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BEFORE THE ARIZONA CORPORATION COMMISSION

IN THE MATTER OF THE COMMISSION'S INQUIRY INTO RETAIL ELECTRIC COMPETITION	DOCKET NO. E-OOOOOW-13-0135 **GOLDWATER INSTITUTE AND ROY MILLER'S COMMENTS IN SUPPORT OF RESTRUCTURING ARIZONA'S ELECTRICITY MARKETS FOR CHOICE AND COMPETITION**

The Goldwater Institute, a non-profit public interest educational organization, and Roy Miller, a ratepayer residing within the exclusive service territory of Arizona Public Service, hereby offer the following comments in response to the specific questions advanced by the Commission on May 23, 2013 together with supporting documentation.

Introduction

Guided by the wisdom of leading independent experts, the Goldwater Institute has been studying how best to reform electrical markets for choice and competition for sixteen years. Most recently, the Institute has published two new policy studies. The first of these is a six page policy brief that summarizes the key benefits and policy recommendations for restructuring by Dr. Byron Schlomach, Goldwater Institute Director of Economic Prosperity, which is entitled, "*A Time for Choosing: Why Choice and Competition in Electricity is Right for Arizona.*" (A copy is attached hereto as Exhibit 1.) The second more comprehensive report, "*Moving Forward: A Roadmap to Restructure Arizona's Electricity Markets for Choice and Competition*," outlines a specific roadmap for reform. It is authored principally by Dr. Andrew Kleit, Penn State University Professor of Energy and Environmental Economics, John and Wille Leone Department of Energy and Mineral Engineering, Department of Meteorology, with legal analysis by Goldwater Institute Policy Development Director and attorney Nick Dranias. (A copy is attached hereto as Exhibit 2.)

The bottom line is that choice and competition can drive Arizona's electricity market to efficiently produce more power at a lower cost, which promises more economic growth and job opportunities for Arizonans. Since restructuring their electricity markets for choice and competition, Pennsylvania and Texas have seen their capacity increase nearly 25 percent and 45 percent respectively. With increased capacity, Texas has seen prices drop well below the national average with consumers choosing among numerous competitive electricity retailers and plans—much like Arizonans

choose cell phone service companies and plans. Where competition prevails in Texas, pricing plans offer consumers electricity prices lower than the average price in Arizona—and even lower than the lowest state average in the nation (just under 7 cents per kilowatt hour for the lowest cost Texas plan versus approximately 11 cents per kilowatt hour in Arizona and just under 8 cents per kilowatt hour in Louisiana). These experiences are not isolated—countries around the world, including the United Kingdom, New Zealand, Canada and Chile, have similarly restructured their markets for choice and competition and have likewise experienced greater capacity and lower prices as a result.

That does not mean, however, that restructuring is an easy or instantaneous process. It must be done right and methodically. Fortunately, competitive electrical markets are now mature enough to chart out a roadmap for Arizona to follow. Exhibit 2 provides that roadmap. It consists of three phases and nine specific steps tailored to Arizona's unique market conditions. *Id.* (pp. 7-20).

Based on this roadmap, the Goldwater Institute strongly recommends restructuring Arizona's electricity markets for choice and competition. This recommendation is based on the findings contained in Exhibits 1 and 2, as well as the following reports previously published by the Goldwater Institute: Stanley Reynolds and Andrew Kleit, *Opening the Grid: How to Recharge Arizona's Electricity System for the 21st Century*, Goldwater Institute Policy Report No. 232 (July 21, 2009), attached hereto as Exhibit 3; Michael K. Block, Robert Franciosi, Melinda L. Ogle, *Hotwiring Deregulation: How SRP Can Lead The Way To A Competitive Electric Market*,

Goldwater Institute Issue Analysis No. 147 (Sept. 1997), http://goldwaterinstitute.org/sites/default/files/Hotwiring%20Deregulation-%20%20How%20SRP%20Can%20Lead%20the%20Way%20to%20a%20Competitive%20Electric%20Market.pdf. These reports, in turn, reflect the findings of numerous peer reviewed academic papers, which are specifically cited.

The principal authors of the foregoing Goldwater Institute policy reports are recognized experts in the fields of economics, law, energy and/or electrical market regulation. The curricula vitae of authors Dr. Andrew Kleit, Ph.D. (Penn State University) and Dr. Stanley Reynolds, Ph.D. (University of Arizona) are respectively attached hereto as Exhibits 4 and 5. The following comments reflect their previously published recommendations, along with the expertise of Goldwater Institute Economic Prosperity Director Dr. Byron Schlomach, Ph.D. (bio @ http://www.linkedin.com/in/bschlomach) and Policy Development Director and attorney Nick Dranias (bio @ http://www.linkedin.com/in/nickdranias). Finally, these comments are strongly supported by ratepayer and citizen-activist Roy Miller (bio @ www.linkedin.com/pub/roy-miller/0/18a/215), who spent four years on the staff of the ACC during 1976-79, serving as administrative assistant to the chairman and hearing officer on several cases.

Questions and Responsive Comments

All answers to the following questions assume that electric competition is adopted as a component of restructuring that incorporates the essential features of the Texas and Pennsylvania models as explained in Exhibits 1, 2 (pp. 7-20) and 3 (pp. 19-20).

Question 1: Will retail electric competition reduce rates for all classes of customers - residential, small business, large business and industrial classes?

Answer: Relative to the higher rates that would otherwise almost certainly arise from maintaining the status quo of monopoly territories for regulated utilities, it is reasonably certain that retail electric competition will result in reduced rates. Where competition prevails in Texas, pricing plans offer all classes of customers rates that are lower than the average rate in Arizona—and even lower than the lowest state average in the nation (just under 7 cents per kilowatt hour for the lowest cost Texas plan versus approximately 11 cents per kilowatt hour in Arizona and just under 8 cents per kilowatt hour in Louisiana). *See* Exhibits 1 (pp. 1-3), 2 (pp. 3-6), and 3 (pp. 3-4, 16-17). The biggest winners might be small businesses which are also the engine of economic growth.

Question 2: In addition to the possibility of reduced rates, identify any and all specific benefits of retail electric competition for each customer class.

Answer: Every customer class in every market benefits from competition and always has. There are electricity rate plans advertised by major providers in Texas for "free weekends" or "free evenings." Who knew such classes of customers existed? If Arizona's electricity market is restructured as recommended here, each customer class, including some we do not know exist, will benefit from increased innovation in methods

of producing, delivering, and billing abundant electricity efficiently and conveniently. We can also expect increases in economic growth and employment from a more efficient electrical market, benefiting all customer classes. *See generally* Byron Schlomach, *Lessons from Texas on Building an Economically Healthier Arizona*, Goldwater Institute Policy Report No. 251 (October 17, 2012), http://goldwaterinstitute.org/sites/default/files/Policy%20Report%20251%20Lessons%20from%20Texas_0.pdf; Exhibits 1 (pp. 1-3), 2 (pp. 3-6), and 3 (pp. 3-4, 16-17).

Question 3: How can the benefits of competition apply to all customer classes equally or equitably?

Answer: Competitive markets in wholesale and retail markets will arise that produce power efficiently. This will discipline production costs and result in an abundance of relatively cheap energy that will benefit all customer classes equally and equitably. *See* Exhibits 1 (pp. 1-3), 2 (pp. 3-6), and 3 (pp. 3-4, 16-17).

Question 4: Please identify the risks of retail electric competition to residential ratepayers and to the other customer classes. What entity, if any, would be the provider of last resort?

Answer: There are no risks to any customer class of a significantly different nature or more significant magnitude than those faced in a regulated monopoly environment. Should a consumer refuse to designate a provider or should a provider fail, the ACC, ISO or RTO would be responsible for designating a provider of last resort, preferably based on an RFP process or its equivalent. The only "risk" is that some electricity shoppers will be wiser in their choices than others. However, all electricity consumers

will benefit from competition even if not all choose the very best deal. *See* Exhibits 1 (pp. 1-3), 2 (pp. 3-6), and 3 (pp. 3-4, 16-17).

Question 5: How can the Commission guarantee that there would be no market structure abuses and/or market manipulation in the transition to and implementation of retail electric competition?

Answer: Such issues will be addressed through vertical and horizontal divestiture/firewall separation of incumbent utilities, and the adoption of market monitoring. *See* Exhibits 1 (pp. 10-11), 2 (pp. 15-16), and 3 (pp. 19-20). Market competition has otherwise proved sufficiently robust to prevent abuses of market power.

Question 6: What, if any, features, entities or mechanisms must be in place in order for there to be an effective and efficient market structure for retail electric competition? How long would it take to implement these features, entities, or mechanisms?

Answer: In essence, the Arizona Corporation Commission needs to restructure Arizona's electricity market for choice and competition in three phases, the completion of which could take between 2 and 8 years depending on the conditions of competition in the wholesale market and the reliability of the adopted system for balancing electrical loads on the grid. First, the ACC should separate existing utilities from their generation, transmission, and distribution capacity to prevent them from abusing the monopoly power they have accrued under the existing regulatory system. At the same time, a system operator needs to be empowered to neutrally balance the load on the grid that will be created by an influx of competitive energy producers. Second, the ACC should take action to create competitive generation markets in which energy producers can

freely enter, exit and compete for business. Third, customers should be empowered by the ACC with the freedom to choose among competitive retailers of electricity. If these steps are taken in the right order, Arizona's electricity market will finally move forward towards greater capacity, choice, competition, innovation and lower prices—spurring new economic growth and job opportunities for Arizonans. These three phases involve nine specific steps that are detailed in Exhibit 2 (pp. 7-20) and discussed as elements of the academic consensus on how to do restructuring right in Exhibit 3 (pp. 19-20).

Question 7: Will retail electric competition require the divestiture of generation assets by regulated electric utilities? How would FERC regulation of these facilities be affected?

Answer: Yes and no. Divesture is the recommended option. However, restructuring can work, albeit typically less optimally, if retail and generation units are instead kept within the same overall corporate umbrella provided that the units are thoroughly firewalled so that cross-subsidization and collusion are not possible. *See* Exhibits 2 (p. 12), and 3 (pp. 19-20, 25-27). FERC regulation would not prevent divestiture or firewall separation.

Question 8: What are the costs of the transition to retail electric competition, how should those costs be quantified, and who should bear them?

Answer: There would be costs associated with establishing a grid operator that can neutrally balance loads. Because the grid and system operator will continue to function as a public utility, the associated costs would be subject to recovery by traditional ratemaking. There would be few other costs because stranded costs have already been recovered by incumbent utilities. However, if the uncertainty and burdens of new EPA regulations threaten the viability of the Navajo Generation Station and Four Corners

facilities in such a way as to result in a disorderly and dramatic reduction in generation capacity during restructuring, then special consideration should be given to defraying those uncertainties and burdens. The best policy recommendation would be to enact a regulatory tax credit at the federal level (or less optimally the state level) that would allow for the costs of new EPA regulations to be reimbursed through corresponding tax credits to the facility operators. *See* Nick Dranias and Byron Schlomach, *The Missing Reform: Regulatory Tax Credits*, Goldwater Institute Policy Brief No. 11-06 (November 9, 2011), http://goldwaterinstitute.org/sites/default/files/gb-Regulatory%20paper%20%283%29_0.pdf. The second best policy recommendation would be to allow the application of a special surcharge to all wholesale or retail sales in an amount sufficient to recoup the costs of complying with new EPA regulations at the NGS/Four Corners facilities, which would be retained by the facility operators. Either policy solution should be narrowly tailored to the specific NGS/Four Corners facilities to prevent expansion to other facilities, based on strict regulatory cost recovery criteria to prevent the possibility of "gold plating" or the financing of facilities expansion that could threaten the emergence of competition, as well as subject to a sunset provision to ensure that the special treatment of these facilities exists only during a transitional period in which capacity might be threatened by the closure or substitution of those facilities. *See* Exhibit 1 (pp. 4-6).

Question 9: Will retail electric competition impact reliability? Why or why not?

Answer: Market forces in competition will generate reliable electrical production equivalent or superior to regulated monopoly systems. Capacity growth has outstripped

economic growth in Pennsylvania and Texas. Because of the incentives provided by competition, innovation will arise with retailers offering lower rates or additional services in exchange for consumers adopting demand mitigation technologies and rate plans, such as the use of smart appliances and peak demand pricing. Moreover, regulators will have the power to establish demand mitigation policies to minimize non-essential consumption during supply shocks. *See* Exhibits 1 (p. 3) and 2 (pp. 3-4, 20).

Question 10: What are the issues relating to balancing area authorities, transmission planning, and control areas which must be addressed as part of a transition to retail electric competition?

Answer: Although Arizona can benefit from the available expertise in the rest of the country, setting up an RTO is technically complex. Currently in Arizona each of the three major utilities has their own "balancing authority" that manages electricity systems in their territory with the Arizona Independent Scheduling Administrator Association (AZISA, http://www.az-isa.org/) overseeing the totality of the grid. Because system operations clearly benefit from economies of scale, running three individual systems, each of which is tiny in size compared to the RTOs in Texas and Pennsylvania, is very costly. Current balancing authorities could be turned into their own RTOs. However, this would not take advantage of any available economies of scale in operating larger RTOs. For example, Arizona's largest utility, Arizona Public Service, only has about 9300 megawatts of capacity, while PJM (which includes Pennsylvania) has approximately 167,000 MWs of capacity, almost eighteen times larger. One possibility is to use the AZISA to act in the role of an RTO, at least for a short period of time. The

AZISA currently coordinates transmission access between the seven balancing authorities, as well as interstate shipments in and out of Arizona. Under such a plan, the AZISA would be responsible for scheduling and dispatching the transmission lines between the three systems of the incumbent utilities. Another possibility would be to expand the CAISO into Arizona. Expansions of RTOs are not uncommon. Where PJM once consisted of Delaware, the District of Columbia, Maryland, eastern Pennsylvania, and New Jersey, it has expanded into almost the entirety of Pennsylvania, as well as most of Virginia and West Virginia, and parts of North Carolina, Ohio, Indiana, Michigan and Illinois. The presence of economies of scale implies that expanding an RTO is relatively inexpensive once the RTO has been established. Expanding CAISO to Arizona would eliminate the current seam between Arizona and California. This in turn would encourage more building of generation facilities in Arizona, a tremendous growth opportunity for Arizona since building electricity generators is so much more difficult in California. All of the foregoing options may be viable means of managing the grid in a way that would support competitive restructuring. However, whichever option is selected, it is important to emphasize that stakeholder buy-in is critical. This is because any firm that does not wish to join an RTO can set up innumerable technological hurdles (real or not) that no regulator can effectively evaluate. Thus, setting up an Arizona RTO would require the cooperation of entities who may not desire such an organization to exist. Therefore, the best policy among the foregoing options should be determined after the Commission receives input from existing stakeholders as to the pros and cons of each alternative. *See* Exhibits 2 (pp. 10-12) and 3 (pp. 19-20).

Question 11: Among the states that have transitioned to retail electric competition, which model best promotes the public interest for Arizonans? Which model should be avoided?

Answer: Exhibits 1, 2 and 3 detail the reasons why Arizona should adopt the essential features of the Texas and Pennsylvania models and avoid the California approach.

Question 12: How have retail rates been affected in states that have implemented retail electric competition?

Answer: Empirical evidence shows that electricity restructuring reduces prices and costs. For the period 1970-2003, one major academic study found the higher the percentage of power produced by non-regulated generators in a state, the lower the prices paid by residential and industrial customers. Similarly, another study found the introduction of retail competition in a state is associated with lower prices for residential and industrial customers. Other studies found electricity plants in states have lower non-fuel expenses per megawatt generated compared to plants in states that have not restructured, and overall electricity restructuring has reduced retail prices by nine percent. Restructuring has also reduced price-margins in the electricity industry, implying cost reductions are being passed on to consumers. More specifically, retail prices in Pennsylvania were well above the U.S. average at the outset of restructuring in 1998. Over the last ten 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 and despite recent peaking above that standard, today Pennsylvania's average retail price of electricity matches that of the

U.S. Texas' average price of electricity is well below that of the U.S. despite peaking well above the U.S. average earlier in the decade when natural gas prices were spiking. Of course, price averages obscure the fact that a competitive market involves a range of available prices, some of which are far lower than the average price. Where competition prevails in Texas, pricing plans offer consumers electricity prices lower than the average price in Arizona—and even lower than the lowest state average in the nation (just under 7 cents per kilowatt hour for the lowest cost Texas plan versus approximately 11 cents per kilowatt hour in Arizona and just under 8 cents per kilowatt hour in Louisiana). *See* Exhibits 1 (pp. 2-4) and 2 (pp. 3-6).

Question 13: Is retail electric competition viable in Arizona in light of the Court of Appeals' decision in *Phelps Dodge Corp. v. Ariz. Elec. Power Coop.*, 207 Ariz. 95, 83 P.3d 573 (App. 2004)? Are there other legal impediments to the transition to and/or implementation of retail electric competition?

Answer: Retail competition is viable and there are no significant legal impediments to the transition to and/or implementation of retail electric competition. The Arizona Legislature fully authorized statewide competition in electrical markets in 1998, including within territories outside of the Arizona Corporation Commission's regulatory jurisdiction. That law is still effective, waiting to be triggered by appropriate ACC rulemaking and stakeholder coordination. Fortunately, the necessary rules for restructuring Arizona's electricity market can be designed to comply with the holding of *Phelps Dodge*.

Phelps Dodge struck down various rules issued by the ACC during its first restructuring effort; including: 1) rules that deemed market pricing "fair and reasonable" without taking into consideration the "fair value" of property owned by electricity service providers in the State of Arizona and without an actual exercise of discretion by the ACC in verifying the fairness and reasonableness of such pricing or effective consumer protections; 2) rules requiring the divestiture of generation assets held by utilities even if those assets were not used to compete against new entrants; and 3) rules relating to consumer protection and the prohibition of anti-competitive behavior that were issued without Attorney General review, as is required for non-ratemaking regulations. All of these specific rulings can be navigated with a carefully designed restructuring regulatory framework—especially since there is good reason to believe that subsequent case law has essentially overruled any interpretation of *Phelps Dodge Corp.* that the Arizona Corporation Commission lacks broad policy making authority in connection with its plenary ratemaking authority. *See Miller v. Arizona Corp. Com'n*, 227 Ariz. 21, 251 P.3d 400 (Ct. App. 2011).

First, transitioning to market competition as the primary mode of setting specific rates can be made consistent with *Phelps Dodge* because the court of appeals specifically affirmed that competitive pricing of electricity can take place within price ranges established by the Arizona Corporation Commission as "fair and reasonable," so long as the setting of the price boundaries for these ranges take into consideration all of the factors that must be considered in the ordinary ratemaking process. Among those ratemaking factors, perhaps the greatest barrier to competitive pricing would arise if an

excessive value were assigned to the fair value of the property owned by electricity service providers either for the recovery of post-reform investment costs or to provide compensation for so-called pre-reform stranded costs.

Fortunately, according to the court of appeals, the fair value of the property owned by electricity service providers within the State of Arizona can be assigned as little weight as the Commission decides in its discretion. With respect to post-reform investments, assigning no weight to the value of such property for purposes of setting the bounds of a competitive price range makes sense in a market in which there is no risk of confiscatory service requirements being imposed on electricity service providers. This is because generation capacity and service plans in an open and competitive market are based on consumer choices rather than regulatory mandates. Any issue of stranded cost recovery for property owned by electricity service providers as a result of past service mandates can be handled as a separate charge, if necessary.

However, it should be recalled that the 1998 effort to require competition in Arizona's electrical markets authorized various surcharges that have already largely compensated incumbent utilities for any reasonable measure of stranded costs. Notably, bondholders have been on notice since 1998 of Arizona's public policy of transitioning to open and competitive electrical markets. Accordingly, holders of bonds acquired since 1998 should not be regarded as having a viable Contracts Clause objection to, or Fifth Amendment claim for compensation arising from, regulatory reforms restructuring the electrical market for competition as somehow impairing incumbent utilities' contractual obligations to them, even with respect to the divestiture of assets. Indeed, it is doubtful

that any constitutional protection has ever existed to shield incumbent utilities or their bondholders from laws restructuring pervasively regulated electrical markets for competition. *Mitchell Arms, Inc. v. United States*, 7 F.3d 212, 216 (Fed.Cir.1993) (stating that an enforceable property interest "cannot arise in an area voluntarily entered into and one which, from the start, is subject to pervasive Government control") (emphasis omitted); *Minneapolis Taxi Owners Coalition, Inc. v. City of Minneapolis*, 572 F.3d 502 (8th Cir. 2009) (rejecting incumbent taxi association's claim of property right to be protected from competition); *Rogers Truck Line, Inc. v. United States*, 14 Cl. Ct. 108, 111 (1987) (same with respect to commercial-carrier licensee).

Further, any concern about the adequacy of consumer protection in a competitive market, such as concerns about service reliability, can be ameliorated by ensuring that new retail entrants post a reasonable bond to provide security for lost service. Arizona's constitutional rule against discriminatory rates for "like" services should not stand in the way of diverse service plans that are made available on equal terms to all qualifying consumers—just as it does not stand in the way of the diversity of service plans available in Arizona's similarly regulated telecommunications market.

Second, rules requiring divestiture of incumbent utility assets can be sustained under *Phelps Dodge* so long as the Commission builds an appropriate record that such divestiture is necessary for competitive retail pricing to arise. This should not be difficult even with respect to the divestiture of generation capacity that incumbents claim to use exclusively to generate sales outside of Arizona because energy markets are interconnected. First of all, because of the nature of the electricity grid in which

electrons flow according to Kirchoff's laws rather than where a supplier might wish, it is unclear how incumbents could project the electricity they generate in Arizona to other markets and avoid impacting pricing in Arizona. Any such price impact would have competitive implications in that any electricity generated in Arizona for any end use will, all other things being equal, increase supply on the grid and tend to reduce pricing in Arizona. Secondly, even if an incumbent utility does not use its generation capacity to compete directly in the Arizona electricity market perhaps by running a new transmission line from the generator to an out-state grid, any sales made out of state will still affect rates in Arizona and also subsidize the incumbent's participation in the Arizona retail market. This would undermine competitive entry in wholesale and retail markets, and hence competitive retail pricing, because it would allow incumbents to leverage market power previously accrued as a result of its past monopoly position.

Third, all rules issued in support of restructuring, which may only be debatably related to the Commission's ratemaking power, can be submitted to the Attorney General for his review prior to adoption. This would avoid any possible controversy over the necessity of such review.

<u>Question 14: Is retail electric competition compatible with the Commission's Renewable Energy Standard that requires Arizona's utilities serve at least 15% of their retail loads with renewable energy by 2025? (See AAC. R14-2-1801 et seq.)</u>

Answer: Not in its current form. However, there is a means of achieving the same policy goal more efficiently. In other states, restructuring of the electricity market has led to a regulatory environment in which each distribution entity is required to buy

permits from generators of renewable permits. If a renewable mandate continues to exist, Arizona should replace its current renewable program with a program that will require retail suppliers to purchase renewable credits equal to their required level. These credits would be purchased from free market providers who would have the proper incentives to generate renewable energy at the lowest possible cost. *See* Exhibit 2 (pp. 17-18). However, there are good policy reasons to abandon any renewable mandate, which are detailed in Exhibit 2 (pp. 22-28).

Question 15: Is retail electric competition compatible with the Commission's Energy Efficiency Standard that requires Arizona's electric utilities to achieve a 22% reduction in retail energy sales by consumption by 2020? (See AAC. R14-2-2401 et seq.)

Answer: There are ways to make this rule compatible with a restructured market, but it is not advisable to retain this rule because an efficient, competitive electricity market is not subject to the inefficiencies of the regulated monopoly market, which can lead to excess capacity and consumption. The price signals of an open and competitive market adequately incentivize the efficient consumption of electricity.

Question 16: How should the Commission address net metering rates in a competitive market?

Answer: In the absence of a rate regulated system, there is no reason for the Commission to dictate the price of electricity generated through net metering. Whatever the market competitively yields as the price of such electricity when it is injected into the grid, should be its price.

Question 17: What impact will retail electric competition have on resource planning?

Answer: Centralized resource planning would be largely restricted to operating, maintaining and expanding the grid, as the sole remaining rate regulated public utility. The constraints of the current grid and the costs of expanding it will continue to require planning when new generation and significant new loads are contemplated. Otherwise planning will be decentralized and determined by market players in developing their competitive strategies based on their available capital and niche knowledge.

Question 18: How will retail electric competition affect public power utilities, cooperatives and federal controlled transmission systems?

Answer: The 1998 legislation authorizing restructuring as a statewide public policy exempts a number of smaller cooperatives and special districts, but otherwise applies to all significant participants in Arizona's electricity markets. Restructuring Arizona's electricity markets would break up the current monolithic system where customers deal directly with monopoly utilities who provide and control everything from the generator to electrical wires to transformers to meters. Generators will constitute a wholesale electricity market. Retailers, as independent entities, will purchase electricity for resale to consumers. The local and regional electric grid will continue as one or more integrated regulated utilities controlled by one or more "balancing authorities" who schedule generation to instantly meet demand. The role of exempted cooperatives and special districts would change in that they would have many more transactional opportunities well beyond their service areas.

The grid will be operated as a utility, so the ACC will continue to play a critical regulatory role. The ACC, along with load balancing organizations, will help determine where it is physically best for generators to connect, whether the local grid has the necessary capacity, and what generators will have to pay in order to physically access the grid, which will continue to be privately owned. To the extent that the grid needs upgrading and expansion, the ACC and the load balancing organization(s) will be in the best position to determine how costs should best be shared where the greatest needs present themselves. It will also be the ACC's job to aid in integrating balancing authorities as the need arises. *See* Exhibits 1 (p. 6), 2 (pp. 10-11), and 3 (pp. 27-28).

RESPECTFULLY SUBMITTED this 15th day of July, 2013.

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Each of the undersigned declare under penalty of perjury under 28 U.S.C. § 1746(2), the laws of the United States and of the State of Arizona, that the foregoing is true and correct to the best of my knowledge, information and belief.

Executed this July 11, 2013.

Roy Miller

Byron Schlomach, Ph.D.
Goldwater Institute Director of the Center for Economic Prosperity

NOTICE OF FILING AND PROOF OF SERVICE

ORIGINAL and 13 copies, including exhibits, were filed this 15th day of July, 2013 with:

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Arizona Corporation Commission
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ADDITIONALLY, one copy of the foregoing, including exhibits, was served on each of the following docket service list entities on July 15, 2013, at or before 5 p.m., by U.S. Mail, sufficient postage prepaid, at the specified address:

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Under penalties of perjury as provided by law, I affirm that I caused to be placed for filing and service the instant document together with referenced exhibits as aforesaid.

Nicholas C. Dranias

Exhibit #1

POLICY *brief*

Goldwater Institute

No. 260 | July 12, 2013

A Time for Choosing: Why Choice and Competition in Electricity are Right for Arizona

By Byron Schlomach, Ph.D., Director of Center for Economic Prosperity

Because Arizona's geographical position is economically disadvantageous, the state must adopt the very best policies in every area to maintain a strong competitive position.[1] After 20 years of waiting, it's time for Arizonans to enjoy the benefits of electric power competition.

Restructuring Arizona's electricity markets would break up the current monolithic system, in which customers deal directly with monopoly utilities that provide and control everything from the generator and electrical wires to transformers and meters. Generators will constitute a wholesale electricity market, selling to each other and retailers. Retailers, as independent entities, will purchase electricity for resale to consumers. The local and regional electric grid will continue as one or more integrated regulated utilities controlled by one or more "balancing authorities" that schedule generation to instantly meet demand. In short, restructuring is choice and competition, not deregulation.

Arizona was once ahead of the electric restructuring curve when the Arizona Corporation Commission (ACC) passed rules to restructure in 1996 and the legislature gave further statutory clarification in 1998.[2] Removable legal roadblocks have stymied progress for a decade, but these can be addressed.[3] Meanwhile, states like Pennsylvania and Texas have demonstrated that California's negative experience in transitioning to competitive electricity markets can be avoided. These states also attest to the benefits of restructuring, including lower rates, more efficient delivery, and innovation. Restructuring works because choice and competition work.

EXHIBIT 1

Choice and Competition Benefit the Economy, Monopoly Hurts

The main benefits of restructuring electricity markets are lower electricity prices, supply efficiently meeting demand, innovation, and cost savings. These benefits lead to sustainable economic growth. By contrast, economists have long shown that monopolies result in inefficiency, little innovation, high prices and low supply.

Choice and Competition Mean Lower Electricity Prices

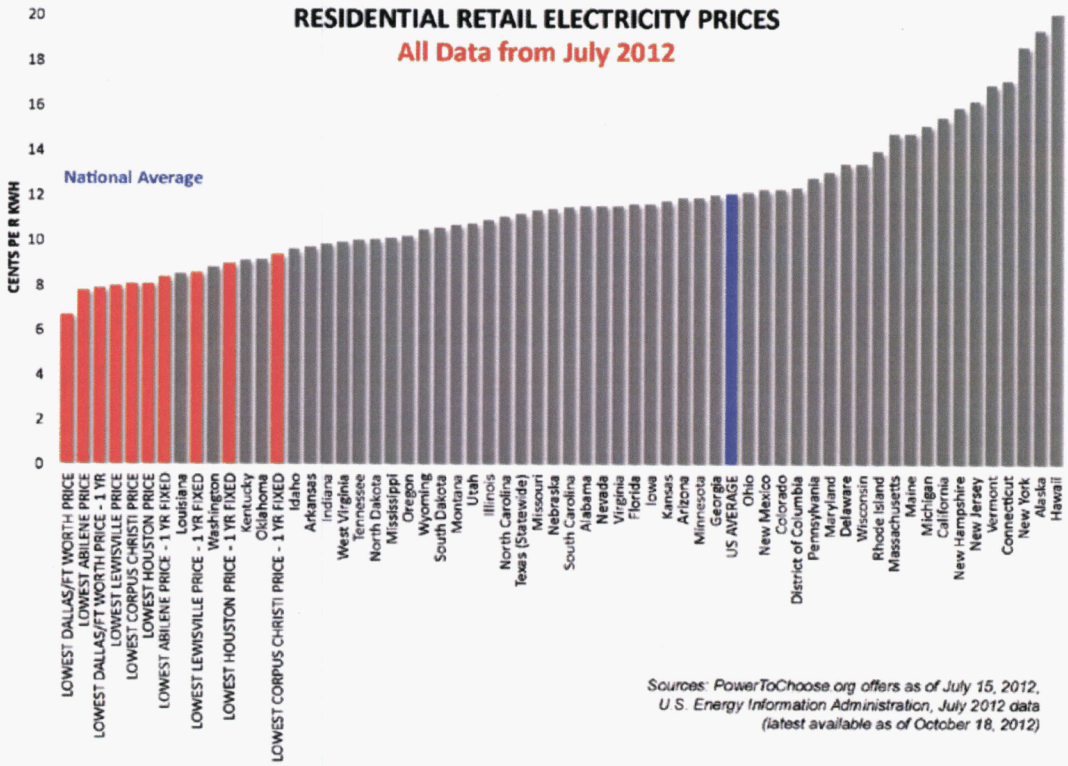
The federal Energy Policy Act of 1992, which gave the Federal Energy Regulatory Commission the authority to introduce wholesale market electric competition, was passed partly in response to rising electricity prices and supply shortages in previous decades. Monopoly utilities routinely failed to respond to new technologies and lower prices of some kinds of energy, particularly natural gas. Their operations were inefficient and relatively inflexible. As a result, during the 1970s and 1980s, regulated electricity prices rose by 60 percent on top of inflation. Meanwhile, deregulation in natural gas, telecommunications, airlines, trucking, and railroads reduced prices in those industries.[4]

In a restructured electricity market, reasonable prices will be ensured through competition. A source of competition will be new entrants into the generation and retail markets, which will see economic opportunities not currently open to them due to regulation.

In a restructured electricity market, reasonable prices will be ensured through competition. A source of competition will be new entrants into the generation and retail markets, which will see economic opportunities not currently open to them due to regulation. Out of competitive necessity, generators will seek the most efficient and least cost methods for generating electricity. Generators will even trade with each other to reduce risk and obtain the most profitable (least cost) deals, often learning from each other to achieve greater efficiencies. It is even possible to contract with suppliers from other major grids due to the presence of extremely high voltage direct current lines that bridge the grids.

As shown in Figure 1, where competition prevails in Texas, pricing plans offer consumers electricity prices lower than the average price in Arizona—and even lower than the lowest state average in the nation. This is just under 7 cents per kilowatt hour for the lowest cost Texas plan versus approximately 11 cents per kilowatt hour in Arizona and just under 8 cents per kilowatt hour in Louisiana.

Figure 1: Lowest Texas Competitive Electricity Rates Compared to National and State Averages[5]



There is no evidence competition has done anything to discourage the expansion of generation capacity and actual electricity production. Evidence points to the opposite.

Choice and Competition Mean Increased Capacity

There is no evidence competition has done anything to discourage the expansion of generation capacity and actual electricity production. Evidence points to the opposite. From 1998 to 2010, electric generation capacity in Texas grew 45 percent, outstripping the state's 39 percent growth in GDP by 6 percentage points. Over the same time period, restructured Pennsylvania saw its generation capacity increase 9 points faster than its GDP growth rate.

Choice and Competition Lead to Cost Savings—Even in Nuclear Power

One study from Pennsylvania conservatively estimates that improved nuclear plant performance due to restructuring saves Pennsylvania electricity consumers more than $120 million. Due to Pennsylvania's restructured system, it has access to a larger regional

market, improving plant operations by allowing shutdowns for maintenance to occur without compromising grid reliability.[6]

Choice and Competition Support Innovation

Shopping for electricity in Texas's competitive electricity markets is like shopping for cell phone plans. Texas consumers enjoy innovative pricing plans. One retailer offers a $250 restaurant gift card to new customers.[7] Others offer guaranteed rate plans of one- and two-year duration as well as plans for wind-only power, and variable rate plans suitable for demand management. Some retail electric providers offer discounts for persuading others to sign up.[8] Generation innovations that can be expected in a restructured market include small megawatt micro generators, as well as micro-grids.

Choice and Competition Encourage Efficiency in Capacity

Shopping for electricity in Texas's competitive electricity markets is like shopping for cell phone plans. Texas consumers enjoy innovative pricing plans.

Rather than building excess electricity generation capacity according to hypothetical maximum demand that leaves some generation capacity idle most of the time, demand will be mitigated by market means.[9] Commercial and industrial customers can financially benefit from making demand response agreements to reduce electricity usage during peak demand periods. Devices can turn off unessential loads during peak demand periods and electricity retailers can create pricing plans to incentivize individuals willing to do so to install such devices.[10] Demand reduction can be substituted for capacity investment through adoption of peak-load, real-time pricing, which customers could choose with smart meters already being installed in Arizona.[11]

Choice and Competition Can Accommodate the EPA Threat to NGS/Four Corners

If the uncertainty and burdens of new EPA regulations threaten the viability of the Navajo Generation Station (NGS) and Four Corners facilities in such a way as to result in a disorderly and dramatic reduction in generation capacity during restructuring, then special consideration should be given to defraying those uncertainties and burdens. The best policy recommendation would be to enact a regulatory tax credit at the federal level (or less optimally the state level) that would allow for the costs of new EPA regulations to be reimbursed through corresponding tax credits to the facility operators.[12] The second best policy recommendation would be to allow the application of a special surcharge to all wholesale or retail sales in an amount sufficient to recoup the costs of complying with new EPA regulations at the NGS/Four Corners facilities, which would be retained by the facility operators. Either policy solution should be narrowly tailored to the specific NGS/Four Corners facilities to prevent expansion to other facilities and based on strict regulatory cost recovery criteria to prevent the possibility of "gold plating" or the financing

of facilities expansion that could threaten the emergence of competition. They should also be subject to a sunset provision to ensure that the special treatment of these facilities exists only during a transitional period in which capacity might be threatened by the closure or substitution of those facilities.

Choice and Competition Will Make Sure Retailers Are Honest and Reliable

Consumers can, should, and will discipline the retail market by having available to them a variety of suppliers and retail electricity plans from which to choose. Just as there is information through *Consumer Reports*, the Better Business Bureau, and AngiesList.com about sellers and products, similar information will arise in a competitive electricity market.[13] Government should resist the urge to impose regulation in the retail and generation electric markets beyond bonding requirements, which are more consistent with flexible markets than more intrusive and arbitrary licensing regulations.

Choice and Competition Will Protect Customers from Retailer Insolvency

Restructured states, on a service area basis, designate a "Provider of Last Resort" in cases where consumers lose their electric retailer due to retailer departure or when consumers refuse to make a choice of retailer. Providers of last resort are chosen by a state regulator, such as the ACC, based on retailer financial health. Providers of last resort are allowed to charge relatively high electricity rates, due to the risk they take on, and are obligated to inform consumers that they have other choices of electric rate plans and retailers.[14] As of August 2012, there were 114 different retail electric providers in Texas offering multiple plans. Customers in restructured electric markets have many alternatives.[15]

Restructured states, on a service area basis, designate a "Provider of Last Resort" in cases where consumers lose their electric retailer due to retailer departure or when consumers refuse to make a choice of retailer.

Choice and Competition Work Even When Some Consumers Don't Choose

Electricity consumers who do not choose an electricity provider receive reliable electricity service from their respective providers of last resort. Texas and Pennsylvania, the two states farthest along in electric restructuring, both have designated retail electric providers once associated with monopoly utilities as providers of last resort. In Pennsylvania, designated providers of last resort were associated with incumbent (pre-existing) utilities. Consequently, many people simply stayed with their original provider, since pre-existing utilities divide their businesses into generation, retail, and transmission components. Texas has a tendency to also use incumbent companies, but consumers are notified by mail and by automated phone calls that they may choose rate plans from a number of companies. The state also provides a website consumers may access for company and pricing information.[16]

Electricity has been a lot like schools for a very long time, with one's electric company, like one's school, determined by one's address and with no active shopping on the part of the consumer. As a result, there will have to be some effort to educate consumers. Although choice might start off slowly, people learn. New retail electric providers will have every incentive to provide information. Incumbent companies will have an incentive to differentiate themselves. It might take some time and patience, but electric consumers will learn how to shop and how to separate reliable companies from the unreliable ones.

Choice and Competition are not Deregulation

The grid will be operated as a utility, so the ACC will continue to play a critical regulatory role. The ACC, along with load balancing organizations, will help determine where it is physically best for generators to connect, whether the local grid has the necessary capacity, and what generators will have to pay in order to physically access the grid, which will continue to be privately owned. To the extent that the grid needs upgrading and expansion, the ACC and the load balancing organization(s) will be in the best position to determine how costs should best be shared where the greatest needs present themselves. It will also be the ACC's job to aid in integrating balancing authorities as the need and desire arises. These authorities can be integrated into a single Regional Transmission Organization (RTO). The existing Arizona Independent Scheduling Administrator Association (AZISA) could become the state's RTO or Arizona could join with other states to form an RTO with a wider region.

Electricity has been a lot like schools for a very long time, with one's electric company, like one's school, determined by one's address and with no active shopping on the part of the consumer.

Conclusion

Highly regulated systems pile risk on consumers, hiding the cost through hidden mandates and preventing those in the best position to mitigate risk (namely, the providers) from bearing its cost through guaranteed rates of return. As has been demonstrated, Arizonans can enjoy innovation, relatively low electricity prices, reliability and efficiency, all producing greater prosperity, with restructured electricity markets that ultimately produce fairer outcomes for all.

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8. For more examples, see http://www.texaselectricityproviders.com/stream-energy-texas/Texas/W/Wichita-Falls/, https://www.championenergyservices.com/register/displayRates.asp, http://www.directenergy.com/en/texas/electricity-oncor-current-pricing.aspx, and http://maketheswitchusa.com/?gclid=CKf0sbWWgrgCFSzhQgod4wgANQ.

9. Johnston and Kiesling, *Turning on the Lights 2011*, 6.

10. For an example of such innovation with respect to lighting, see http://www.sciencedaily.com/videos/2007/0506-saving_electricity_and_saving_money.htm

11. In 2012, Texas was the only region in which the reserve capacity target, at 14 percent more generation capacity than estimated maximum demand, was not met or exceeded. Despite significant capacity growth, Texas fell short by one percentage point. However, this temporary one percentage point shortage in reserve capacity was not a market failure. It is to be expected that an efficient competitive market would have a different level of reserve capacity than an inefficient rate-regulated monopoly. The capacity growth in Texas' fully restructured market has been responsive to actual and anticipated consumer demand, rather than to regulatory mandates that promise incumbent utilities the recovery of costs and a reasonable rate of return. However, even if reserve capacity targets established by regulators were somehow the correct measure of reserve capacity for a competitive market, the solution for a temporary inadequacy in reserve capacity is not subsidies to generators or less competition and choice. Regulators of the grid should instead reach arrangements with non-essential consumers of electricity to

reduce their demand in the event of supply shocks. For example, in Pennsylvania, the Regional Transmission Organization (RTO) recently negotiated an arrangement with Pennsylvania State University to reduce its consumption of electricity in the event of excess electricity demand. Likewise, regulators should encourage retailers to compete for consumers by offering insurance to cover power losses in exchange for consumers adopting "smart appliances" that cease drawing electricity from the grid during supply shocks or excessive demand. Lastly, regulators should do everything they can to minimize government distortion of the free market. Because of their relatively unreliable nature, excessive use of wind and solar power, rather than conventional electrical generation, can contribute to a loss of generation capacity when needed.

12. Nick Dranias and Byron Schlomach, *The Missing Reform: Regulatory Tax Credits* (Phoenix, AZ: Goldwater Institute Policy Brief No. 11-06, November 9, 2011), http://goldwaterinstitute.org/sites/default/files/gb-Regulatory%20paper%20%283%29_0.pdf.

13. See http://www.powertochoose.org/, http://www.texaselectricityratings.com/, http://www.electricitycompaniestexas.com/, and http://maketheswitchusa.com/?gclid=CJiV8p6tkbgCFQdyQgodjQgAGQ.

14. Pennsylvania http://www.powerscorecard.org/state_issues.cfm?state_cd=PA Texas http://www.puc.texas.gov/consumer/electricity/polr.aspx

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The Goldwater Institute

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Exhibit #2

POLICY *report*

Goldwater Institute

No. 259 | July 12, 2013

Moving Forward: A Road Map for Choice and Competition in Arizona's Electricity Markets

By Andrew Kleit, Ph.D., and Nick Dranias, J.D.[1], Addendum by Byron Schlomach, Ph.D.

EXECUTIVE SUMMARY

Choice and competition can drive Arizona's electricity market to produce more power at a lower cost—with greater economic efficiency propelling greater economic growth and job creation. Since restructuring their electricity markets for choice and competition, Pennsylvania and Texas have seen their capacity increase nearly 25 percent and 45 percent respectively. Texas has seen prices drop 13 percent below the national average. Texans choose among numerous competitive electricity retailers and plans, much like Arizonans choose from multiple cell phone service companies and plans. These experiences are not isolated—countries around the world, including the United Kingdom, New Zealand, Canada and Chile, have similarly restructured their markets for choice and competition, and have similarly experienced greater capacity and lower prices as a result.

That does not mean, however, that restructuring for choice and competition is an easy or instantaneous process. It must be done right. Fortunately, competitive electrical markets in the United States and around the world are now mature enough to chart out a road map for Arizona to follow. This article provides that road map with specific recommendations tailored to Arizona's unique market conditions to ensure the reform is a success.

In essence, the Arizona Corporation Commission needs to restructure Arizona's electricity market for choice and competition in three phases. First, the ACC should separate existing utilities from their generation, transmission, and distribution capacity to prevent them from abusing the monopoly power they have accrued under the existing regulatory system. At the same time, a system operator needs to be empowered to neutrally balance the load on the grid that will be created by an influx of competitive energy producers. Second, the ACC should take action to create competitive generation markets in which energy producers can freely enter, exit and compete for business. Third, customers should be empowered by the ACC with the freedom to choose among competitive retailers of electricity. If these steps are taken in the right order, Arizona's electricity market will finally move forward towards greater capacity, choice, competition, innovation and lower prices—spurring new economic growth and job opportunities for Arizonans.

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EXHIBIT 2

Restructuring for Competition Leads to More Capacity, Lower Prices and More Choice

In a nutshell, restructuring electrical markets means adopting regulatory reforms that eventually allow for free and open competition in the generation and retailing of electricity. These reforms also give firms the freedom to innovate and consumers the opportunity to support such innovation. There have been a number of studies that address the impacts of restructuring on producers and consumers. They confirm what we expect to see when monopoly is eliminated and free market competition is increased – decreased prices and supply increases driven by economic incentives.

One of the first examples of electricity restructuring was the 1990 privatization of the electricity industry in England and Wales. 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 offered to supply 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.

One of the first examples of electricity restructuring was the 1990 privatization of the electricity industry in England and Wales.

Several changes in the organization and regulation of the England and Wales 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. Between 1998 and 2010, England and Wales saw a capacity increase of 33.2 percent.

Other jurisdictions across the world have also engaged in electricity restructuring with similar experiences, including Alberta, Australia, Chile, and New Zealand. Each showed significant increases in electricity capacity.[2] From 1998 to 2012 electricity generating capacity in Alberta rose slightly less than 28 percent. From 1998 to 2010, Australia's capacity rose nearly 55 percent, Chile's rose almost 115 percent, and New Zealand's increased 22.5 percent despite slow economic growth.

Similarly, a number of states and regions in the U.S. began restructuring their electricity industries following British restructuring. In Pennsylvania, electricity restructuring began in July 1998. In 1999 the Texas legislature passed Senate Bill 7, which called for the development of 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 affiliate retail provider of the incumbent utility that operates the local distribution network. Customers have the option of staying with their retail provider affiliated with the incumbent distributor, or switching to a non-affiliated competitive REP. One of the keys to successful retail competition is how the state commission regulates pricing by incumbent distributors/affiliated retail providers during the transition to retail competition. Texas established a "price-to-beat" mechanism that set a regulated rate for the affiliated retailer of each incumbent utility. The price-to-beat rate established a price ceiling for an affiliated retailer of an incumbent utility that remained in effect during a specified transition period.[3] The Texas price-to-beat was designed so that customers would find it economically advantageous to switch to a competitive supplier.

As exemplified by the experiences of Texas and Pennsylvania, electricity restructuring has provided strong incentives for investment in new generation facilities. From 1998 to 2010, Pennsylvania's generation capacity grew almost 25 percent while its GDP increased only 16 percent.[4] Texas saw its capacity increase 45 percent, outstripping the state's 39 percent growth in GDP by 6 percentage points. New York, which has not fully restructured, saw its generation increase at half the rate of its GDP growth. Arizona, however, did see a big capacity increase, far outstripping its GDP growth, but much of that capacity is feeding California.[5] While total Arizona generation (electricity supply) increased 36 percent, exports increased 56 percent from 1998 to 2010.[6] In short, the evidence is clear that restructured markets act to encourage the expansion of generation capacity and actual production.

As exemplified by the experiences of Texas and Pennsylvania, electricity restructuring has provided strong incentives for investment in new generation facilities.

Additionally, it is important to underscore that the capacity growth in Texas' fully restructured market has been responsive to actual and anticipated consumer demand, rather than to regulatory mandates that promise incumbent utilities the recovery of costs and a reasonable rate of return. Texas' increased capacity thus reflects a more efficient allocation of resources than can be found in a regulated monopoly environment, in which central planning mandates the construction of costly excessive capacity and a captured consumer base enables exploitation of ratepayers through "gold-plating"—or the tendency of regulated monopolies to overbuild infrastructure and capacity because of their legal right to recover their costs plus a reasonable rate of return from ratepayers.[7] Although there have been recent controversies in Texas about the low cost of natural gas keeping prices too low to incentivize the construction of sufficient reserve capacity, it is to be expected that an efficient competitive market would have a different level of reserve capacity than an inefficient rate-regulated monopoly.

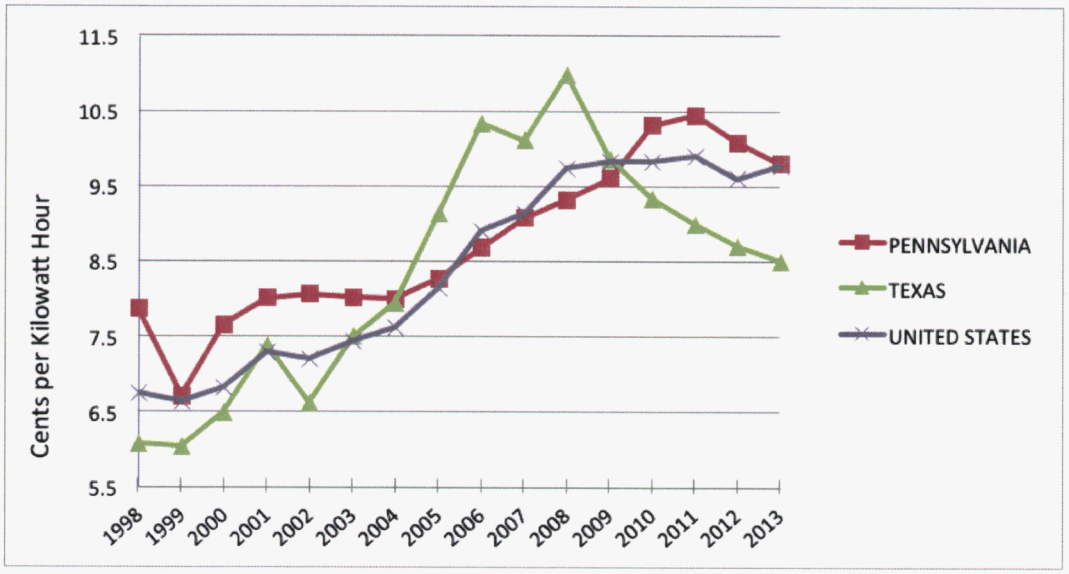
Empirical evidence shows that electricity restructuring reduces prices and costs. Economist Paul Joskow, for example, examined the impact of restructuring on prices for residential customers and industrial customers, using state-level data for the period 1970-2003. Joskow found that the higher the percentage of power produced by non-regulated generators in a state, the lower the prices paid by residential and industrial

customers. Similarly, the introduction of retail competition in a state is associated with lower prices for residential and industrial customers. Catherine Wolfram reports that electricity plants in restructured states have lower non-fuel expenses per megawatt generated, compared to plants in states that have not restructured.[9] Dean and Savage find that electricity restructuring has reduced retail prices by nine percent.[10] Swadley and Yucel find that restructuring has reduced price margins in the electricity industry, implying cost reductions are being passed on to consumers.[11]

Figure 1 shows average retail prices (adjusted for inflation) in Pennsylvania, Texas, and 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 ten 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. Despite recent peaking above that standard, today Pennsylvania's average retail price of electricity matches that of the U.S. Texas' average price of electricity is well below that of the U.S., despite peaking well above the U.S. average earlier in the decade when natural gas prices were spiking.

The introduction of retail competition in a state is associated with lower prices for residential and industrial customers.

Figure 1: Average Retail Prices (1998-2013)



(Price in Cents per Kilowatt Hour)

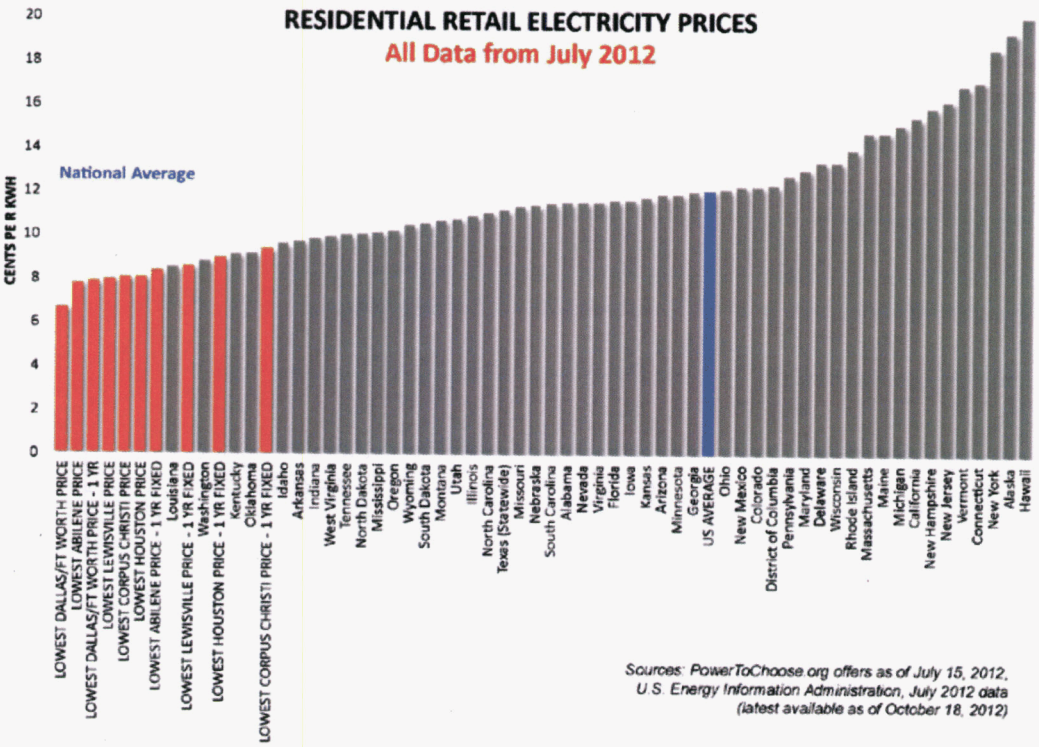
Source: U.S. Energy Information Administration[12]

Of course, price averages obscure the fact that a competitive market involves a range of available prices, some of which are far lower than the average price. In Texas, for example, bargain shoppers can find electricity rates far below the average rate as shown in Figures 2 and 3.

Figure 2: Difference between 2001 Texas Regulated Rate and Lowest Offers in 2013

Sources: Public Utility Commission of Texas and Bill Peacock, Texas Public Policy Foundation

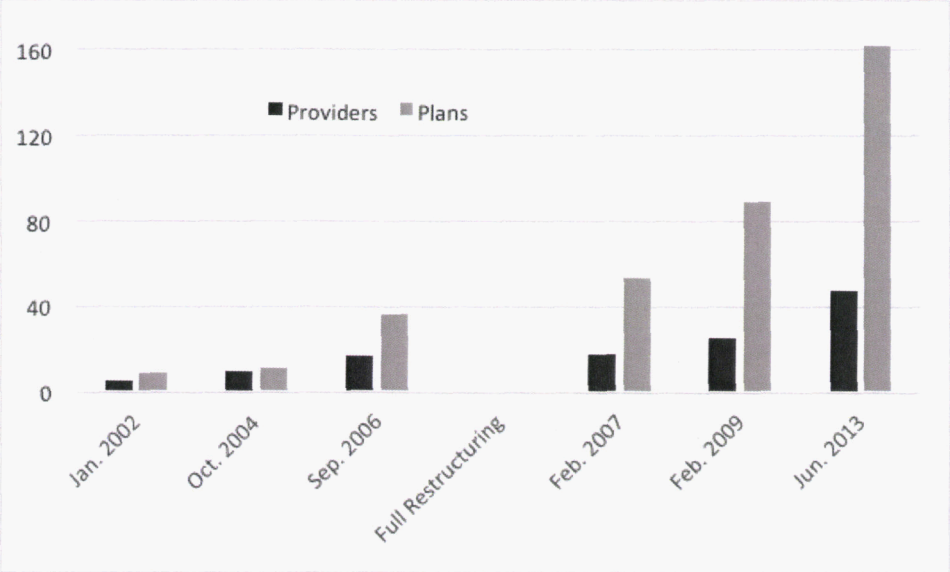
Figure 3: Lowest Texas Competitive Electricity Rates Compared to National and State Averages[13]



Price averages obscure the fact that a competitive market involves a range of available prices, some of which are far lower than the average price.

Especially in Texas, the average price decreases and increased capacity have translated into greater consumer choices among electricity providers as shown in Figures 4 and 5 below.

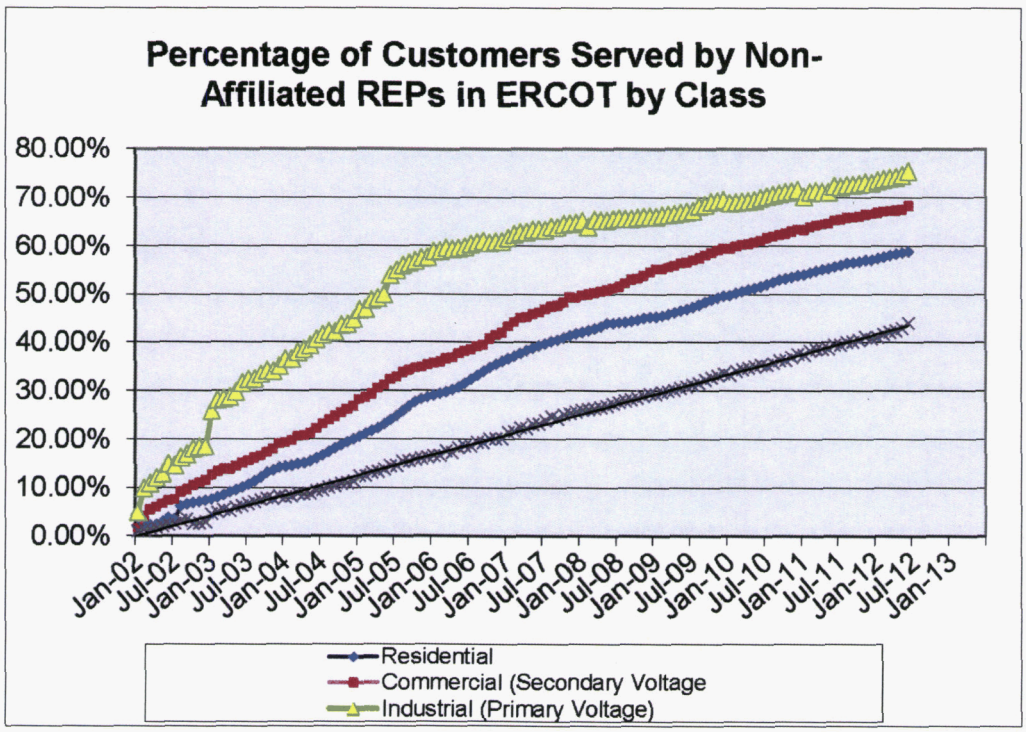
Figure 4: Number of Competing Electricity Retailers and Plans in Texas (Averaged Across Major Distribution Areas)



Sources: Public Utility Commission of Texas and Bill Peacock, Texas Public Policy Foundation

Especially in Texas, the average price decreases and increased capacity have translated into greater consumer choices among electricity providers

Figure 5: Percentage of Consumers Choosing Competitive Retailers and Plans in Texas[14]



The Texas-Pennsylvania Road Map to Restructuring Arizona for Electrical Competition

Successful electricity market restructuring in other nations and in states like Pennsylvania and Texas has brought consensus regarding crucial elements that need to be in place for restructuring to work effectively.[15] This involves understanding how the current system works to recognize where the major roadblocks to competitive enterprise and efficient markets lie. As already discussed in the Goldwater Institute's previous report by Andrew Kleit and Professor Stanley Reynolds,[16] the electricity system can be divided into generation, transmission, and distribution. High voltage transmission lines take power from generators to load centers. From there, the power is "stepped down" into low voltage distribution lines and taken to consumers. Transmission is most easily subject to economies of scale and natural monopoly issues, so it appears to be most appropriately regulated as such. While transmission may have some competitive aspects, it appears appropriate for rate of return regulation.

In contrast, the generation of electricity can be done at many different sites (as occurs in Arizona and elsewhere) and therefore is consistent with the operation of competitive markets. Retail electricity sales are also appropriate for competitive markets. Indeed, both these areas promise increased efficiency and lower cost through competition.

Creating Efficient and Effective Electricity Markets for Arizona

It should not be forgotten that the Arizona Legislature fully authorized statewide competition in electrical markets in 1998, including within territories outside of the Arizona Corporation Commission's regulatory jurisdiction. That law is still effective, waiting to be triggered by appropriate ACC rulemaking and stakeholder coordination.[17]

The Three Phases and Nine Steps of the Road Map for Choice and Competition

Phase 1: Create the Framework for Choice and Competition through Vertical Restructuring of Lines of Production

- **Step 1:** Create an independent non-profit organization to support network operations and transmission management and investment.
- **Step 2:** Vertically separate utilities.

Phase 2: Release the Forces of Competition in Electricity Generation through Horizontal Restructuring

- **Step 3:** Create a transparent wholesale spot market and development of institutions to provide ancillary services.
- **Step 4:** Set up a system that allows wholesale suppliers and buyers to mitigate the financial risk of moving power across the grid.
- **Step 5:** Allow free entry into the generation sector to increase supply and competition in the wholesale market for electricity.
- **Step 6:** Engage in horizontal divestiture in electricity generation to prevent the exercise of market power in the sale of generation.
- **Step 7:** Replace existing renewable mandates with a market for renewable generation and distributed energy.

Phase 3: Give the Electricity Customer Competitive Retail Choices

- **Step 8:** Allow free entry of retail service providers that can compete for customers' generation needs against incumbent local distributors.
- **Step 9:** Establish real time (dynamic) pricing.

However, this legislative effort at bringing choice and competition to Arizona's electricity markets suffered a setback when key components of the reform promulgated by the ACC were struck down by the Arizona Court of Appeals in *Phelps Dodge Corp. v. Ariz. Elec. Power Coop.*[18] Although there is reason to challenge the holding of *Phelps Dodge* as disregarding earlier Arizona Supreme Court precedent, as discussed in the Goldwater Institute's previous report on restructuring, it is not necessary to engage in such confrontation to bring choice and competition to Arizona's electricity markets. This is because the necessary rules for restructuring Arizona's electricity market can also be designed to comply with the holding of *Phelps Dodge.*

Phelps Dodge struck down various rules issued by the ACC during its first restructuring effort, including: 1) rules that deemed market pricing "fair and reasonable" without taking into consideration the "fair value" of property owned by electricity service providers in the State of Arizona, and without an actual exercise of discretion by the ACC in verifying the fairness and reasonableness of such pricing or effective consumer protections; 2) rules requiring the divestiture of generation assets held by utilities, even if those assets were not used to compete against new entrants; and 3) rules relating to consumer protection and the prohibition of anti-competitive behavior that were issued without Attorney General review, as is required for non-ratemaking regulations. All of these specific rulings can be navigated with a carefully designed restructuring regulatory framework—especially since there is good reason to believe that subsequent case law has essentially overruled any interpretation of *Phelps Dodge Corp.* that the Arizona Corporation Commission lacks broad policymaking authority in connection with its plenary ratemaking authority.[19]

Among those ratemaking factors, perhaps the greatest barrier to competitive pricing would arise if an excessive value were assigned to the fair value of the property owned by electricity service providers, either for the recovery of post-reform investment costs or to provide compensation for so-called pre-reform stranded costs.

First, transitioning to market competition as the primary mode of setting specific rates can be made consistent with *Phelps Dodge.* This is because the court of appeals specifically affirmed that competitive pricing of electricity can take place within price ranges established by the Arizona Corporation Commission as "fair and reasonable," so long as the setting of the price boundaries for these ranges take into consideration all of the factors that must be considered in the ordinary ratemaking process. Among those ratemaking factors, perhaps the greatest barrier to competitive pricing would arise if an excessive value were assigned to the fair value of the property owned by electricity service providers, either for the recovery of post-reform investment costs or to provide compensation for so-called pre-reform stranded costs. Fortunately, according to the court of appeals, the fair value of the property owned by electricity service providers within the State of Arizona can be assigned as little weight as the Commission decides in its discretion.

With respect to post-reform investments, assigning no weight to the value of such property for purposes of setting the bounds of a competitive price range makes sense in a market in which there is no risk of confiscatory service requirements being imposed on providers. This is because generation capacity and service plans in an open and competitive market are based on consumer choices rather than regulatory mandates. Any

issue of stranded cost recovery for property owned by electricity service providers as a result of past service mandates can be handled as a separate charge, if necessary. However, it should be recalled that the 1998 effort to require competition in Arizona's electrical markets authorized various surcharges that have already largely compensated incumbent utilities for any reasonable measure of stranded costs.[20]

Further, any concern about the adequacy of consumer protection in a competitive market, such as concerns about service reliability, can be ameliorated by ensuring that new retail entrants post a reasonable bond to provide security for lost service. Arizona's constitutional rule against discriminatory rates for "like" services should not stand in the way of diverse service plans that are made available on equal terms to all qualifying consumers—just as it does not stand in the way of the diversity of service plans available in Arizona's similarly regulated telecommunications market.

Second, rules requiring divestiture of incumbent utility assets can be sustained under *Phelps Dodge* so long as the Commission builds an appropriate record that such divestiture is necessary for competitive retail pricing to arise. This should not be difficult, even with respect to the divestiture of generation capacity that incumbents claim to use exclusively to generate sales outside of Arizona because energy markets are interconnected. First of all, because of the nature of the electricity grid, in which electrons flow according to Kirchoff's laws rather than where a supplier might wish, it is unclear how incumbents could project the electricity they generate in Arizona to other markets and avoid impacting pricing in Arizona. Any such price impact would have competitive implications in that any electricity generated in Arizona for any end use will, all other things being equal, increase supply on the grid and tend to reduce pricing in Arizona. Secondly, even if an incumbent utility does not use its generation capacity to compete directly in the Arizona electricity market, perhaps by running a new transmission line from the generator to an out-state grid, any sales made out of state will still affect rates in Arizona and also subsidize the incumbent's participation in the Arizona retail market. This would undermine competitive entry in wholesale and retail markets, and hence competitive retail pricing, because it would allow incumbents to leverage market power previously accrued as a result of their past monopoly position.

Any concern about the adequacy of consumer protection in a competitive market, such as concerns about service reliability, can be ameliorated by ensuring that new retail entrants post a reasonable bond to provide security for lost service.

Third, all rules issued in support of restructuring, which may only be debatably related to the Commission's ratemaking power, can be submitted to the Attorney General for his review. This would avoid any possible controversy over the necessity of such review.

Within these constraints, the rulemaking process for implementing restructured electricity markets in Arizona should involve three important phases. For the first phase, the Arizona electricity industry must be reorganized along vertical lines of production to insure that access to critical infrastructure is not biased against new competitors. In the second phase, competitive generation markets for power are created. In the third

phase, consumers are given access to competitive retail markets that will allow innovative products to occur. These three phases involve nine specific steps that should be taken in the order specified below.

Phase 1: Create the Framework for Choice and Competition through Vertical Restructuring of Lines of Production

The rapidity with which restructuring arrives at retail competition should largely be a function of the establishment of a reliable system for balancing electrical loads on the grid and the robustness of the wholesale electricity market. Fortunately, Arizona's wholesale electricity market is already robust in the sense that both incumbent utilities and merchant generators engage in a significant number of competitive wholesale electricity transactions. The greater challenge for Arizona lies in the establishment of an unbiased system for balancing electrical loads on the grid and in ensuring that existing incumbent utilities do not wield their previous monopoly power to preempt new entrants and the evolution of competitive markets. The first phase of restructuring thus focuses on creating an independent nonprofit organization to balance electrical loads on the grid and unbundling the generation, transmission and distribution segments of the market.

The rapidity with which restructuring arrives at retail competition should largely be a function of the establishment of a reliable system for balancing electrical loads on the grid and the robustness of the wholesale electricity market.

Step 1: Create an independent non-profit organization to support network operations and transmission management and investment.

All electricity delivery systems require system operation to balance load. In restructured systems, certain organizations—typically referred to as either an Independent System Operator (ISO) or Regional Transmission Organization (RTO)—have the responsibilities to manage network operations, schedule generation to meet demand, and maintain frequency and voltage so that the lights stay on. The system operator also controls generation at each generation plant, which can respond to dispatch orders, as well as transmission lines.

It is important that RTOs are independent of any particular generation or transmission company. Otherwise, they would have incentives to favor that firm's transmission or generation assets. This would reduce the gains from restructuring through competition.

Across the United States and around the world, independent not-for-profit RTOs run electricity systems. In the U.S. the relevant RTOs are ISO-NE (for the New England states), PJM (for the Mid-Atlantic States,), the Midwest ISO (for Midwestern states), ERCOT (for most of Texas) and CAISO (for California). For restructuring to be a success, some type of independent system operator must be established.

This is likely the most challenging aspect of electricity restructuring in Arizona. Currently in Arizona, each of the three major utilities has their own "balancing authorities" that manage electricity systems in their territory. Because system operations

clearly benefit from economies of scale,[21] running three individual systems, each of which is tiny in size compared to the RTOs listed above, is very costly. Unfortunately, setting up an RTO is technically complex. Thus, any firm that does not wish to join an RTO can set up innumerable technological hurdles (real or not) that no regulator can effectively evaluate. Thus, setting up an Arizona RTO would require the cooperation of entities that may not desire the existence of such an organization. It would also fail to alleviate the current "seams"[22] issue – systemic market differences that create transactions costs – for Arizona power traders. Differing rules across RTOs make electricity trades between RTOs potentially costly. In addition, these rules can be difficult to apply in areas without RTOs.

Fortunately, there are alternative methods available. For example, the balancing authorities could be turned into their own RTOs. Such a move, however, would not take advantage of any available economies of scale in operating RTOs. For example, Arizona's largest utility, Arizona Public Service, only has about 9300 megawatts of capacity, while PJM has approximately 167,000 MWs of capacity, almost eighteen times larger.[23]

Another possibility would be to expand the CAISO into Arizona. Expansions of RTOs are not uncommon. For example, PJM in the late 1990s consisted of Delaware, the District of Columbia, Maryland, eastern Pennsylvania, and New Jersey. Since that time, PJM has expanded into almost the entirety of Pennsylvania, as well as most of Virginia and West Virginia, and parts of North Carolina, Ohio, Indiana, Michigan and Illinois. The presence of economies of scale implies that expanding an RTO is relatively inexpensive once the RTO has actually been established.

All of the foregoing options may be viable means of managing the grid in a way that would support competitive restructuring.

If Arizona were to join CAISO, there would be another important benefit. Expanding CAISO to Arizona would eliminate the current seam between Arizona and California. This in turn would encourage more building of generation facilities in Arizona. Because building electricity generators is far more difficult in California than in Arizona, building electricity generators is a tremendous growth opportunity for Arizona. Thus, joining CAISO would aid economic development in Arizona.

Another possibility is to use the Arizona Independent Scheduling Administrator Association (AZISA, http://www.az-isa.org/) to act in the role of an RTO, at least for a short period of time. The AZISA currently coordinates transmission access between the seven balancing authorities, as well as interstate shipments in and out of Arizona. Under such a plan, AZISA would be responsible for scheduling and dispatching the transmission lines between the three systems of the incumbent utilities.

All of the foregoing options may be viable means of managing the grid in a way that would support competitive restructuring. Accordingly, the best policy among the foregoing options should be determined after the ACC receives input from existing stakeholders as to the pros and cons of each alternative.

Step 2: Vertically separate utilities.

A restructured electricity industry has a combination of utility-regulated and competitive levels of production. This requires important policy innovations. Restructuring requires that the competitive segments (wholesale power generation and retail/marketing services) be separated from segments that continue to be regulated as public utilities (transmission, system operation, and distribution). 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).

Pricing and access strategies of the regulated segments of a firm must have firewalls sufficient that they are completely separate from the unregulated, competitive segments. For example, it may be possible for a firm that owns both competitive generation and regulated monopoly distribution to effectively subsidize generation with what it is allowed to charge in distribution. This would result in an inefficient subsidy from all customers to the generation product from that one supplier and an anti-competitive, artificial advantage in generation. Competitive rival generation firms, without recourse to such subsidies, might go out of business even if they were actually more efficient generators, to the detriment of consumers.

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Alternatively, if a generation company also controls transmission access, it may be able to withhold transmission access from other companies and increase the price paid for its power. Additionally, a transmission company may be able to increase the price it gains for its product by reducing its transmission availability. Thus, firms with distribution and transmission systems must be sufficiently operationally divided so that distribution and transmission business decisions are made independently of any consideration for the generation or retail parts of the firms.

Thus, operation of utility generation assets must be separated from the operation of utility distribution and transmission. A firewall must be created between these two sections of the utility company. Should a firewall prove insufficient to deter anticompetitive vertical behavior, vertical divestiture would be appropriate.

Phase 2: Release the Forces of Competition in Electricity Generation through Horizontal Restructuring

Restructuring also creates several issues to be dealt with at one level of production—generation. These steps will allow markets to form and encourage electricity generation in Arizona to be done at the lowest cost possible.

Step 3: Create a transparent wholesale spot market and development of institutions to provide ancillary services.

Successful electricity markets have a series of markets, most of which are operated by the RTO. First, the RTO operates a "real time market" where generators bid at what price they will operate. The RTO makes sure the supply of power equals the demand.

Prices in real time markets are often highly variable. To mitigate the risk of real time markets, the RTO also runs a day-ahead market. This market generally acts as a one-day futures market where a variety of financial (but not physical) transactions are made. The day-ahead market also serves to schedule the dispatch of generators one day later, though those schedules are not always followed.

Outside of organized markets, there are a large number of bilateral transactions that take place. In RTO markets, these take the form of financial transactions. For example, in exchange for payments, a generator could agree to "cover" the expenses of a distribution company that consumes electricity with respect to the RTO. The generator would cover these expenses by generating electricity. In this manner, the load-serving entity has reduced the variance of its payments, and the generator has reduced the variance of its income. One of the flaws of the failed California restructuring plan was that it precluded such bilateral trades, increasing the risk to all parties in the market.

Because of the nature of electricity, the supply of power must (nearly) equal the demand for power at all times.

The existing Palo Verde market may assist in this transition. Currently, Palo Verde hosts an extremely active market for traders sending power west into California. This market can be used to send necessary price signals to investors, and may limit the need for an RTO to be involved in this area.

Because of the nature of electricity, the supply of power must (nearly) equal the demand for power at all times. To make sure that this occurs, system operators run a variety of ancillary (or backup) markets. Ancillary markets vary across RTOs. Short-term ancillary markets (often called "regulation" markets) deal with unexpected changes in supply and demand. RTOs also have longer term reserve markets to address unexpected capacity outages. Each of these markets has to be established. Each of these markets has costs. Currently, these costs are hidden, as the needed assets are directed by the monopoly balancing authorities who do not have to publicly report their actions.

A crucial part of an RTO's role in restructured markets is ensuring market transparency. Transparency is important so that market actors receive information on what steps they can take to offer supply to the market, and when such actions are not appropriate. Thus, all RTOs in the U.S. have extensive information about all their markets available, such as prices and quantities in 15-minute increments. Thus, if and when RTOs are established in Arizona, they should make as much data available as possible as quickly as possible to wholesale market participants.

Step 4: Set up a system that allows wholesale suppliers and buyers to mitigate the financial risk of moving power across the grid.

Transmission capacity is often scarce. This scarcity results in higher prices at some areas of the grid, and lower prices in other places in the grid. This results in variance in prices for producers and consumers, and corresponding financial risk. To deal with this risk financial transmission rights (FTRs) are created in RTO markets and traded across parties.[24] The following discussion presents a simplified version of FTR.

Assume two points in an electricity grid, A and B. Assume there is a 100 megawatt transmission line between the two points, and the line is not congested. Power flows from A to B. Because the line is not congested, the price of electricity at A and B are equal, say at $50/MWH.

Transmission capacity is often scarce. This scarcity results in higher prices at some areas of the grid, and lower prices in other places in the grid. This results in variance in prices for producers and consumers, and corresponding financial risk.

Now assume the transmission line is congested. This will reduce the flow of power from A to B. Because of the limited supply, the price at B will therefore rise, say to $60/MWH. Because of reduced demand (as the access to a market is reduced), the price of power at A will fall, say to $45/mwh for one hour. Both demanders at B and suppliers at A are harmed by this congestion.

To deal with this risk, FTRs are used. The value of this particular FTR is equal to the price at node B minus the price at node A. Therefore, to hedge their risks, electricity buyers at B will want to purchase ahead of time "AB" FTRs, while sellers at A will want to sell them. In the case discussed above, each FTR will pay 60-45=$15/MWH. Because the transmission line has 100 MW of capacity, the total value of the FTRs in this period will be 15*100=$1500. Thus, purchasing FTRs will reduce the losses of buyers at B, and selling FTRs will reduce the losses of sellers at A in the event of congestion.

Thus, once an RTO is established with transparent markets, the RTO should auction off FTRs on important transmission lines in Arizona. This will promote competition by allowing market participants to hedge their risk.

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

Competitive markets work best when firms have the freedom to enter or exit them. Prices above the costs of entry signal entrants to enter the market. Entering the market creates wealth, because the new producers can create the relevant good at a cost that is less than what consumers are willing to pay for that product.

There are currently a number of independent power producers in Arizona. Indeed, they constitute more than 28 percent of the electricity capacity in Arizona. Yet these producers

are severely constrained. They have difficulty gaining access to transmission lines needed to reach the competitive California market. They have no guarantee of gaining market prices in Arizona. Despite this, the competitive sector has created power plants in Arizona. Were restructuring to occur, no doubt more of this would occur.

Allowing free entry will allow new innovation to take place. Examples of innovation in open and competitive electrical markets abound. They include individual solar panels and wind turbines, small megawatt micro generators, as well as microgrids. Another current promising area for innovation in electricity markets is in battery storage.[25] If the costs of battery storage can be lowered, batteries can serve to store electricity produced at low cost times, and to release power at high cost times. This would serve to reduce the costs of the electricity system. In addition, batteries can serve as important suppliers in regulation markets.

While some power supplies are likely to be on their own internal small grids, most new power supplies will have to be connected to the larger grid serving the state. This will require a connection process through the system operator. There are always issues related to new generation. However, it is important that new sources of supply be connected to the grid as soon as technically feasible. Thus, Arizona should end any entry requirement on new generation.

While some power supplies are likely to be on their own internal small grids, most new power supplies will have to be connected to the larger grid serving the state.

Step 6: Engage in horizontal divestiture in electricity generation to prevent the exercise of market power in the sale of generation.

In general, market power that is gained through efficiency should not be discouraged. In this instance, however, were restructuring to take place without proper divestiture, firms could gain market power. The source of this market power, though, would not be firms' economic efficiency, but rather from gains made possible by the prior anti-competitive regulation that restructuring aims to replace. Accordingly, restructuring should be done in a way that minimizes opportunities for generators to exercise market power in the wholesale market. This can be done through a careful generation divestiture plan and, if necessary, through the use of market rules (e.g., on wholesale market bidding) aimed at mitigating market power.

Experience has shown that electricity markets are more vulnerable to the exercise of market power than other markets. There are three reasons for this. First, electricity is not storable in large quantities at reasonable cost. Thus, consumers cannot stockpile to protect against price fluctuations. Second, if supply is not sufficient to meet demand, costly blackouts will occur. Third, electricity generators have highly different cost structures. This means, for example, that independent nuclear power generators will have no influence on the competitive nature of a market. Because nuclear power generators have such low marginal costs, they are (almost) always generating as much electricity as they can. They

therefore are not in a position to respond to the exercise of market power when other firms reduce their output in order to raise market price.[26]

The counterintuitive result is that, at least in certain circumstances, a relatively small supplier could have just as much market power as a large supplier. For example, assume a firm owns some amount of "baseload" (low marginal cost) generation, and a small amount of "peaking" (high marginal cost) generation. If demand is such that the firm's peaking plant is the marginal plant in the market, the firm may be able to increase profits by not operating its peak plant. It will therefore lose some money on its peak operations, but make more money by increasing the price paid to its baseline facility. In this circumstance, traditional measures of market power do not describe the actual competitiveness of electricity markets.

Another form of this problem occurs when demand reaches close to system capacity. In this circumstance, if the system operator must buy from a firm in order to avoid blackouts, then that firm is a "pivotal supplier." If the system operator must buy from a group of X firms, then that group of X firms together is "a jointly pivotal group of size X." Thus, if the capacity a firm owns is greater than the system surplus capacity (total system capacity minus total system demand), then that firm is a pivotal supplier and in a position to exercise market power. (Note that this problem occurs because of a lack of "demand response" in the system. See the discussion below.)

The counterintuitive result is that, at least in certain circumstances, a relatively small supplier could have just as much market power as a large supplier.

There are two methods to address these horizontal market power problems. The first is to require a careful divestiture of generation plants from incumbent utilities. This path has been taken in several states, including California, Ohio, and Pennsylvania.[27]

The second possible step is to engage in bid mitigation. The Federal Energy Commission encourages RTOs to have "market monitors" that monitor the bidding activity of suppliers in order to gain FERC approval for market-based prices. These monitors are (perhaps nominally) independent of the RTO, as the RTO hires the market monitor on a long-term contract and does not (at least directly) interfere in their work. RTO market monitors run screening tests to determine if a firm or set of firms is pivotal, and to determine whether those suppliers have engaged in the exercise of market power. Suppliers that fail the screening tests may be forced to offer electricity at marginal cost. RTOs vary widely on how often these "conduct" screens are applied to suppliers.

Market monitoring, however, is subject to criticism. In particular, it implies that the market monitor can correctly observe market price. If, however, the market monitor enforces a market price based on estimates of marginal costs that are too low, it will deter new entry into the generation market. Thus, market monitoring may represent a tradeoff between the short-run exercise of market power and long-run investment prospects

for generation. This is the rationale for the policy in ERCOT (not subject to FERC regulation), where the market monitor analyzes and reports on market conditions for state regulators, but does not engage in bid mitigation.[28]

Thus, Arizona needs to engage in horizontal divestiture to ensure competitive electricity markets. It also should create a market monitoring unit with some ability to mitigate potentially anticompetitive bids. This authority, however, should be limited in order not to discourage entry into generation.

Step 7: Replace existing renewable mandates with a market for renewable generation and distributed energy.[29]

Although technology is rapidly improving, renewable energy sources (often wind and solar power) are not currently economically competitive with other sources of electricity. To encourage their production, the Arizona Commerce Commission (ACC) requires utilities to gain renewable credits equal to a rising percentage of their customers' electricity consumption, peaking at 15 percent in 2025. Unfortunately, this renewables initiative is being undertaken in Arizona in perhaps the least efficient method possible. Whatever their virtues, no one would claim that regulated electric utilities are particularly good at innovation and entrepreneurship. Yet innovation and entrepreneurship are exactly what is needed in the emerging renewables sector.

Although technology is rapidly improving, renewable energy sources (often wind and solar power) are not currently economically competitive with other sources of electricity.

In other states, restructuring of the electricity market has led to a regulatory environment in which each distribution entity is required to buy permits from generators of renewable permits.[30] Entry into the market for producing renewables is open to all. Thus, renewable producers compete against each other to produce power, ensuring it will be done at the lowest cost possible.

Similar analysis holds for distributed electricity production. Distributed electricity has the potential, should the technology advance, to largely decentralize the electricity grid and reduce pollution. With restructured markets, every household could potentially have the opportunity to participate in producing its own electricity.

Thus, if a renewable mandate continues to exist, Arizona should replace its current renewable program with a program that will require retail suppliers to purchase renewable credits equal to their required level. These credits would be purchased from free market providers that would have the proper incentives to generate renewable energy at the lowest possible cost.

Phase 3: Give the Electricity Customer Competitive Retail Choices

In free markets, consumers are active participants in marketplace decisions. They decide which products to purchase, and which features those products will possess. Further, consumers review price signals that encourage them to increase consumption when the product is less scarce, and decrease consumption when the product is more scarce. Thus, a critical feature of restructuring is to empower consumers.

Restructuring has two critical impacts on consumers. First, it allows competition for consumer choice, including allowing consumers to purchase "green" energy. Second, it permits consumers to respond to price signals of the relative scarcity of electric power.

Step 8: Allow free entry of retail service providers that can compete for customers' generation needs against incumbent local distributors.

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, which would compete by offering a variety of services.

There appears to be little difficulty in creating an effective choice system for industrial and commercial customers. The question is more challenging with respect to residential retail customers.

There appears to be little difficulty in creating an effective choice system for industrial and commercial customers. The question is more challenging with respect to residential retail customers.

There are different methods of making effective residential choice occur. The most common method is to require that customers make an active choice of a competitive supplier. If they make no choice, they remain on their incumbent supplier and pay regulated "default" rates. In a recent study,[31] however, only about 30 percent of retail consumers in Northeastern Pennsylvania switched to a competitive supplier when offered a 10 percent discount. Clearly, there are problems in marketing retail power to consumers, perhaps in large part because consumers are not used to purchasing electricity.

The most recent statistics for Pennsylvania show a gradual movement away from default providers and toward competitive suppliers for residential customers, and a larger movement for commercial and industrial customers. In April 2013, 34 percent of the residential load had switched to competitive suppliers, while 69 percent of commercial load and 93 percent of the industrial load had switched.[32]

One approach to addressing this issue, used in Texas, is to continuously increase the default price. As the difference between the default price and the competitive price grows, more and more consumers will switch to competitive offerings. Such a system is effective

in creating retail competition. This approach, however, (sometimes referred to by its critics as "ugly default service") has the drawback of harming those consumers who choose not to choose a competitive supplier.

Another method, currently being considered in Pennsylvania, is to allow current retail ratepayers to continue paying the default rate, or switch to a competitive rate. Should a residential customer move, however, they would then be required to make a positive choice of retail supplier. As a large fraction of ratepayers move each year, this method would strongly support retail competition without exposing ratepayers to high default prices.

Another approach, popular in Illinois and Ohio, is to allow municipal aggregation. Under municipal aggregation, a town or other political entity takes bids for the electricity customers in its area. The town attempts to use the size of its population to gain lower bids to supply its electricity needs.

In addition, individual consumers in Arizona would be allowed to participate in a second market (beyond the market for generation mandates) for renewable power. In restructured states, each consumer has the option of paying an additional price for renewable power. In such circumstances, the supplier of the power must purchase additional permits (above any regulatory requirement) as part of supplying customers.

Under municipal aggregation, a town or other political entity takes bids for the electricity customers in its area. The town attempts to use the size of its population to gain lower bids to supply its electricity needs.

For example, in Pennsylvania, eight companies offer 100 percent wind products to consumers. Five companies offer 100 percent renewable energy product. Four companies offer products that are less than 100 percent renewable.[33]

Finally, the state of Arizona may wish to embark on a consumer education program to inform retail customers about the opportunities that are available under electricity choice. The Pennsylvania Public Utility Commission has an active program in this area. (See http://www.puc.state.pa.us/general/consumer_ed/pdf/PAPowerSwitch_Trifold.pdf.)

Thus, to create retail electricity markets in Arizona, several steps should be taken. First, default retail prices based on competitive procurement by incumbent utilities should be created. Second, retail customers should have the option to switch from their incumbent supplier into the competitive retail sector. Third, a default service provider should not be imposed on any customer who moves to a new residence or business location, or any retail customer who is new to Arizona. Instead, they should be given the opportunity and responsibility to select a competitive retail provider. Finally, municipalities in Arizona should be allowed to engage in aggregation to obtain the best electricity price for their residents.

Step 9: Establish real time (dynamic) pricing.

Prices in wholesale electricity markets can vary widely in one day. Residential customers, however, are generally protected from such price swings. Generally, residential customers sign contracts with retails for fixed power prices across one year, or across several years. The existing regulatory regime is flawed in that it does not allow customers to respond to fluctuating wholesale prices during the day. This is because customers have meters that simply record the flow of electrons, rather than the time of day of those flows. Such meters do however exist, and can be used in restructured markets.

When the price of a good rises, that is a signal to consumers that the product has grown scarce, and it encourages consumers to reduce their consumption. Similarly, when the price of a good falls, it is a signal of reduced scarcity and encourages increased production. This is a critical part of the efficiency of the competitive marketplace. Unfortunately, the meters available to regulated consumers do not generally allow these consumers to respond to wholesale electricity prices, which can vary widely across the day.

Prices in wholesale electricity markets can vary widely in one day. Residential customers, however, are generally protected from such price swings.

Modern innovations in metering technologies now allow for the measurement of the timing of electricity flows. Thus, customers can pay the "real time" price of electricity—a price based on the wholesale price of power at any point in time. Arizona is currently in the process of installing "smart meters" for retail consumers. Permitting restructuring would increase the use of this important innovation through robust and innovative market incentives—such as retailers offering consumers applications to monitor and minimize the cost of their energy usage.

It is important to note, however, that residential consumers have shown a limited demand for any version of real time pricing. It appears that the costs of such activity, both monetary (through buying a modern meter) and monitoring (as household activities have to be coordinated with the wholesale price of power) are sufficient to deter real time pricing among relatively small customers. Larger customers, who may have their own energy specialists, find real time pricing more attractive.[34]

Using the demand side through dynamic pricing and access to ancillary markets will enable the system operator to reduce demand in periods of short supply and increase reliability with economic efficiency. This will reduce costs to all customers, as well as reduce the threat of market power in the system.

Demand response can also be used in ancillary markets. As is done in several jurisdictions, including Pennsylvania, demanders can bid their load into these markets. For example, 12,400 mega-watts of capacity were recently cleared in a PJM ancillary market.[35] In effect, in exchange for payments from the system operator, demanders

promise to drastically reduce their demand when the system operator faces the threat of electricity shortages. By allowing this new source of "supply" to occur, the costs of the market can be reduced, as well as any demand for new capacity. In addition, system reliability is improved, as the system operator now has a clear option to reduce demand from particular loads during times of system stress.[36]

Thus, when opening up retail markets, Arizona should allow retail providers to offer electricity prices that vary based on the wholesale price of power. They should also ensure that the rules for ancillary markets allow the demand side to participate.

Conclusion

Arizona now has the opportunity to modernize its electricity markets and allow market competition to guide investments and consumer decisions in this sector. Building on learning from around the world, the path forward for restructuring is clear. First, the ACC needs to empower a system operator to neutrally balance the load on the grid that will be created by an influx of competitive energy producers. The ACC also needs to separate incumbent utilities from their generation capacity to eliminate the distortions that would be caused as a result of vertical integration in this market. Second, the state needs to take action to create competitive generation markets and a competitive generation sector. Third, customers should be empowered with the freedom to choose among competitive retailers of electricity. If this is done, history shows that electricity prices will decline in all sectors of the economy and capacity will increase—in other words, free markets will perform like they perform in all other segments of the economy.

Arizona now has the opportunity to modernize its electricity markets and allow market competition to guide investments and consumer decisions in this sector. Building on learning from around the world, the path forward for restructuring is clear.

Addendum
The ACC Should Consider Repealing or Reforming REST

Introduction

The scientific basis for Arizona's Renewable Energy Standard (REST) is becoming murkier even as the technological and economic feasibility of renewable energy sources is showing increasing promise. These facts counsel in favor of the ACC giving serious consideration to repealing or reforming REST as part of restructuring electrical markets for competition. The policy choices the ACC should consider range from abandoning renewable mandates altogether to replacing the current regulatory framework with one that is more transparent, market-oriented and efficient.

Arizona's Renewable Energy Standard and Tariff

Although the greenhouse effect of certain gases in the earth's atmosphere had been known to science for quite some time, concern about effects of the rising concentration of carbon dioxide only began to become widespread in the 1980s.

On November 1, 2006 the ACC passed rules implementing the Renewable Energy Standard and Tariff (REST) for Arizona's electricity power generators. These standards require electric power producers in the state to generate 15 percent of the electricity they sell from renewable sources by 2025, phased in over time. Currently, 4 percent of electricity sold must be generated from renewable sources. The ACC rules specify eligible renewable sources, allow for the purchase of credits across generators, and impose a minimum amount of renewable generation that must come from distributed sources, such as rooftop residential solar panels.

The Current State of Greenhouse Science

Although the greenhouse effect of certain gases in the earth's atmosphere had been known to science for quite some time, concern about effects of the rising concentration of carbon dioxide only began to become widespread in the 1980s. By the mid-1990s, the concept of the greenhouse effect was well known even outside of scientific circles, partly as a result of efforts by Margaret Thatcher, Prime Minister of Great Britain in the 1980s. She helped to mobilize governments around the globe to consider curbing carbon dioxide emissions, since the compound is a known greenhouse gas, its concentration in the atmosphere was increasing, and mankind is almost certainly the main reason for that increase. We produce carbon dioxide when we burn fossil fuels such as coal, petroleum, and natural gas.

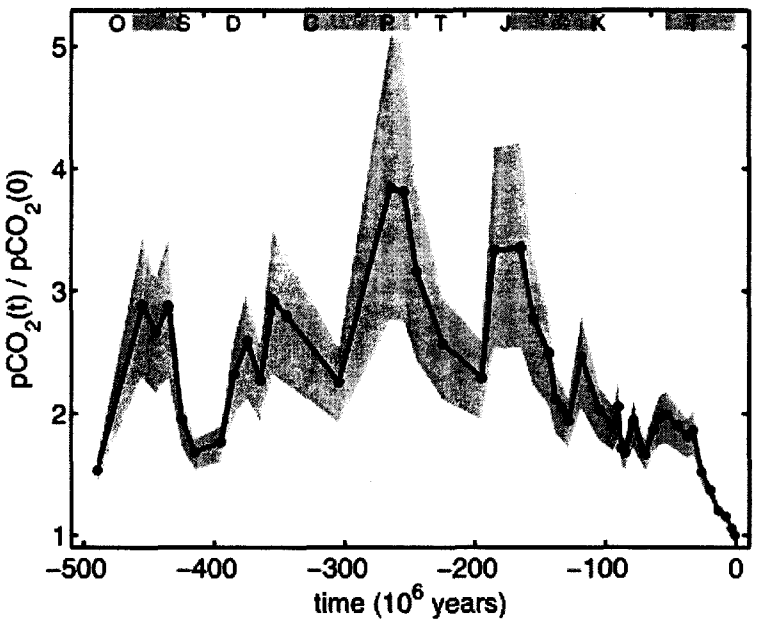
The possibility of rapid global warming is scary. Although the magnitude of temperature change necessary to cause the ice caps on Greenland and Antarctica to melt is up for debate, coastal flooding is a real threat from higher average global temperatures. The popular press has passed on predictions of increased drought and accompanying famine, more violent and more frequent storms, and the destruction of ecosystems that can lead

to extinctions. Amid such dire warnings, it is no wonder many policy makers want to respond, despite the fact that there are good reasons to doubt mankind's release of carbon dioxide is significantly leading to global warming. In fact, there are growing scientific doubts about the connection between both natural and human-generated atmospheric carbon dioxide and greenhouse warming.

Recently, the carbon dioxide atmospheric concentration measured at the Mauna Loa volcano in Hawaii exceeded 400 parts per million (ppm) or .04 percent of the atmosphere, the highest concentration ever measured.[37] Left unsaid in the announcement is that prior to the recent steady increase in carbon dioxide, its atmospheric concentration had reached its lowest point in the last 500 million years. As can be seen in Figure 6, taken from a 2001 academic paper by Harvard scientist Daniel H. Rothman, carbon dioxide concentrations over the last 500 million years have often been three times the current level. The current concentration is the lowest point on the graph. Interestingly, cold periods shown with grey shading at the top of the graph often coincide with high concentrations of carbon dioxide, directly opposite the relationship we would expect according to today's global warming fears.

Amid such dire warnings, it is no wonder many policy makers want to respond, despite the fact that there are good reasons to doubt mankind's release of carbon dioxide is significantly leading to global warming.

Figure 6: Carbon Dioxide Atmospheric Concentration, Last 500 Million Years[38]



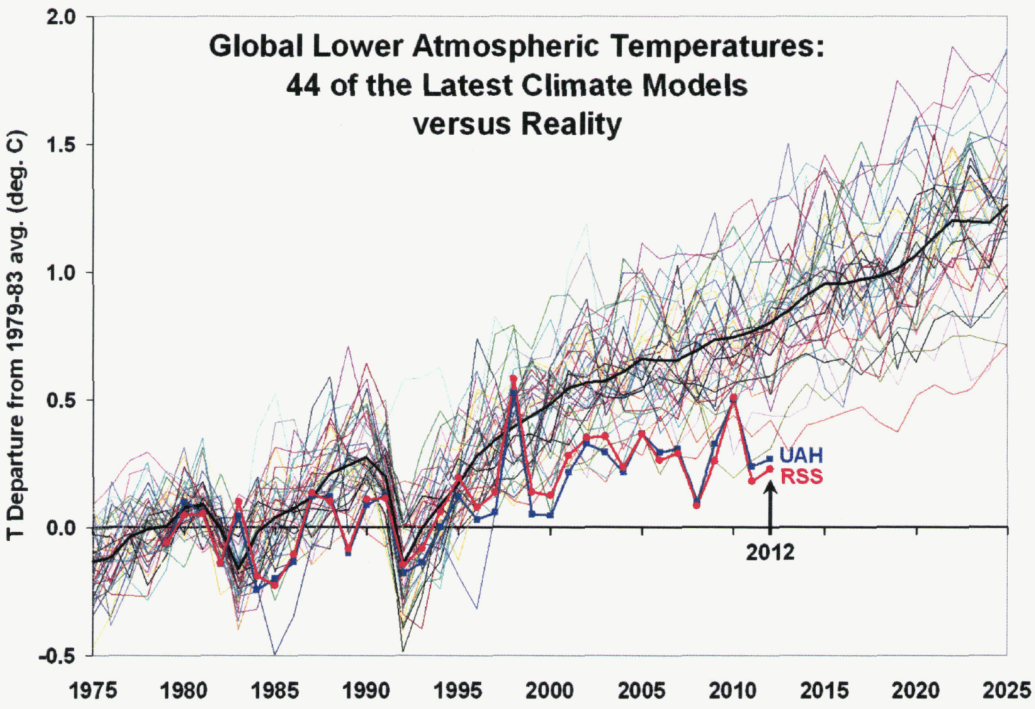
According to one set of ice core measurements, carbon dioxide atmospheric concentration fell to 275 ppm around 1600,[39] a mere 125 ppm above the level necessary to sustain photosynthesis in green plants dependent on carbon dioxide for life.[40] Without green plants, humans would die. If carbon dioxide were to fall much below the recent

minimum, it would be an imperative to determine ways to increase its concentration in the atmosphere. As it is, mankind's release of naturally sequestered carbon dioxide through fossil fuel burning has had a positive impact on plant growth.[41] After all, plants would prefer a carbon dioxide concentration closer to that inside an average house, about 1,000 ppm. Increased carbon dioxide especially benefits arid environments like Arizona because plants grow better, even if the amount of water they receive stays constant.[42]

The fear of global warming as a result of increased carbon dioxide has mostly been based on computer modeling, which builds in feedback effects involving water vapor. Basically, the theory is that increased carbon dioxide, a relatively minor greenhouse gas, warms the earth enough to increase water vapor, which is a major greenhouse gas due to its volume.[43] These models have predicted a significant warming of the earth's atmosphere in the future, as illustrated in Figure 7 by the black line that averages the various predictions. These predictions deviate a great deal from the bold blue and red lines that illustrate two different measures of the earth's actual temperature. Even *The Economist*, a publication firmly in the warming alarmist camp, has been forced to acknowledge that predictions of carbon dioxide's earth-warming effects have failed to match reality.[44] A recent peer-reviewed survey of geoscientists and engineers shows a majority are skeptical of the proposition that human-induced carbon dioxide production has caused planetary warming.[45]

A recent peer-reviewed survey of geoscientists and engineers shows a majority are skeptical of the proposition that human-induced carbon dioxide production has caused planetary warming.

Figure 7: Global Warming Slowdown[46]



REST's Shaky Foundation

If humanity's release of carbon dioxide into the atmosphere has had positive effects by improving plant growth, but has had very little impact on the earth's average temperature,[47] the basis for the REST rules collapses. However, even if global warming were occurring as predicted and as a result of increased carbon dioxide in the atmosphere, REST would fail the test of effectiveness because of the minor role Arizona's electricity generation plays in global carbon dioxide production. After all, it is important to recognize that, in 2000, about 38 percent of Arizona's greenhouse gas emissions resulted from electricity generation.[48] Assuming that proportion still holds, that means Arizona emitted about 40,000 metric tons of carbon dioxide to generate electricity in 2008. That was about 0.13 percent of the world's total carbon dioxide production.[49] This means that even if Arizona somehow reduced its electricity-related carbon dioxide emissions by half, it would have reduced world carbon dioxide emissions by a mere 6 one-hundredths of one percent. There is no scientific evidence suggesting this miniscule amount of carbon dioxide abatement would have any impact on global temperatures without the simultaneous implementation of REST-like standards by an extremely large number of jurisdictions in which carbon dioxide is emitted.

If humanity's release of carbon dioxide into the atmosphere has had positive effects by improving plant growth, but has had very little impact on the earth's average temperature,[47] the basis for the REST rules collapses.

The Tradeoff between REST and Arizona's Economy

The Beacon Hill Institute of Suffolk University in Massachusetts recently evaluated the economics of Arizona's REST mandate. It estimates that in 2025 the ACC mandate will cost Arizonans from $239 million to $626 million and from 1,500 to 4,100 jobs. This would result from electricity prices 4 percent to 10 percent higher than they otherwise would be, due to the high costs of renewable energy.[50] Odds are the economic damage is understated, since costs like connecting windmills to the grid can only be guessed. Texas, for example, is spending $7 billion to connect windmill farms to its grid. Beacon Hill also accounts for costs associated with coal and gas backup facilities that prevent brownouts on still and cloudy days. These otherwise redundant facilities are absolutely necessary if people are to survive Arizona's hot summers. This is one reason that renewable energy, when its costs are fully accounted for, has such a hard time competing with conventional energy, even as the cost of solar panels, for example, falls precipitously.

REST is a Barrier to Entry in Electric Competition

In light of the growing uncertainty about greenhouse warming, REST's almost certain ineffectiveness in reducing greenhouse warming (if it exists), and the economic costs imposed by REST, it is time for the ACC to consider repealing REST in the course of restructuring. Such reconsideration is clearly pertinent to the question of restructuring. This is because if Arizona's electricity markets were restructured for competition, REST would pose a significant barrier to entry for either electrical generators or electrical retailers.

Although either generators or retailers could purchase credits from renewable generators in order to meet their REST quotas, renewable capacity is likely to be limited. At some point, electricity suppliers will have to look at making their own investments in renewable generation or pay much higher prices for a limited supply of renewable generation so as to encourage the creation of more supply.

The circumstance just described creates risk. Electric power providers might find themselves unexpectedly unable to fulfill the REST requirement and at the mercy of firms with scarce renewable generation credits to sell. New companies will have to master a market in credits that can be quite sophisticated. Anyone wishing to enter the conventional electricity generation business in Arizona will have to gauge more than the current overall supply of electricity. Such a potential entrant will also have to gauge whether there is capacity for his type of generation in light of whether there is enough renewable generation to allow him to find a niche. New entrants could find it necessary to invest in costly and potentially unfamiliar renewable technologies in addition to conventional systems.

Repealing REST does not mean that the adoption of renewable technology would cease.

Whether the issue is risk or a need to invest in renewables, REST thus increases the cost of entering the supply side of an electricity market. Higher costs of entering the market make it less likely potential new entrants will materialize. Therefore, REST is a barrier to entering the supply side of the electricity market. To be sure, renewable energy mandates do not mean there will be no new entrants on the supply side of a competitive electricity market. Texas has a renewable mandate and has seen significant entry at the same time. Nevertheless, the likelihood is that Texas could have seen even more benefit from electric competition had its renewable mandate not been in force.

If Renewable Tech is "Disruptive," REST May be Unnecessary to Achieve Green Goals

Repealing REST does not mean that the adoption of renewable technology would cease. Many consumers choose renewable-sourced electricity because of their personal concern for the environment, even though "green" systems cost more.[51] Were Arizonans given the chance, many would do so. Retailers could encourage their customers to purchase renewable-generated electricity as a percentage of their total usage. Some might choose to have all their electricity generated at renewable rates. Others might only choose a small percentage. The only government mandate necessary to meet goals might be a requirement that retailers make efforts to make consumers aware of their renewable energy options.[52]

In Texas, where wind power has made significant inroads in the generation market, voluntary renewable sales more than tripled from 2006 to 2010.[53] Wind power does receive significant federal subsidies. All forms of renewables do. Since the marginal cost of wind power is essentially zero, these subsidies can sometimes be used to encourage consumption that might not otherwise occur, especially at the industrial level. However,

residential consumption of renewable generation has increased greatly, even in the face of higher prices than conventional generation. As technology continues to push the price of renewables down, consumers will respond by purchasing even more renewable electricity. Solar power shows the greatest promise of bringing down costs through innovation, and solar is the preferred renewable in Arizona.

One more option mentioned explicitly above would have consumers generate their own electricity and allow for net metering. Solar photo voltaic panels serve as the most common generation method for individual home electricity generation. During summer months when the sun is most intense, some rooftop systems, which are large enough, can produce a surplus of electricity for a home and put the electric meter into reverse. Current regulation requiring homeowners to be credited for this generation can be maintained on retailers. Consumers who are concerned about the environment can install their own solar systems. However, REST's current mandate for minimum amounts of this type of "distributed" electricity generation should be repealed.

The REST Mandate, If Not Repealed, Should Be Transparent to Consumers

Despite the controversy over the benefits of carbon dioxide mitigation, many people have been persuaded that global warming is a threat. Solar and wind electricity generation have been heavily subsidized, and it is not surprising that many want to take advantage of those subsidies.[54] Therefore, it may be difficult to repeal the REST mandate.

Despite the controversy over the benefits of carbon dioxide mitigation, many people have been persuaded that global warming is a threat.

If the REST mandate, in some form, is to be retained as discussed in the main part of this report, it should also be reformed in a way that makes it honest and transparent to consumers. In a competitive market, generation and retail are separated. Right now, the mandate is applied to generators as a proportion of the amount of electricity they sell. In a competitive system, the mandate as it stands would be applied in the wholesale market, and generators would all be required to meet the same renewable energy quota. Although no particular generator would be required to produce electricity from renewables due to the ability to trade renewable generation credits, credit trading at the wholesale level makes it more difficult for a consumer, through a retailer, to directly purchase renewable energy. Electric generators, instead of concentrating on generating electricity as efficiently as possible, would be forced to develop expertise in credit trading, which is best suited to the retail sector where such expertise would be a natural outgrowth of the trading done on an hourly basis.

Arizona electricity consumers should also be aware of the cost of government mandates. Were the REST mandate continued at the wholesale level, the cost would be once removed from the consumer and it would be logistically difficult to separate the cost of renewable-generated electricity from conventionally generated electricity to then pass this information on to the consumer. If the mandate were applied at the retail level, retailers

could separate the various rates for different types of generation relatively easily and pass this information on to the consumer. Armed with this information, consumers would then be in a more informed position to hold elected ACC commissioners accountable for their policy decisions. Retailers, responding to competitive pressure, would have an incentive to find the least cost renewable producers. Generators would have no incentive to obfuscate costs by using conventional generation to subsidize renewable generation. There would be a tendency to specialize in one type of generation or the other with the cost benefits that specialization produces. To make REST work properly, there should be no effort on the part of the ACC to obfuscate to consumers the cost of renewable generated energy as compared to conventionally generated electricity.

In short, in a competitive electricity environment with vertical separation between the wholesale generation and retail markets, REST standards should be applied on the retail market. Retailers should be required to transparently bill customers separate rates, as necessary, for electricity generated with renewable energy. In this way, consumers can make the most informed decisions possible.

In short, in a competitive electricity environment with vertical separation between the wholesale generation and retail markets, REST standards should be applied on the retail market.

Conclusion

Arizona's REST mandate was imposed at the height of concerns about global warming due to carbon dioxide emissions in the context of a fully regulated and monopolistic electrical generation and distribution system. If Arizona is to move to a competitive system of electrical generation and retail sale, REST constitutes a barrier to new entrants, making the move to competition less beneficial than otherwise. REST will already cost Arizona jobs and money, making the state in general less economically competitive. The REST mandate is based on shaky science as well. Especially in the context of a restructured, competitive electricity market where consumers can choose renewable sources of electricity, REST should be repealed. If REST is not repealed, it should be reformed and applied to electric retailers instead of generators, with mandated renewable electricity separately listed on customers' bills.

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6. See "Table 10. Supply and Disposition of Electricity, 1990 through 2010 (Million Kilowatt hours)" at http://www.eia.gov/electricity/state/arizona/index.cfm.
7. Rather than subsidizing reserve capacity through guaranteed payments to generators, regulators in restructured markets should instead reach arrangements with non-essential consumers of electricity to reduce their demand in the event of supply shocks. For example, in Pennsylvania, the RTO recently negotiated an arrangement with Pennsylvania State University to reduce its consumption of electricity in the event of excess electricity demand. Likewise, retailers in restructured markets are free to innovate and minimize the risk of brownouts. For example, nothing stops retailers from competing for consumers by offering insurance to cover power losses in exchange for consumers adopting "smart appliances" that cease drawing electricity from the grid during supply shocks or excessive demand.
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Exhibit #3

POLICY *report*

Goldwater Institute

No. 232 | July 21, 2009

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

By Stanley S. Reynolds, Professor of Economics, Public Policy and Markets, University of Arizona; and
Andrew N. Kleit, Professor of Energy and Environmental Economics, Pennsylvania State University

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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EXHIBIT 3

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By Stanley S. Reynolds, Professor of Economics, Public Policy and Markets, University of Arizona; and Andrew N. Kleit, Professor of Energy and Environmental Economics, Pennsylvania State University

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-

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.

States that have deregulated their wholesale electricity markets have experienced significant new investment in generation capacity.

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

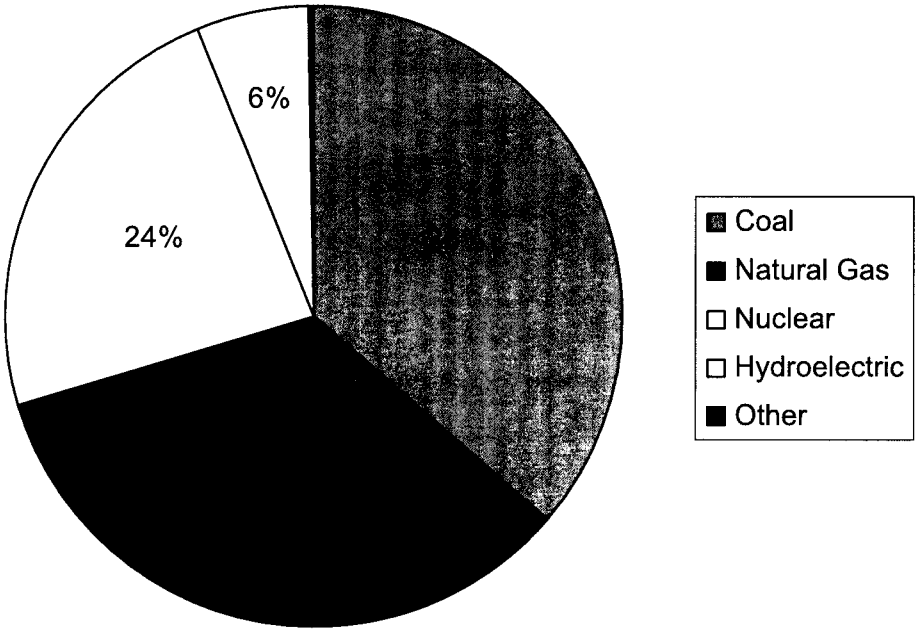
Arizona is served by three vertically integrated utilities, federal power generators, and a host of smaller generation and distribution operations. The three large utilities are investor-owned utilities: Arizona Public Service (APS) and Tucson Electric Power (TEP), which are regulated by the Arizona 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.

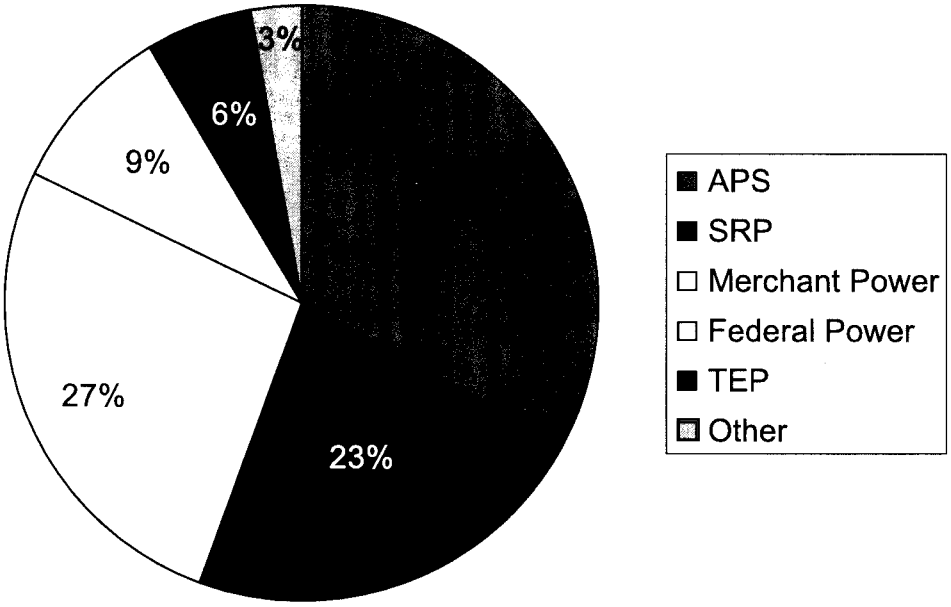
Figure 1 shows electricity generation for 2007 by fuel type. Coal, natural gas, and nuclear-powered generators produce over 90 percent of power in Arizona, with coal making up the largest share. Almost all of the new generation capacity added in the last 20 years is fueled by natural gas, which is now 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.

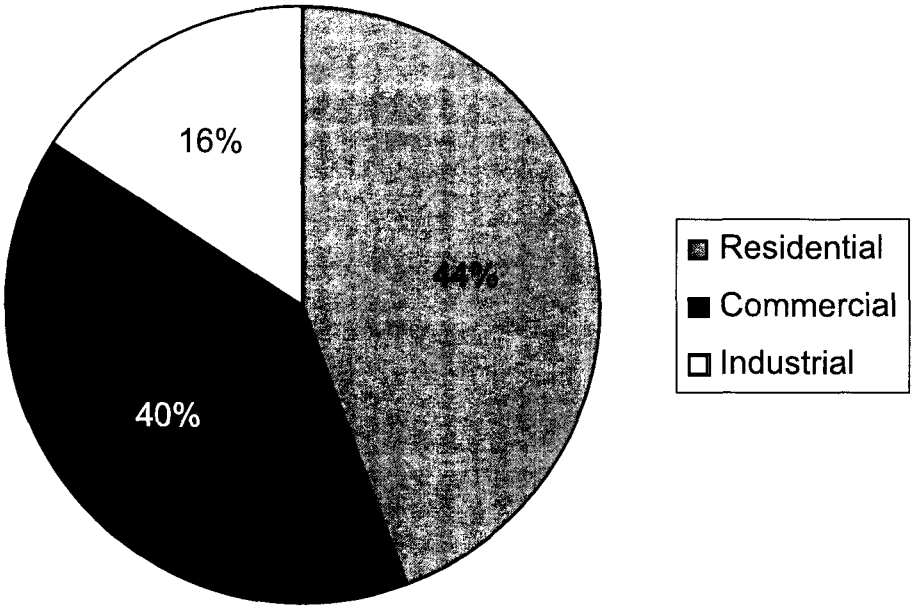
Electricity consumption is broken out by sector in Figure 3. The residential and commercial sectors are the largest consumers, with industrial a distant third.

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

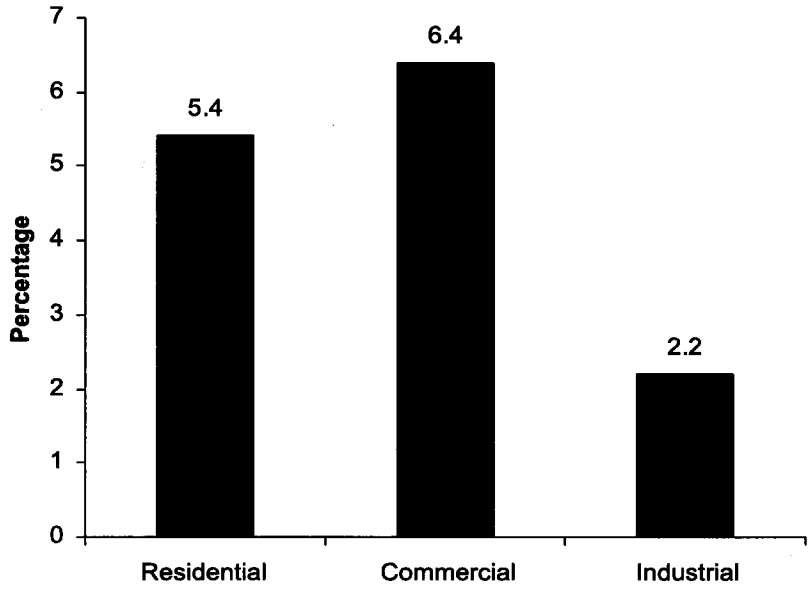
On balance, Arizona is a net exporter of electric power, with about 27 percent of electric power produced in Arizona shipped out of state.

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.

If electricity usage grows at the same rate as population, then the state will consume about 40 million more megawatt hours in 20 years than it does now.

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

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]

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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

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

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 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.

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.

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.

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

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

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.

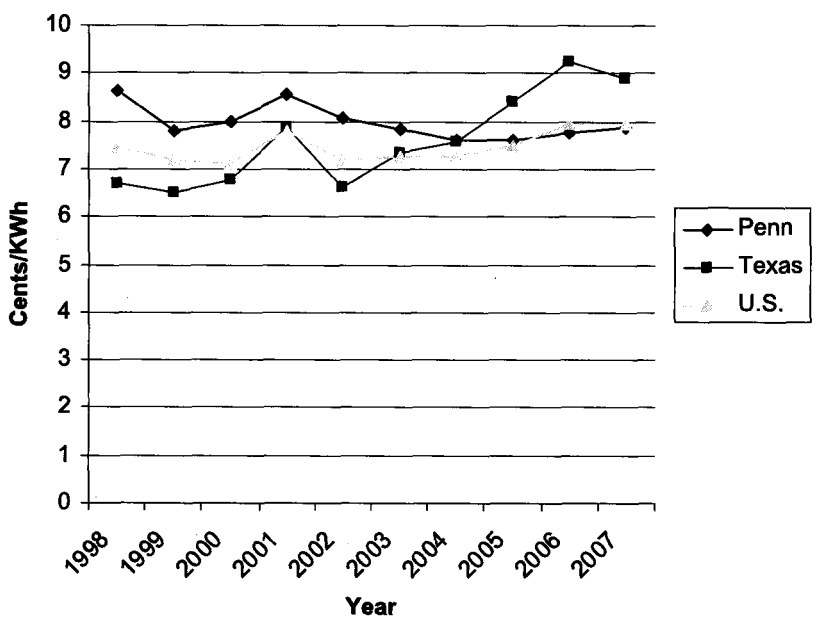
Table 1: Average Retail Prices in Pennsylvania, Texas and U.S.*

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.

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.

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

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:

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.

- 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.

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.

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

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

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.

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

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.

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.

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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PROFESSIONAL EXPERIENCE:

Professor of Energy and Environmental Economics July 2002-Present, holding a joint appointment in the Meteorology and Energy and Mineral Engineering Departments in the College of Earth and Mineral Sciences at Penn State. Courtesy Professor, School of International Affairs July 2009 – Present. Associate Professor of Energy and Environmental Economics, July 1998 to June 2002, Research Associate, the Center for Health Care and Policy Research, July 1998 to present, MICASU Fellow in Energy, Environmental and Mineral Economics, September 2003 to Present, Professor-In-Charge, major in Energy Business and Finance, University Park, PA, 2004-2006, Program Officer, Energy Business and Finance, 2006-Present.

- As EBF program officer, I direct:

• The major in Energy Business and Finance, www.eme.psu.edu/ebf/index.html, which involves recruiting students, designing curriculum, bringing guest speakers to campus, and assisting with fundraising. I was the faculty member in charge of establishing this major. Begun in May 2004, the EBF major is an interdisciplinary course of study that draws on classes in economics, business, finance, and the earth sciences. The major currently has approximately 400 students, making it the largest major in the College of Earth and Mineral Sciences.

EXHIBIT 4

• The development of a M.S. and Ph.D. option in Energy Management and Policy, http://www.eme.psu.edu/emp/index.html, which is part of the graduate program in the Department of Energy and Mineral Engineering. Our first students were admitted in Fall 2008.

• Support for the Meteorology Department's unique option in Weather Risk Management, www.met.psu.edu/risk/.

• As a professor, I teach classes in environmental economics, energy markets, corporate finance, and financial risk management, and engage in research on environmental, energy, health care, and antitrust issues, as well as weather economics. I was named as one of the top competition economists in the world by *Global Competition Review* (London) in 1998, 2000, and 2002.

Visiting Scholar, Office of the Chief Economist, Commodity Futures Trading Commission, July 2004-June 2005 (on sabbatical from the Pennsylvania State University).

Conducted research on facets of the CFTC's mission and analyzing litigation matters relating to market manipulation and antitrust issues on competition between commodity exchanges.

Associate Professor of Economics, Ourso School of Business Administration, Louisiana State University, Baton Rouge, LA, August 1994 - June 1998, Assistant Professor, August 1992 - July 1994.

Taught classes in introductory (honors), intermediate, and graduate microeconomics, undergraduate and graduate industrial organization, and undergraduate environmental economics. Received Departmental Award for Excellence in Undergraduate Teaching, 1996.

Senior Economic Adviser to the Director for Investigation and Research, Consumer and Corporate Affairs Canada, Ottawa/Hull, Canada, September 1991 - August 1992.

Assigned to review all significant antitrust and regulatory matters for the chief antitrust law enforcement officer of the Canadian government. Analyzed merger and monopolization cases, as well as reviewed competition policy issues in interagency settings.

Economic Advisor to the Director, Bureau of Competition, Federal Trade Commission, Washington D.C. November 1989 - January 1991.

Reviewed all significant antitrust matters and advised the FTC's chief antitrust attorney. Analyzed mergers, horizontal restraints cases, comments to other agencies, and additional competition matters. Served on the Administration Staff Working Group on Automobile Fuel Economy, 1990.

Economist, Division of Economic Policy Analysis, Bureau of Economics, Federal Trade Commission, Washington, D.C. September 1987 - August 1991.

Conducted research on railroad, trucking and airline regulation. Prepared Bureau comments to the National Highway Traffic Safety Administration on automobile fuel economy standards, to the Environmental Protection Agency on marketable permits for pollution abatement, and to state agencies on trucking regulation. Served as staff antitrust economist on major food industry merger. Prepared to testify as antitrust expert witness in major chemical industry merger case. Served as staff economist on consumer protection case. Member, Secretary of Transportation's Task Force on Competition in the U.S. Domestic Airline Industry, 1989-90. Reviewed and critiqued drafts of the Secretary's Airline Competition Report.

Junior Staff Economist, Council of Economic Advisers, Executive Office of the President, Washington, D.C., July 1984-July 1985.

Responsible for monitoring transportation and regulation issues. Wrote comments to the Civil Aeronautics Board on allocating landing rights at capacity-constrained airports. Edited chapters in the Economic Report of the President on contests for corporate control and health care. Devised the pricing plan for the space shuttle cargo bay that was adopted by the Administration.

Lecturer and Teaching Fellow in Economics, Yale University, 1983-84, 1985-87.

Taught undergraduate seminar on topics in Industrial Organization. Assisted in a graduate course in microeconomics, an undergraduate seminar in macroeconomics, and intermediate level courses in industrial organization and regulation.

PUBLISHED ARTICLES IN REFEREED JOURNALS:

"Value of storage and wind power in South Korea's electricity markets," (with Shcherbakova, Blumack, and Cho), Wind Energy, forthcoming.

"Valuing Electricity Transmission: The Case of Alberta" (with Doucet and Fikirdanis). 36 Energy Economics (2013) 396-404.

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"Testing the Efficacy of Telemedicine: A Detection Controlled Estimation Approach" (with W. David Bradford, R. R. Re, and M. A. Krousel Wood), Health Economics, 10 (2001) 553-564.

"Measuring Potential Efficiency Gains from Deregulation of Electricity Generation: A Bayesian Approach" (with M. Dek Terrell), Review of Economics and Statistics, 83:3 (August 2001) 523-530.

"Stochastic Cost Frontier Estimation of Hospital Production Functions" (with W. David Bradford, R. R. Re, and M. A. Krousel Wood), Review of Economics and Statistics, 83:2 (2001) 302-309.

"Defining Electricity Markets: An Arbitrage Approach," Resource and Energy Economics 23 (2001) 259-270.

"Creating the Public Good to Fight Monopolization: The Formation of Broadcast Music, Inc.", Review of Industrial Organization 18:1 (August 2001) 243-256.

"Are Vertical Restraints Anti- or Pro-competitive? Lessons from *Interstate Circuit*" (with David A. Butz), Journal of Law and Economics 44:1 (April 2001) 131-160.

"Are Regional Oil Markets Growing Closer Together?: An Arbitrage Cost Approach," Energy Journal. 22:2 (April 2001) 1-15.

"ASCAP vs. BMI (*vs. CBS*): Modeling Competition Between Performance Rights Organizations," Economic Inquiry 38:4 (2000) 579-590.

"Horizontal Concentration and Anticompetitive Behavior in the Central Canadian Cement Industry: Testing Arbitrage Cost Hypotheses" (with Halldor P. Palsson), International Journal of Industrial Organization 17 (1999) 1189-1202.

"Cogeneration and Electric Power Industry Restructuring," (with David Dismukes), Resource and Energy Economics 21 (1999) 153-166.

"Did Open Access Integrate Natural Gas Markets? An Arbitrage Cost Approach," Journal of Regulatory Economics 14 (July 1998) 19-33.

"Environmental Protection, Bureaucratic Incentives, and Rent-Extraction: The Regulation of Water Pollution in Louisiana" (with Meredith A. Pierce and R. Carter Hill), Journal of Regulatory Economics 13 (March 1998) 121-137.

Does It Matter That the Prosecutor is Also the Judge: The Administrative Complaint Process at the Federal Trade Commission (with Malcolm B. Coate), 19 Managerial and Decision Economics 19 (1998) 1-11.

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"Market Failure or Market Efficiency? Evidence on Airport Slot Usage" (with Bruce Kobayashi). Research in Transportation Economics 4 (1996) 1-32.

"Is There Anticompetitive Behavior in the Central Canadian Cement Industry?: Testing Transaction Cost Hypotheses" (with Halldor P. Palsson), Canadian Journal of Economics 29:2 (May 1996) 343-356.

"Disentangling Regulatory Policy: The Effects of State Regulations on Trucking Rates" (with Timothy Daniel), Journal of Regulatory Economics 8:6 (November 1995) 267-284.

"Fight, Fold or Settle?: Modeling the Reaction to FTC Merger Challenges" (with Malcolm B. Coate and Rene Bustamonte), Economic Inquiry 33:4 (October 1995) 537-551.

"Exclusion, Collusion, or Confusion?: The Underpinnings of Raising Rivals' Costs," (with Malcolm B. Coate), Research in Law and Economics 16 (1994) 73-93.

"Antitrust, Rent-Seeking, and Regulation: The Continuing Errors of *Otter Tail*" (with Robert J. Michaels), Antitrust Bulletin 39:3 (Fall 1994) 689-725.

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"Antitrust Policy for Declining Industries," (with Malcolm B. Coate) Journal of Institutional and Theoretical Economics 147:3 (September 1991) 477-498.

PUBLISHED ARTICLES IN REFEREED JOURNALS (continued):

"*Terminal Railroad* Revisited: Foreclosure of an Essential Facility or Simple Horizontal Monopoly?" (with David Reiffen), Journal of Law and Economics 33:2 (October 1990) 419-438. Reprinted in "Landmark Antitrust Decisions Revisited," The Journal of Reprints for Antitrust Law and Economics 26:2 (1997) (Blair and Esquibel, eds.), pages 681-702.

"The Unclogged Bottleneck: Why Competitive Access Should Not Be an Antitrust Concern," Logistics and Transportation Review 26:3 (September 1990) 229-247.

"The Effect of Annual Changes in Automobile Fuel Economy Standards," Journal of Regulatory Economics, 2:2 (June 1990) 151-172.

"The Efficiency Effects of Railroad Deregulation in the United States," (with Christopher C. Barnekov) International Journal of Transport Economics 17:1 (February 1990) 21-36.

LAW REVIEW ARTICLES

"Commodity Exchanges and Antitrust" (with James M. Falvey), 4:1 Berkeley Business Law Journal (Spring 2007).

"The Mystery of *Lorain Journal* and the Quest for Foreclosure" (with John E. Lopatka), Texas Law Review 73:6 (May 1995) 1255-1306. Reprinted in "Landmark Antitrust Decisions Revisited," The Journal of Reprints for Antitrust Law and Economics 26:2 (1997) (Blair and Esquibel, eds.), pages 703-756.

BOOKS AND MONOGRAPHS:

Electricity Restructuring: The Texas Story, (coeditor with Lynne Kiesling), American Enterprise Institute Press (2009).

Electric Choices: Deregulation and the Future of Electric Power (editor) Rowman and Littlefield, London (2006).

Antitrust and Competition Policy (editor) Edward Elgar Publishing, Cheltenham, UK (2005).

Comparing Electricity Regulation in California and Pennsylvania: Implications for the Appalachian Region (with Timothy J. Considine), Final Report to the Appalachian Regional Commission, ARC Contract Number CO-12884 (January 2002), 113 pages, www.arc.gov/images/reports/utility/UtilityDereg.pdf.

Competition Policy Enforcement: The Economics of the Antitrust Process (coedited with Malcolm B. Coate). Kluwer Publishing (1996), 260 pages.

Disentangling Regulatory Policy: The Effects of State Regulations on Trucking Rates (with Timothy Daniel). Federal Trade Commission (November 1995), 70 pages.

BOOK CHAPTERS:

Direct to Consumer Advertising: Research Amid the Controversy (with W. David Bradford). Chapter 31, pages 329-34 in Elgar Companion to Health Economics (Andrew N. Jones, editor) Cheltenham, UK (2012).

"Introduction: Telling the Texas Story," (with Lynne Kiesling) in Electricity Restructuring: The Texas Story, (Kiesling and Kleit, editors), American Enterprise Institute (2009).

"Market Monitoring, ERCOT Style," in Electricity Restructuring: The Texas Story, (Kiesling and Kleit, editors), American Enterprise Institute (2009).

"Introduction," pages 1-8 in Electric Choices: Deregulation and the Future of Electric Power (Andrew N. Kleit, editor) Rowman and Littlefield, London (2006).

"Can Electricity Restructuring Survive? Lessons from California and Pennsylvania" (with Timothy Considine), pages 39-62 in Electric Choices: Deregulation and the Future of Electric Power (Andrew N. Kleit, editor) Rowman and Littlefield, London (2006).

"Direct to Consumer Advertising (with W. David Bradford), Chapter 29, pages 306-316 in Andrew M. Jones (editor) Elgar Companion to Health Economics, Edward Elgar Publishing Cheltenham, UK (2006).

"Introduction," chapter in Antitrust and Competition Policy (Andrew N. Kleit, editor) Edward Elgar Publishing, Cheltenham, UK (2005).

"Metering in Electricity Markets: When is More Better?" (with Joseph Doucet) pages 87-108 in Markets, Pricing, and Deregulation of Utilities (Michael A. Crew and Joseph C. Schuh, ed.) Kluwer Academic Publishers Boston (2002).

"Are Electricity Markets Getting Closer Together?: An Arbitrage Cost Approach for Market Integration Analysis," pages 41-54 in Expanding Competition in Regulated Industries (Michael Crew, ed.) Kluwer: Boston (2000).

"Using Advertising to Generate Information and Signals for Product Quality: Lessons for Biotechnology Markets in Canada From Pharmaceutical Markets in the United States," pages 257-275 in Biotechnology and the Consumer (Knoppers and Mathios, eds.) Kluwer: Boston (1999).

"Introduction: The Economics of the Antitrust Process," (with Malcolm B. Coate) in Competition Policy Enforcement: The Economics of the Antitrust Process (Coate and Kleit, eds.). Kluwer Publishing (1996).

OTHER PUBLISHED ARTICLES:

"If You Buy the Power, Why Pay for the Powerplant? Reforming Texas Electricity Markets," (with Robert J. Michaels). Forthcoming, Regulation 36:2 (Summer 2013).

"Impact of Electricity Restructuring on Rural Pennsylvania" (with Seth A. Blumsack and others), Report to the Center for Rural Pennsylvania, March 2011, http://www.rural.palegislature.us/electricity_restruct2011.pdf

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"Monopsony" entry in Encyclopedia of Business Ethics and Society (Robert W. Kolb, general editor) Sage Publishing (London) November 2007.

"Evaluating the Welfare Effects of Drug Advertising" (with W. David Bradford) Regulation 28:1 (Spring 2006) 58-62.

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"Comparing Willingness to Pay for Telemedicine Across a Chronic Heart Failure and Hypertension Population," (with Bradford, Kleit, Krousel-Wood and Re) Telemedicine Journal, 11:4 (2005) 450-438.

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"Impacts of Long-Range Increases in the Corporate Average Fuel Economy (CAFE) Standard," AEI-Brooking Joint Center on Regulation Working Paper 02-10, October, 2002, http://www.aei.brookings.org/publications/abstract.php?pid=284.

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"Uncommitted Entry and Repositioning Under the *Merger Guidelines*: Fringe Competitors in Your Industry are Closer Than They Appear" (with Stephen Stockum) 1:1 Clayton Act Newsletter (2000) 13-18.

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"Will Competitors Be Allowed To Compete? The Regulation of Long-Term Contracts in the Telecommunications Industry." (with Dennis Weisman), *info* 1:5 (1999) 389-395.

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"Divorced from the Facts: Retail Gasoline Divorcement Redux," (with Larry Goldstein and Ron Gold) Oil and Gas Journal November 8, 1998, 27-33.

"How the Market Self-Polices Against Predatory Pricing" (with Donald J. Boudreaux), Competitive Enterprise Institute Monograph, June 1, 1996.

"Cleaning Hands In Predation Cases: A Modest Proposal To Improve Predatory-Pricing Suits" (with Donald J. Boudreaux), Competitive Enterprise Institute Monograph, October 1, 1996.

"Predation in the Classroom," Classroom Experinomics, 4:2 (1995) 3-10.

"The Perfect Is Not The Enemy of the Good," (with Margaret Sanderson) Canadian Competition Policy Record 13:2 (June 1992) 48-51.

"Competition Without Apology: Market Power and Entry in the Deregulated Airline Industry," Regulation 14:3 (Summer 1991) 68-75.

"Blackout at Bonneville Power," (with Richard L. Stroup) Regulation 11:2 (1987) 30-36.

OP-ED PIECES:

"Coal, Oil and the Price We're Willing to Pay," CNN.COM, April 27, 2010, http://www.cnn.com/2010/OPINION/04/27 kleit.energy.coal/index.html.

"Consumers Win With Competition in Electricity," (with Nick Dranias and Bill Peacock) Arizona Republic, January 9, 2010, http://www.azcentral.com/arizonarepublic/ opinions/articles/2010/01/08/20100108dranias09.html.

"Texas Plan Would Spark Energy Grid," Arizona Republic, December 8, 2008. http://www.azcentral.com/ arizonarepublic/opinions/articles/2009/12/08/20091208kleit08.html,

"Let Competition Deliver Necessary Jolt to Energy Prices," Wilkes-Barre Times Leader, September 28, 2010, http://www.timesleader.com/opinion/commentary/ Let_competition_deliver_necessary_jolt_to_energy_prices_Commentary_Andrew_N__Kleit_09-28-2009.html.

"Pennsylvania Must Move Forward on Electricity Competition," Harrisburg Patriot News, June 9, 2009, http://www.pennlive.com/editorials/index.ssf/ 2009/06/pennsylvania_must_move_foward.html.

"It Wasn't Deregulation That Failed," Orange County Register, July 2, 2003.

"How to Streamline Antitrust," Wall Street Journal, March 4, 1997.

"Last Vestige of a Silly Energy Policy," New York Times, August 3, 1986.

EDITORIAL BOARDS

Journal of Consumer Research 1999-2008
Journal of Regulatory Economics 1999-Present
Energy Studies Review, 2001 to 2006
Regulation, 2010-Present

REFEREE:

Advances in Econometrics
American Economic Review
Australian Economic Papers
Bulletin of Economic Research
Economic Inquiry
Energy Journal
Health Economics
Journal of Consumer Research
Journal of Economic Education
Journal of Environmental Economics and Management
Journal of Industrial Economics
Journal of Law and Economics
Journal of Transportation and Statistics
Journal of Regulatory Economics
Logistics and Transportation Review
Managerial and Decision Economics
Quarterly Review of Economics and Business
Research in Law and Economics
Research in Transportation Economics
Review of Industrial Organization
National Science Foundation

RESEARCH GRANTS

"Modeling Strategic Rare Earth Supply Chains: a Geographic Data Management Approach," Defense Logistics Agency, U.S. Department of Defense, August 2012-July 2013 Co-Principle Investigator ($90,000).

"Demand Response Management in the Philadelphia Naval Yard, Principle Investigator, Greater Philadelphia Innovation Cluster," U.S. Department of Energy, February 2011 to January 2012 ($110,000).

"The Costs of Pennsylvania's Renewable Portfolio Standards," Internal funding from Penn State, January to August 2011.

"Policy Issues for Rare Earth Elements," Penn State Institutes of Energy and the Environment, Principle Investigator ($40,000), June 2010 to May 2013, This grant was supplemented by a $15,000 grant from the Penn State Electro-Optics Center, August 2012-May 2013.

"Retail Competition for Electricity in Pennsylvania," Penn State Electricity Markets Initiative, Principle Investigator ($61,000), June 2010- to May 2011.

"Assessing and Mitigating Rising Electricity Prices in Rural Pennsylvania," Center for Rural Pennsylvania, Principle Investigator ($50,000), January 2009 to December 2009).

"Effect of FDA Boxed Warnings and Public Information on Pharmaceutical Use," Agency for Healthcare Quality Research and Quality (September 2007 to August 2011), Co-Principle Investigator ($1,172,609).

"What is a 'Better' Prediction System? Combining Statistical and Economic Metrics of Prediction Quality," National Science Foundation, Program in Decision Making, Risk, and Uncertainty, September 2007 to August 2010, Co-Principle Investigator ($749,992).

"Decision Markets and Uncertainty in Weather Forecasting," National Science Foundation, Program in Decision Making, Risk, and Uncertainty, January 2006 to December 2009, Co-Principle Investigator ($475,692).

"Impact of Direct to Consumer Pharmaceutical Marketing," Agency for Healthcare Research and Quality, July 2003 to June 2006, Co-Principle Investigator ($551,502).

"DTC Advertising Effect on Adherence to Statin Therapy," National Heart, Lung and Blood Institute, July 2004 to May 2007, Co-Principle Investigator ($480,280).

Estimating the Settlement Process in Environmental Litigation: A Game-Theoretic Approach (Principal Investigator), National Science Foundation, Law and Social Science Program, $60,000, September 2002 to August 2003.

"Advanced Telecommunications in Rural Pennsylvania (Co-Principal Investigator), Center for Rural Pennsylvania, $49,000, January 2002-March 2003.

"The Economics of Electricity Metering," Principal Investigator, Alberta Ministry of Energy, September 2001-December 2001, $4000.

"The Impact of Automobile Fuel Economy Standards," Principal Investigator, General Motors Corporation, June 2001-December 2001, $12,400.

"Comparing Electricity Deregulation in California and Pennsylvania: Implications for the Appalachian Region," (Co-Principal Investigator) Appalachian Regional Commission Number CO-12884, $89,000, June 2000-May 2001

"Detection Controlled Estimation in the Presence of Sample Selection Bias: Applications to California's Motor Vehicle Inspection Program," Principal Investigator. Wilson Research Fund, College of Earth and Mineral Sciences, $7500, May 2000-April 2001.

"Mammography and Detection Controlled Estimation," Grant 1 R03 HS 10068-01, Principal Investigator, Agency for Health Care Policy Research, $66,380, July 1999 to June 2000.

"Extension of The Role of Technology in Health Care Costs," Department of Energy, Sandia National Laboratories, Contract No AN6261. September 1997 to December 1999 ($1 million). Varying Percentage Effort.

"Estimating the Efficiency Effect of Electricity Deregulation in Louisiana" (Co-Principal Investigator, with M. Dek Terrell). Louisiana Energy Enhancement Program, 1997-98, $21,345.

"Cogeneration and Electric Power Industry Restructuring," (Co-Principal Investigator with David Dismukes). Louisiana Energy Enhancement Program, 1996-97, $22,401.

"The Role of Technology in Health Care Costs," Department of Energy, Sandia National Laboratories, Contract No AN6261 May 1995 to April 1997 ($1.2 million). Varying Percentage Effort.

PUBLIC PRESENTATIONS:

Keynote Speaker, "Understanding the Restructured Electricity Industry and the Move Towards Full Wholesale & Retail Electricity Competition: Impact on Electric Rates, Reliability & Quality, the Economy and the Environment," Fifteenth Annual Ohio Energy Management Conference, Columbus, Ohio, February 22, 2011.

Panelist, "Caps-Off," television program on electricity restructuring in Pennsylvania, WITF-TV Harrisburg (Public Broadcasting System) November 2009.

Presentation, "Opening The Arizona Grid," discussing the potential for electricity restructuring in Arizona, before Representative Lucy Mason and colleagues, Arizona House of Representatives, November 2009. Presentation made on behalf of the Goldwater Institute.

"The Carbon Constrained Economy and its Impacts on Pennsylvania's Electricity Market," Pennsylvania Chamber of Commerce, Harrisburg, PA, June 4, 2009.

As part of the promotion for my volume Electric Choices: Deregulation and the Future of Electric Power I conducted 25 radio interviews in January 2008, including interviews on Air America, the Star Talk Radio Network, WLW (Cincinnati), WTEK (Houston) and XEPE (San Diego). One of my interviews can be found in the archives at TerryLowry.com.

Guest on Pennsylvania Inside Out, public affairs program on WPSU-TV, State College, PA, Pennsylvania Inside Out, WPSU-TV, January 24, 2008. Topic: Energy Independence, http://www.wpsu.org/insideout/archives_detail.php?id=01242008173000

Guest on Pennsylvania Inside Out, public affairs program on WPSU-TV, State College, PA, October 11, 2006 Topic: The Effect of Drug Ads, wpsu.psu.edu/insideout/ archives_detail.php?id=10112006173000.

Presentation at Food and Drug Administration, Public Hearing on Direct-to-Consumer Promotion of Medical Products, November 1 and 2, 2005, "The Effect of Direct to Consumer Television Advertising on the Timing of Treatment," http://www.fda.gov/cder/ddmac/dtc2005/Kleit.ppt.

Statement and answering questions from Commissions and Staff, "Non-Transmission Barriers to Entry," Technical Conference, Market Based Rates for Public Utilities, Docket No. RM04-7-000, Federal Energy Regulatory Commission, December 7, 2004.

Consultant for Pennsylvania Legislative Budget and Finance Committee on gasoline market report, July – October, 2000. Testified before the committee, October 2000.

Testified before Pennsylvania House of Representatives Consumer Committee on oil price increases, April 2000.

LEGAL AND REGULATORY TESTIMONY

Submitted statement, "Title Insurance Regulation in the Face of Reverse Competition," (with Keith Crocker) to the Insurance Commissioner of Pennsylvania, May 2009, on behalf of the Pennsylvania Office of the Attorney General. Presented testimony to and answered questions from Insurance Commissioner at hearing, May 28, 2009. Submitted additional statement, July 2009. See http://www.ins.state.pa.us/ins/cwp/view.asp?a=1280&Q=549944&PM=1.

Submitted expert witness statement for Eastern Petroleum in Johnson and Johnson vs. Eastern (Circuit Court for Prince George's County, MD, CASE NO.: CAL 07-12671), petroleum distribution pricing matter. Deposition, May 2009.

Submitted expert witness statement for Eastern Petroleum in Kazemzadeh v. Eastern Petroleum Corp, (Superior Court for the District of Columbia, Civil Action No.: 2006 CA 009077 B.) petroleum distribution pricing matter. Deposition, March 2009.

Cross-examination before Public Service Commission Administrative Law Judge, March 2006 on submitted testimony and rebuttal testimony to the New York Public Service Commission (with L. Lynne Kiesling) on behalf of Direct Energy in NYSEG Rate Plan, Case 05-E-1222, February 2006.

Deposition May 2004 on statement on behalf of BP in Feeley v. BP, Circuit Court of Baltimore County, Case No. 03-c-02-11605, April 2004.

Testified on behalf of Williams Companies to the Mississippi Public Service Commission on Electricity Restructuring, April 1998.

Made presentation on behalf of Enron on electricity restructuring to the New Orleans City-Council, October 1997.

Depositions, April and May 1994 on Verified Statement on behalf of the Union Pacific Railroad in Union Pacific Corp., Union Pacific R.R. & Missouri Pacific R.R. -- Control -- Chicago & North Western Holdings Corp. and Chicago and North Western Transportation Co., April 1994, before the Interstate Commerce Commission. Analyzed issues of market power and efficiencies.

OTHER CONSULTING EXPERIENCE:

Submitted expert witness statement in Royal Mile Company Inc, et. al. vs UPMC and Highmark, Case No. 2:10-cv-01609-JFC, January 2013.

Consultant for Eastern Petroleum in *Kazemzedah vs. Eastern*, petroleum distribution pricing matter, 2008-9. Prepared expert witness statement.

Prepared Expert Witness Testimony for Pennsylvania and Ohio Offices of the Attorney General in landfill merger matter, Fall 2008.

Prepared Expert Witness Testimony for Pennsylvania Office of the Attorney General in natural gas pipeline merger matter, Spring 2007.

)

Submitted Testimony to New York Public Service Commission (with L. Lynne Kiesling) on behalf of Direct Energy in Proceeding on Motion of the Commission as to Policies, Practices and Procedures For Utility Commodity Supply Service to Residential and Small Commercial and Industrial Customers, Case 06-M-1017, November 2006. Rebuttal comments submitted December 2006. Submitted additional comments June 2007.

Submitted comments to the Federal Energy Regulatory Commission on behalf of Direct Energy in Exelon/PSEG, Docket No. EC05-43-000, April 2005.

Economic Analysis of the Proposed Merger of OSI and CooperVision (with Elhauge and Singer). White Paper on behalf of 1-800-CONTACTS, http://criterioneconomics.com/docs/merger_white_paper_final.pdf

"The Economics of Gasoline Retail Markets," grant from the American Petroleum Institute, 2003.

Verified Statement on behalf of the Kansas City Southern Railroad in Kansas City Southern Railroad Company – Control – The Texas and Mexican Railroad, before the Surface Transportation Board, September 2003. Analyzed vertical competition issues in the railroad industry.

"The Costs and Benefits of NHTSA's Proposed Increase in Truck CAFE Standards." Notice of Proposed Rulemaking, Light Truck Average Fuel Economy Standards Model Years 2005-2007, National Highway Traffic Safety Administration, Docket No. 2002-11419, February 15, 2003. Submitted on Behalf of General Motors.

Consultant for the Pennsylvania Office of the Attorney General on market power in electricity capacity markets, 2002-2003.

"Metering in Electricity Markets: Should it Be Encouraged?", (with Joseph A. Doucet), report for the Alberta Ministry of Energy March 2002.

"Short- and Long-Range Impacts of Increases in the Corporate Average Fuel Economy (CAFE) Standard," report for the General Motors Corporation, January 2002.

"The Economics of the Municipal Waste Collection, Transportation, and Disposal Industry in Pennsylvania," (with Thomas C. Kinnaman), report for the Pennsylvania Waste Industry Association, December 2001.

Analyzed issues related to a patent antitrust case in the pharmaceutical industry, In the Matter of Hoechst Marion Roussel, Inc., (Docket No. 9293 Federal Trade Commission) for Glassman-Oliver Economic Consultants, Inc., Washington, D.C., 2000.

Filed testimony on behalf of the Upper Dauphin Area Citizens' Action Committee in Dauphin Meadows, Inc. v Pennsylvania Department of Environmental Protection, Environmental Hearing Board Docket No. 99-190-L, February 2000. Analyzed costs and benefits of proposed landfill expansion.

Analyzed issues related to indirect damages and overcharge pass-through in a large class-action case for Glassman-Oliver Economic Consultants, Inc., Washington, D.C., 1999-2000.

Analyzed antitrust issues in the minerals and hospital industries for Glassman-Oliver Economic Consultants, Inc., Washington, D.C., 1997.

"Economic and Political Markets for Airport Landing Slots," prepared for Citizens for a Sound Economy, August 1993.

"The Economics of Airline Computer Reservation Systems," prepared for American Airlines, June 1993.

Exhibit #5

July 2013

VITA
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PROFESSIONAL EXPERIENCE

University of Arizona, Department of Economics
- Eller Professor of Economics
- Department Head (1998 – 2001)
- Professor (1994 – present)
- Associate Professor (1988 – 1994)
- Assistant Professor (1982 – 1988)

University of Arizona, Eller College of Management, Vice Dean (2004 – 2008)
Universidad Autónoma, Instituto de Análisis Económico, Barcelona, Visiting Scholar, Fall 2002.
Charles University, Prague, Visiting Professor of Economics, Center for Economic Research & Graduate Education, 1997.
University of Virginia, Visiting Associate Professor of Economics, Summer 1990.

EDUCATION

1983: Ph.D. in economics; Northwestern University
1977: M.A. in economics; Northwestern University
1976: B.A. cum laude, in mathematics; Miami University

PROFESSIONAL ACTIVITIES

Antitrust Economics Expert – Consultant for construction industry case for Gammage & Burnham, Attorneys at Law, Phoenix, AZ. 2002 – 2003.
Organized symposia on Electricity Industry Restructuring and Public Policy, Phoenix, Arizona: 2001, 2002 & 2003.

EXHIBIT 5

Chair of Social and Behavioral Sciences Review Panel for the Texas Higher Education Coordinating Board's 2001 grants competition.
Panelist at Conference of Western Attorneys General (CWAG) Energy Summit in Phoenix, AZ - October 2001. Topic: Collusion, Market Manipulation and Pricing Irregularities in the California Electricity Market.
Appointed member of Tucson Telecommunications Policy & Advisory Committee 2000 – 2001.
Expert testimony on the Arizona gasoline market before Arizona Joint Legislative Committee on Transportation, October 1998.
National Science Foundation Dissertation Fellowship Review Panels, 1994 – 96.
Consultant on gasoline market competition, Navajo Refining Co., 1993.

TEACHING EXPERIENCE

Principles of Economics
Microeconomics (Intermediate, Graduate)
Economics of Strategy (Undergraduate)
Managerial Economics (MBA)
Competitive Strategy (MBA)
Industrial Organization (Undergraduate and Graduate)
Energy Markets and Environmental Economics (Undergraduate)
Energy, the Environment & Business Strategy (MBA)

RESEARCH INTERESTS

Industrial Organization
Energy Economics
Applied Microeconomic Theory
Experimental tests of market mechanisms

REFEREED ARTICLES

"The Economics of Solar Electricity", with Erin Baker, Meredith Fowlie and Derek Lemoine, forthcoming in *Annual Review of Resource Economics*.

"Pivotal Suppliers and Market Power in Experimental Supply Function Competition", with Jordi Brandts and Arthur Schram, forthcoming in *Economic Journal*.

"Supply Function Equilibria with Capacity Constraints and Pivotal Suppliers", (with Talat Genc), *International Journal of Industrial Organization*, 29 (July 2011).

"Auctions with a Buy Price", (with John Wooders), *Economic Theory*, 38 (January 2009), 9-39.

"Dynamic Oligopolistic Games Under Uncertainty: A Stochastic Programming Approach", (with Talat Genc and Suvrajeet Sen) *Journal of Economic Dynamics and Control*, 31 (January 2007), 55-80.

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UNIVERSITY AND COLLEGE SERVICE

University Level:

Faculty Senate, elected representative (four years)
Faculty Senate Budget and Planning Committee (one year as chair)
Strategic Planning and Budget Committee
Institutional Research College Advisory Council
Graduate Council
University Promotion and Tenure Committee (one year as chair)
University Fees Committee
Ad hoc Committee on Differential Tuition
Engineering Dean Review Committee
Sierra Vista (branch campus) Dean Review Committee
Search Committee for Vice Provost
Institute of the Environment – Faculty Advisory Committee
Arizona Research Institute for Solar Energy – Faculty Advisory Committee

College Level:

College Promotion and Tenure Committee
Graduate Professional Studies Committee
Research and Doctoral Studies Committee
Finance Department Head Review Committee, chair
Economic Science Laboratory Advisory Committee
Ad hoc IT Strategy Committee
Accounting Department Academic Program Review Panel
College Advisory Committee (faculty governance committee)
MBA Review Committee, co-chair
Ad hoc Accreditation Committee, chair