from distributed generators. In order for real-time pricing to be utilized for distributed generation, ESPs would need to adopt net metering. In its simplest form, net metering allows a retail customer's meter to run backward, so that transmission onto the grid offsets purchases from the grid. The customer receives a credit from its ESP, at the same rate it pays to buy power, for the electricity it supplies onto the grid. Like many other states, Arizona recently adopted new rules governing net metering for retail customers.[55]

Real-time pricing used in conjunction with net metering can provide improved incentives for customers to invest in distributed generation, such as rooftop photo-voltaic solar panels. Under real-time pricing, credits for distributed generation would be based on the wholesale price of electricity in each hour rather than the average price for the month. Such rates provide the price incentives for customers to operate their units during peak periods, when wholesale prices are highest. This would align investment incentives for distributed generation with the economic benefits of distributed generation. That is, the types of distributed generation that are productive during peak periods when wholesale prices are high would be the most attractive types for customers to invest in.

Renewable Energy

In 2006, the Arizona Corporation Commission approved new Renewable Energy Standards for the state, requiring generators to increase the percentage of power generated from renewable sources.[56] The standards will require regulated electric utilities to generate 15 percent of the total megawatts sold from renewable resources by 2025.[57] The Commission's Renewable Energy Standards also require that 30 percent of the renewable energy be from distributed generation. Assuming these requirements are not struck down by court action, it is important for the restructuring effort to take them into consideration.

We make two points. First, retail competition may stimulate consumer demand for renewable energy. In Texas, ESPs such as Green Mountain Energy specialize in renewable energy offerings; other Texas ESPs typically include one or more renewable energy offerings for their customers. Consumer demand for renewable energy has helped stimulate a large increase in wind power capacity in Texas. Second, as noted in the previous sub-section, when real time pricing is coupled with net metering it can provide improved incentives for customers to invest in distributed generation; i.e. solar panels on residential roofs or perhaps even more exotic forms of distributed generation, such as small-scale nuclear power generation for neighborhoods or community institutions based on military technologies.[58] Such improved incentives will be important if Arizona is to meet the distributed generation targets of the Renewable Energy Standards at a reasonable cost. This is because competition will make it possible for the costs of renewable mandates to be born by those most willing and able to bear them.

Conclusion

The Arizona electricity system faces a host of challenges. Currently, Arizona's energy sector is geared to produce and export electricity expensively. Increasing demand for electricity in Arizona and elsewhere will require more capacity for electricity generation in Arizona, and more consumer response to differential electricity pricing. Restructuring represents a method to vigorously meet those challenges. Without competition in the wholesale and retail markets, there will be inadequate price signals to both producers and consumers of electricity to ensure that capital and resources are allocated to the most efficient means of producing and distributing electricity to meet Arizona's needs.

The experience with restructuring in Britain, Pennsylvania and Texas shows that competition can work if the regulatory transition is done right. Arizona has every reason to follow in their footsteps. The key is to ignite competition in the wholesale and retail markets, while maintaining rate regulation over transmission facilities and establishing a non-profit organization to manage the grid. If this is done, economic theory and practical experience dictate that prices will remain stable, generation capacity will be greatly increased, and renewable energy mandates will be met with a minimum of economic harm.

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In short, events around the world have shown that, if done correctly, restructuring can serve to efficiently meet electricity demands. Arizona is now well-placed to resume its progress toward restructuring.

NOTES

1. Timothy Considine and Dawn McLaren, *Powering Arizona, Choices & Trade-Offs for Electricity Policy A Study Assessing Arizona's Energy Future,* http://www.communicationsinstitute.com/home/140000768/140000791/files/Powering%20Arizona%20Study%20Draft%20Final%202.pdf (reporting "total electricity use growing 3.4 percent annum between 2000 and 2007 while the national average annual growth rate is 1.3 percent.")

2. *Id.* at 6 (Figure 6).

3. *Id.* at 5 (Figure 4).

4. *Id.* at 4 (Figure 2).

5. ACC. Decision No. 59943. Docket No. U-0000-94-165. December 1996.

6. The Energy Information Administration website, http://www.eia.doe.gov/cneaf/electricity/page/restructuring/arizona.html, provides a history of restructuring activity in Arizona.

7. Op cit, footnote 4.

8. Op cit, footnote 31.

9. 207 Ariz. 95 (Ct. App. 2004).

10. P. Joskow, "Markets for Power in the United States: An Interim Assessment", *The Energy Journal,* vol. 27 (2006).

11. C. Wolfram, "The Efficiency of Electricity Generation in the United States after Restructuring", in, *Electricity Deregulation: Choices and Challenges,* edited by J. Griffen and S. Puller, University of Chicago Press, Chicago: 2005.

12. Op cit, footnote 27.

13. All data on U.S. state capacity in this section comes from the Energy Information Administration, and dates from 1998 to the last year data was available, 2006. The capacity measure used is "summer capacity," to reflect the relevant peak system demands.

14. Our data on international capacity, obtained from the Energy Information Administration (except for the Canadian province of Alberta), do not extend past 2005.

15. In addition to vertically integrated utilities, Arizona also has entities such as merchant power generators that operate at only one stage of the production process. Also, there is wholesale power exchange between utilities and between merchant power generators and utilities.

16. Considine and McLaren, 5.

17. Economic inefficiency occurs when a product is priced above its marginal cost of production. When price exceeds marginal cost, there are units of the product that consumers value more than their marginal cost but less than the price. As a result, these units are neither produced nor purchased, even though there would be benefits to society from doing so.

18. See, for example, Gregg A. Jarrell, The Demand for State Regulation of the Electric Utility Industry *Journal of Law and Economics,* Vol. 21, No. 2 (Oct., 1978), pp. 269-295.

19. http://www.census.gov/compendia/statab/tables/09s0014.pdf.

20. We use the concept of levelized cost for average production cost. Levelized cost is calculated by taking the discounted present value of all investment, operating and maintenance costs of a plant over its expected life, and finding a constant average cost per unit of output that yields the same discounted present value. The $50 figure is from Considine and McLaren, *supra.*

21. Considine and McLaren, supra, at 26.

22. *Id.*

23. See, for example, Hoff and Cheney, Matthew, *The Potential Market for Photovoltaics and Other Distributed Resources in Rural Electric Cooperatives*, 21:3 Energy Journal. p 113-27 (2000) and

Nat Treadway, Distributed Generation Drives Competitive Energy Services in Texas, in Kiesling and Kleit, Electricity Restructuring: The Texas Experience (Forthcoming, 2009).

24. R. Randazzo "APS bid for rate increase is rejected", *The Arizona Republic,* November 14, 2008.

25. Ratepayers in Arizona are represented by the Residential Utility Consumer Office (RUCO) as well as ACC staff members. However, the resources behind RUCO and ACC staff are dwarfed by the resources that IOUs can bring to bear on regulatory issues.

26. However, regulated utilities are not given a blank check by regulators to cover egregious overspending. During the 1980s, state regulators disallowed hundreds of millions of dollars of costs for new plants. The bulk of disallowances were for nuclear plants. See, T. Lyon and J. Mayo, "Regulatory opportunism and investment behavior: evidence from the U.S. electric utility industry", *RAND Journal of Economics,* vol. 36 (2005). The costs were then born by the utilities themselves.

27. When Arizona was pursuing restructuring 10 years ago, the ACC approved $800 million in stranded costs for utilities. The utilities have operated under rate regulation since then and much of this cost has been recovered in consumer rate payments, since they were embedded in the rate base. Current wholesale market prices are higher relative to utility costs than they were 10 years ago. As a consequence, stranded costs may not be a significant issue for restructuring now in Arizona.

28. Consider Tucson, the second-largest city in Arizona, with a metropolitan area population of about one million. In 2007, TEP sold 9.6 million MWh of electricity to Tucson-area customers. Using average utilization rates for coal and natural gas fueled plants in Arizona, it would take three large coal plants (each with capacity of 400 MW) plus six natural gas plants (each with capacity of 100 MW) to serve a city of this size.

29. F. Wolak, "Lessons from the California Electricity Crisis", in, *Electricity Deregulation: Choices and Challenges,* edited by J. Griffen and S. Puller, University of Chicago Press, Chicago: 2005, p. 157. Given the uncertainties associated with estimation of competitive market benchmark prices, this $2/KWh difference is not large. Wolak notes that the competitiveness of the California wholesale market during this period was comparable to that of wholesale markets in the eastern U.S.

30. S. Borenstein, J. Bushnell, F. Wolak, "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market", *The American Economic Review,* December (2002).

31. E. Mansur, "Measuring Welfare in Restructured Electricity Markets", *The Review of Economics and Statistics,* May (2008).

32. Wolak, *supra,* suggests that a third deficiency of California's restructuring was a lack of an effective market power mitigation process from FERC. This issue becomes less important when the first two problems noted in the text above are addressed.

33. R. Green, "Restructuring the Electricity Industry in England and Wales", in, *Electricity Deregulation: Choices and Challenges,* edited by J. Griffen and S. Puller, University of Chicago Press, Chicago: 2005, p. 137.

34. *See Electric Restructuring: The Transition from Rate Caps to Market-Based Pricing* (Jan. 2008), available at http://www.puc.state.pa.us/general/consumer_ed/pdf/Rate_Caps.pdf.

35. Baldick and Niu, "Lessons Learned: The Texas Experience", in, *Electricity Deregulation: Choices and Challenges,* edited by J. Griffen and S. Puller, University of Chicago Press, Chicago: 2005, p. 215.

36. Data from Energy Information Administration, http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html.

37. See, www.seco.cpa.state.tx.us/re_rps-portfolio.htm

38. These elements are described in greater detail in: P. Joskow, "The Difficult Transition to Competitive Electricity Markets in the United States", in, *Electricity Deregulation: Choices and Challenges,* edited by J. Griffen and S. Puller, University of Chicago Press, Chicago: 2005.

39. This aspect of real time pricing is important because it would leave generation suppliers with much less incentive to raise wholesale prices. Nobel laureate Vernon Smith and his coauthors report on laboratory market experiments in which precisely this effect of real-time pricing is observed. See Rassenti, Smith, and Wilson, Controlling Market Power and Price Spikes in Electricity Networks: Demand-Side Bidding, *Proceedings of the National Academy of Sciences,* 100(5), March 4, 2003.

40. PECO's petition to the PUC appears on their website: http://www.exeloncorp.com/ourcompanies/peco/pecores/energy_rates/filing_information/Real-Time+Pricing+Program+-+Phase+I.htm

41. M. Block, "Hotwiring Deregulation…"

42. See the article by Peltzman (Op cit. ft. 17) for more discussion of this point.

43. ACC. Decision No. 59943. Docket No. U-0000-94-165. December 1996.

44. The Energy Information Administration website, http://www.eia.doe.gov/cneaf/electricity/page/restructuring/arizona.html, provides a history of restructuring activity in Arizona.

45. Op cit, footnote 31.

46. The Appeals Court decision did not completely reject the use of competitive market mechanisms, in spite of its rejection of the 1996 Competition Rules. The language in paragraph 26 of the decision suggests that alternative competition rules that provided for oversight and market monitoring of electricity markets by the ACC based on factors including fair market value might have been accepted by the Appeals Court.

47. The following is on p. 17 of FERC's strategic plan for 2006-2011: "The Commission is charged by statute with ensuring that prices in jurisdictional energy markets remain just and reasonable and not unduly discriminatory or preferential. One way the Commission can do this is to preserve and expand the transparency of information and operations in energy markets. This in turn relies on Commission rules being effective at encouraging fair and efficient competitive markets." http://www.ferc.gov/about/strat-docs/FY-06-11-strat-plan-print.pdf.

48. 201 Ariz. at 246.

49. It may be advisable to divest baseload and peaking plants into separate entities. A firm that owns and operates both types of plants may sometimes have an incentive to turn off its peaker as a means of increasing price for its baseload sales. See Borenstein, Bushnell, and Knittel, Market Power in Electricity Markets: Beyond Concentration Measures, 20:4 *Energy Journal.* 65 (1999) and Kleit, Market Monitoring in ERCOT in Electricity Restructuring: The Texas Story (Kiesling and Kleit, editors) American Enterprise

Institute, forthcoming 2009.

50. See, P. Crampton and S. Stoft, "A Capacity Market that Makes Sense", *Electricity Journal,* August-September, 2005.

51. The price volatility discussed here occurs on an hourly or daily time frame. Consumers, who pay their electricity bills on a monthly basis, may not even notice such volatility in their charges.

52. In Texas, this central coordination is done by the Electric Reliability Council of Texas (ERCOT), which manages the flow of electric power to 21 million Texas customers and represents most of the state's electric load and land area. Texas has implemented both wholesale and retail competition across most of the state. As the ISO for the region, ERCOT schedules power on an electric grid that connects 38,000 miles of transmission lines and more than 550 generation units. ERCOT also manages financial settlement for the competitive wholesale bulk-power market. ERCOT operates as a membership-based nonprofit corporation, governed by a board of directors and subject to oversight by the state utility commission. In the east-central part of the U.S., this coordination is done by an RTO called the PJM Interconnection.[52] The PJM Interconnection coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. PJM operates the world's largest competitive wholesale electricity market and ensures the reliability of the largest centrally dispatched grid in the world. As a federally regulated non-profit RTO, PJM is required to act independently and impartially in managing the transmission system and the wholesale electricity market.

53. L. Kiesling, "Retail Restructuring and Market Design in Texas",

54. See S. Borenstein and S. Holland, "On the Efficiency of Competitive Electricity Markets with Time-Variant Retail Prices", *RAND Journal of Economics,* vol. 36 (2005).

55. http://www.cc.state.az.us/divisions/utilities/electric/Netmetering.asp

56. See, http://www.cc.state.az.us/divisions/utilities/electric/environmental.asp.

57. Arizona's Renewable Energy Standards establish tradable certificates for renewable energy production. The ability of firms to trade these certificates in a market should permit the standards to be met at lower cost than would otherwise be possible.

58. *See* http://www.hyperionpowergeneration.com (promoting distributed nuclear power generation by Hyperion Power Generation, Inc., "based on the small, modular, non-weapons grade nuclear power reactor invented by Dr. Otis "Pete" Peterson at the United States' famed Los Alamos National Laboratory (LANL) in New Mexico").

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