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Electricity Markets and Energy Security: Friends or Foes?

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RESOURCES
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Abstract

For a host of economic, geopolitical, and environmental reasons, the security of energy supplies has moved to the forefront of U.S. policy concerns. Here, I address the extent to which the U.S. electricity sector is affected by these factors and, in turn, whether increased electricity competition exacerbates them. After defining four dimensions of energy security that might pertain to electricity, I examine the role of global energy markets on that sector. Oil is currently used to generate only a small fraction of U.S. electricity supplies, although as recently as the late 1970s it generated about one-sixth of the total. Oil markets can affect electricity indirectly via substitution with natural gas. Competition in electricity markets should improve energy security by adding redundancy, but competition is threatened by unanticipated price increases, peak-load management, and risks associated with separating competitive generation from regulated transmission and distribution. Other complications include residential aversion to competition, residual market power, and the aspiration to reduce demand through conservation policies. The central security issue has been and remains the degree of conflict between competition and central control necessary to maintain reliability of the grid.

Key Words: electricity markets, electricity market restructuring, energy policy, energy security

JEL Classification Numbers: L94, Q48, L51

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Timothy J. Brennan*

Introduction

Throughout the last 30 or 40 years, energy policy has made brief forays from its usual location on the back burner of the policy stove. One of those forays is taking place now, and this time a confluence of at least three factors suggests that energy policy may settle into a more permanent place on the front burner. A relatively long span of declining real oil prices—which fell by almost 75 percent in real terms between 1980 and 2000—has ended, with prices close to the levels that followed the oil embargos of the 1970s.[1] Although high prices are likely to stimulate supplies of what the U.S. Department of Energy (DOE) classifies as "unconventional liquids," DOE does not expect prices to fall significantly.[2] In the face of increasing economic growth around the world—particularly in India and China—and, in the views of some, declining supplies of readily extractable reserves, prices may continue to rise.[3]

Second, oil figures into the persistent political instability in the Middle East. Many believe that the continuing involvement of the United States in armed conflict in Iraq is tied to its need to maintain the flow of oil from this region.

The third development is the increased attention to global climate change. Perhaps stimulated by the success of former Vice President Al Gore's film and book, *An Inconvenient Truth*,[4] along with recent temperature trends,[5] governments around the world are taking action to

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[1] U.S. Department of Energy (DOE) Energy Information Administration (EIA), *Annual Energy Outlook: 2007* (Washington, DC: DOE, 2007): 70 (hereafter, AEO 2007).

[2] *Id.*

[3] *Platt's Oil Price Risk-Management*, "High Indian, Chinese Demand Squeezes Supply, Keep Prices Volatile" (Apr. 20, 2005), available at http://www.platts.com/Oil/Resources/News%20Features/riskmanagement/index.xml.

[4] Gore, Al, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It* (Emmaus, PA: Rodale, 2006).

mitigate carbon dioxide (CO_2) emissions that contribute to global warming.[6] Although the U.S. federal government has not taken much substantial action, other governments, both at the U.S. state level and in other nations, are setting policies to limit CO_2 emissions. Notable examples include the European Union's cap-and-trade system[7] and the Regional Greenhouse Gas Initiative (RGGI) in the United States.[8] These developments are related, to be sure, because the leading contributor to CO_2 concentrations in the atmosphere is the burning of carbon-based fossil fuels, including oil, coal, and natural gas.

At the same time that these concerns have affected world oil markets, the U.S. electricity sector has been the focus of public concern and policy initiatives. Since the mid-1990s, the United States has embarked on a journey with the goal of transforming a vertically integrated, top-to-bottom regulated electricity sector into one in which competition among independent energy suppliers sets prices charged to local utilities and, eventually, to commercial users and households.[9] This path has not been smooth. Its most prominent sinkhole was the implosion of the California electricity market in the fall of 2000, which continued through the spring of 2001.[10] In addition, much of the Northeast suffered under a massive blackout in August 2003.[11] At the residential level, customers have not generally taken advantage of opportunities to choose residential suppliers. More recently, as price controls imposed as part of the political bargain

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[5] Intergovernmental Panel on Climate Change, *Climate Change 2001—Synthesis Report*, "Global Temperature Change, 1861-2000 and 1000-2000" (2001), available at http://www.ipcc.ch/present/graphics/2001syr/ppt/05.16.ppt, linked from IPCC, *Presentations and Graphics*2-3, available at http://www.ipcc.ch/present/graphics.htm, accessed Nov. 2, 2007.

[6] European Commission, Director General-Environment, "Climate Change" (Aug. 16, 2007), available at http://ec.europa.eu/environment/climat/home_en.htm; Pew Center on Global Climate Change, "What's Being Done in the World," available at http://www.pewclimate.org/what_s_being_done/in_the_world, accessed Aug. 23, 2007.

[7] Kruger, Joe, and William Pizer, "The EU Emissions Trading Directive: Opportunities and Potential Pitfalls," RFF Discussion Paper DP 04-24 (April 2004), available at http://www.rff.org/documents/RFF-DP-04-24.pdf

[8] Regional Greenhouse Gas Initiative, "About RGGI," available at http://www.rggi.org/about.htm, accessed Aug. 23, 2007.

[9] Brennan, Timothy, Karen Palmer, and Salvador Martinez, *Alternating Currents: Electricity Markets and Public Policy* (Washington, DC: RFF, 2002).

[10] Brennan, Timothy, *The California Electricity Experience, 2000-2001: Education or Diversion?* (Washington, DC: RFF, 2001).

[11] U.S.-Canada Power System Outage Task Force, *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations* (Washington, DC: DOE, 2004), available at https://reports.energy.gov/BlackoutFinal-Web.pdf.

expire, customers in some localities are facing increases in electricity prices of as much as 50 percent.[12]

These developments give rise to the question: To what extent is overall energy security affected by competition in the electricity sector? To address this question, I begin with a variety of topics that might fall under the energy security rubric when it comes to electricity. Next, I examine the extent to which global oil markets and environmental concerns affect these dimensions of electricity security. With that as background, most of my discussion centers on why markets should improve security. I also examine the reasons why competition in electricity markets has proven exceedingly difficult to institute and may exacerbate some of these security concerns, particularly supply reliability.

Energy Security in Electricity: Multiple Dimensions

Even when restricted to electricity, the term "energy security" can take on a number of different meanings or dimensions. Rather than adopt one at the risk of excluding others, it is useful to have as a reference point as many of these different meanings as is reasonable. Four such dimensions come to mind.

The Short Term

Following standard practice in economics, we can define the "short term" as the effects in a sector given the productive capacity already in place. From that perspective, energy security in electricity has two manifestations. One has to do with sheer availability—will outages be short, rare, and localized, or long, frequent, and widespread? I return to that aspect later. A second manifestation of short-term energy security has to do with the variation in the price of electricity, assuming that it is available. Blackouts are harmful, but so are high energy prices, particularly for those with low incomes for whom utility bills constitute a significant fraction of their monthly spending.

Importantly, and unfortunately, mitigating one of these security interests can exacerbate the other. The cost of preventing blackouts is quite high. Because electricity cannot be stored, it must be produced when it is demanded. And energy demand is far from constant; it can hit very

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[12] Baltimore Gas & Electric Company, "Rate Stabilization Update July 2007" (2007), available at http://www.bge.com/portal/site/bge/menuitem.caefa696086c677e0153ff10016176a0/gHref.

high peaks for short periods of time. The generation capacity needed to meet that demand, then, is in service for only a small fraction of time, perhaps 1/100 of a year (a year = 8,760 hours), and maybe less. Recovering the costs of that capacity in a short time makes that generation quite expensive, even if the generator employs technologies where the up-front capital costs are relatively small (e.g., using natural gas instead of nuclear or hydroelectric power).[13] This means that providing incentives to ensure that electricity will be available when needed—limiting the likelihood of a blackout—will make electricity expensive to produce during peak periods, potentially exacerbating insecurities arising from price fluctuations.

The Long Term

The security of the grid is not just a matter of supply and price in the short run. The viability of the electricity system in markets with growing demand depends on the expansion of capacity to generate, transmit, and distribute electricity. Numerous political and policy factors come into play here. Construction of power plants and transmission lines is often hampered by the NIMBY (not in my back yard) effect, in that everyone wants electricity generated as long as they do not see it. Some recent examples include the controversy about the Cape Wind installation off Cape Cod in Massachusetts, and the proposals to build new transmission lines through wealthy "horse country" in northern Virginia.[14]

A particular and related policy problem affecting transmission is that a line needed to improve the efficiency of delivering electricity between generators in one state and customers in another may have to traverse multiple other states. States along the path might resist having lines built, figuring that they are bearing costs and reaping none of the benefits. Recent federal legislation has given the Secretary of Energy the authority to order states to allow transmission construction, specifically to counteract this potential impediment to secure electricity supplies in the long run.[15]

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[13] See *infra* n. 34–35 and accompanying text.

[14] Ebbert, Stephanie, "Cape Wind Is Dealt a Setback: Bill Would Give Romney Final Say," *Boston Globe* (Apr. 7, 2006), available at http://www.boston.com/news/local/massachusetts/articles/2006/04/07/cape_wind_is_dealt_a_setback/; Somashekhar, Sandhya, "Dominion Virginia Has Inflated Power Needs, Some Experts Say: Opponents' Advisors Push Alternatives to High-Voltage Lines," *Washington Post* (Jan. 28, 2007): C03.

[15] Energy Policy Act of 2005 (H.R. 6), Public Law No: 109-58 (2005), Sec. 1221.

The Environment

Around the world, the threat of global climate change resulting from increased CO_2 atmospheric concentration is becoming more pressing. Assessing the science behind the probability and magnitude of that threat is beyond the scope of this paper, but its increased salience in public policy discussions, particularly in North America and the European Union, is noteworthy. As I mentioned earlier, examples include carbon permit trading programs in the European Union and among some U.S. states.[16] In addition, Canada selected a Liberal Party leader based in large measure on concerns about climate change and environmental sustainability.[17]

Environmental security plays a role in electricity for two reasons. First, most electricity in the United States (and much of it elsewhere) is produced by burning fossil fuels—primarily coal and natural gas—that emit CO_2 as a by-product. In 2005, fossil fuels burned to generate electricity produced 2363 million metric tons of CO_2, about 40 percent of the U.S. total.[18] Second, unlike automotive use of gasoline—the other major contributor to greenhouse gas emissions, producing about 32 percent in 2005—there are comparatively few electric power plants. This makes the plants relatively easy targets for efficient and effective policies to control emissions, such as carbon taxes or permit trading, based on the quantities that polluters actually emit.[19] Just as power plants were the initial participants in trading sulfur dioxide emissions permits, they are likely to be leading players in market-based policies to address CO_2 emissions.

National Security

A final security dimension is the realm of threats from external enemies, the most prominent of which these days involve terrorist threats to the public—either directly or to its infrastructure. Considering such threats here would be purely and highly speculative. In

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[16] See *supra* n. 6–8 and accompanying text.

[17] Liberal Party of Canada, "Stéphane Dion in Depth" (2007), available at http://www.liberal.ca/depth_e.aspx.

[18] Calculated from data for Figure 92, AEO 2007, *supra* n. 1 at 101, available at http://www.eia.doe.gov/oiaf/aeo/excel/figure92_data.xls.

[19] Transportation and other fuel uses can be targeted in one of two ways. First is "command and control" regulation, which mandates technology that reduces emissions or increases the level of performance per unit of fuel used (e.g., miles per gallon). Such regulations may be relatively easier to monitor, but they tend to lock in technologies and give consumers little incentive to take emissions from additional usage into account. Second, carbon taxes can be imposed on the producers of the fuels themselves, so those who use fuelsincorporate emissions-related costs of fuel use when they decide how much fuel to use, how much to drive, and what kinds of cars to buy.

assessing the effect of opening electricity markets to vulnerability to such threats, the interstate transmission system is the part of the electricity sector where an attack would probably wreak the most havoc.[20] Because of the interconnectedness of the transmission system, it remains regulated even if wholesale and retail markets for electricity become open. That continuing regulation suggests that the transmission sector is not affected by opening other markets, and so national security is not directly affected. To the extent that expanding competition among generators increases their propensity to sell to distant users, however, the transmission grid becomes an ever more crucial component of the electricity infrastructure.

Global Energy and U.S. Electricity

In understanding how opening electricity markets might speak to energy security issues, we should first recognize the extent to which electricity is a national or continental—rather than global—commodity. Geographic markets for bulk electricity are determined by the geographic coverage of transmission grids. The availability of electricity in area A is not relevant to that in area B if there is no transmission conduit between A and B (perhaps going through C and D). High-voltage transmission lines are required for transporting electricity, and because of cost and splicing considerations—and to keep lines from overheating—they are almost always aboveground. Underground transmission lines cover only relatively short distances and operate at low voltages.[21]

As a practical matter, these considerations preclude transoceanic transmission of electricity, making markets continental at most. Reflecting that reality, the United States imports relatively little electricity. In 2005, the latest year reported by the U.S. Energy Information Administration (EIA), the United States imported about 44.5 million megawatt-hours (mWh) of

[20] An attack on a power plant can create considerable local damage, particularly if the plant is nuclear-powered and the attack leads to substantial radiation leakage in a populated area.

[21] For example, in Wisconsin, the longest underground transmission line is only five miles and operates at less than half the voltage of aboveground lines. *Source:* Public Service Commission, State of Wisconsin, *Underground Electric Transmission Lines* (August 2004), available at http://psc.wi.gov/thelibrary/publications/electric/electric11.pdf.

electricity, not quite 1.1 percent of the just over 4 billion mWh we generated domestically.[22] Almost all of the imports are from Canada.

The main global energy security concern involves oil markets. In the short term, concerns about oil arise from the fact that a large share of the supply comes from parts of the world that are subject to considerable political instability, particularly directed at the United States. A related effect is that this supply is concentrated in a few countries that, in the past, have been able to cartelize the supply of oil as well as subject world oil markets to shocks from wars and boycotts.. Perhaps more important and more certain is the growth in demand as China and India, with nearly half the world's population, race toward the developing world in terms of per capita wealth and, as a result, much greater use of automobiles and other goods and services that rely on petroleum.

A potentially significant relationship between electricity and global energy security would exist if oil were an important part of electricity generation. At least in the United States, though, this effect is likely to be minor. As of 2005, only about 3 percent of U.S. electricity was generated by oil, down from 10 percent in 1949 and 1950.[23] The decline in the use of oil in U.S. energy generation has not been smooth, however. In the 1970s, when oil prices were skyrocketing because of OPEC embargos, the percentage of generation from oil rose to nearly 17 percent (Figure 1). The spike matched a temporary decline in the fraction of coal in the generation mix (Figure 2). Part of the explanation undoubtedly is that from about 1966 to 1974, the price of oil products relative to coal plummeted by about 50 percent by some measures, as indicated by the ratio of gasoline to coal prices (Figure 3.)[24] If current trends continue, the electricity sector is not likely to be directly vulnerable to variations in world oil markets, certainly not nearly to the same degree as the transportation sector.

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[22] Import data for 2005 from EIA, Electric Power Industry - U.S. Electricity Imports from and Electricity Exports to Canada and Mexico" (2006), available at http://www.eia.doe.gov/cneaf/electricity/epa/epat6p3.html; Total U.S. generation figures from Summary Statistics for the United States (2006), available at http://www.eia.doe.gov/cneaf/electricity/epa/epates.html.

[23] Calculated from EIA, Electric Power Sector by Plant Type, 1989-2006, available at http://www.eia.doe.gov/emeu/aer/txt/stb0802c.xls.

[24] The top line is constructed from coal data from the Bureau of Labor Statistics (BLS) and gasoline price data from EIA, *infra* n. 31. The second line uses a BLS index of prices for refined petroleum products petroleum product. This figure is instructive only. Oil-fueled generators use diesel fuel, not gasoline, but I used gasoline because a time series of prices for diesel fuel going back to 1949 was not available. Also, DOE's price for gasoline switches from leaded to unleaded regular in 1990, but in the last couple of years before the department stopped pricing leaded gasoline, the price of unleaded was reasonably close.

Figure 1. Percentage of Electricity Generated by Oil, 1949–2005

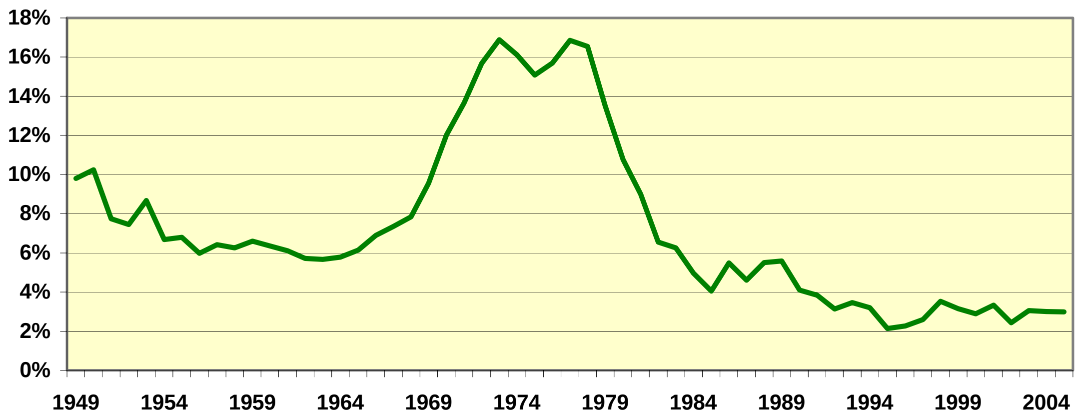


Figure 2. Percentage of Generation by Fuel, 1949–2005

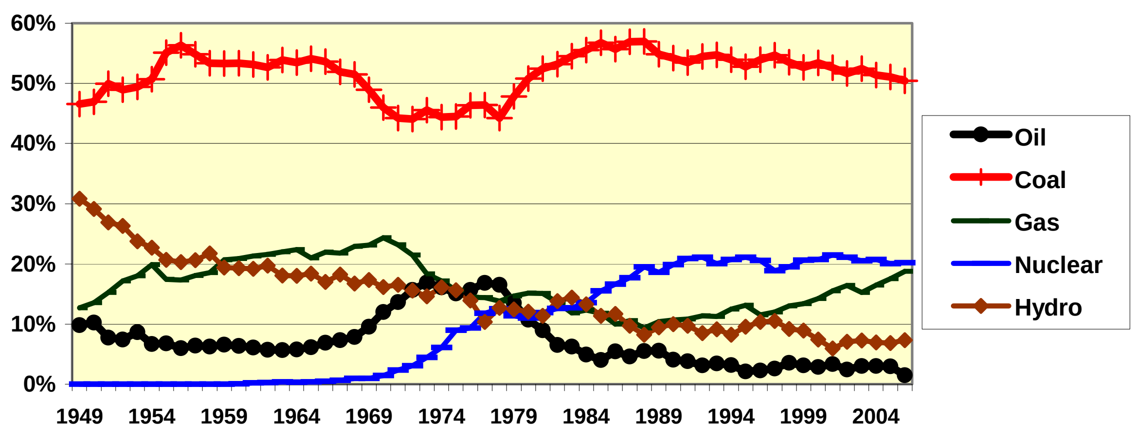
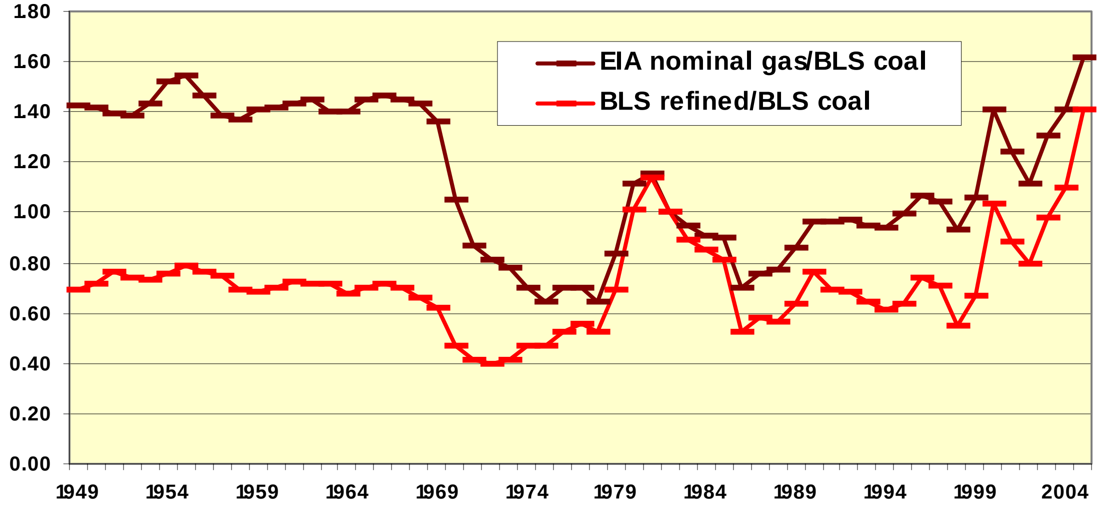


Figure 3. Gasoline/Coal Price Ratio, 1949–2005 (1982 = 1.00)



Notes: BLS = Bureau of Labor Statistics; EIA = Energy Information Administration

A less direct but potentially more significant relationship between oil markets and electricity use arises because of substitutions in other markets, particularly involving heating. For example, if the price of oil goes up, more consumers, offices, or factories might switch to electricity for heating and other power uses. We would see an even less direct but still important effect if consumers, particularly factories, switched to natural gas in response to an increase in the price of oil. This would have a significant effect on the price of electricity because the marginal unit needed to supply electricity, particularly when demand is at its greatest, is generally a plant powered by natural gas.[25]

The bottom line is that although oil is a small and generally decreasing segment of the electricity generation portfolio, the electricity sector has not been and is not necessarily immune to perturbations in the world oil market. With that recognized, we can turn our attention to how well opening markets promote or impede energy security within the electricity sector itself.

[25] See *infra* n. 33.

Markets Generally Boost Security

Living in an economy in which most goods and services are allocated "in the market"—that is, not by a central government or regulatory authority—we probably need only a brief reminder of the general principles in favor of markets. Most are not directly related to security. In the short run, markets allow for efficient resource allocation. Absent significant market power or substantial nonmarket effects—both of which are important in electricity, as we will see—competition among suppliers will result in prices approximating the marginal cost of producing a good. Buyers, as "end users" or "final consumers," decide how much to buy based on whether the price they have to pay is more or less than the item's worth to them in terms of "opportunity cost" (i.e., the best alternative use to which they could put that money).

Ideally, the system is free from other political or economic forces that distort prices or interfere with consumer decisions. These decentralized decisions lead to allocations where the marginal benefit to consumers of producing more of something is about the same as the marginal cost of that production. There is neither too little—measured by being able to produce benefits greater than those costs—nor too much—as when those marginal benefits are less than those costs.

Markets have longer term benefits as well. They are not only conducive to efficient allocation of current goods and services, but they also provide both the opportunity and the incentive for innovation. And innovation is not only the development of new technologies that lead to new goods and services. It also includes general entrepreneurial discoveries of market opportunities and novel ways to produce and deliver goods and services. In his review of the benefits of deregulation, Clifford Winston found that the major gains have not been in the efficiencies economists predicted up front, but in the unforeseen ways in which businesses would organize their operations to cut costs and eventually prices (e.g., the development of hub-and-spoke airlines).[26]

When it comes to security, markets should help, not hurt. Opening markets to new competitors and, over time, to new entrepreneurs and innovators should result in redundancy. And a region or nation should be less vulnerable to disruptions if it is not depending on the facilities and services of a single monopoly provider. Examples from recently deregulated

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[26] Winston, Clifford, "Economic Deregulation: Days of Reckoning for Microeconomists," *Journal of Economic Literature* 31 (1993):1263–1289.

industries include banking, transportation, and telecommunications. The Internet offers an excellent example. With packet switching and routing available over multiple backbone networks, removing one company's facilities should not bring the entire system down.

More directly, markets can actually help to provide security. Security of service, like any other product feature is one of the attributes that suppliers will offer in an open market, as long as the consumer's willingness to pay exceeds the cost of furnishing it. We can view security in the same way, as ranging, for example, from the protection against physical invasion of buildings by burglars to the electronic invasion of data by hackers. Not every service will have the same level of reliability. Some cars will have more air bags or engines less likely to need repair than others; some buildings will have more elaborate security systems than others; some data sites will have more elaborate firewalls than others. But to the extent that markets are open to entrepreneurship and innovation, security need not be a matter of public policy.

Past and Present Complications

Much of the a priori justification for opening electricity markets to competition rested on the general benefits of competitive markets and, more specifically, on the overall economic gains achieved in the financial, transportation, and telecommunications sectors when they were opened. At least to some extent, the view that these benefits would simply and readily come to electricity markets has not been realized. In the sections that follow, I look at three complicating factors—electricity prices, the inability to deregulate the entire sector, and difficulties in protecting competitive parts of the sector from portions that remain regulated.

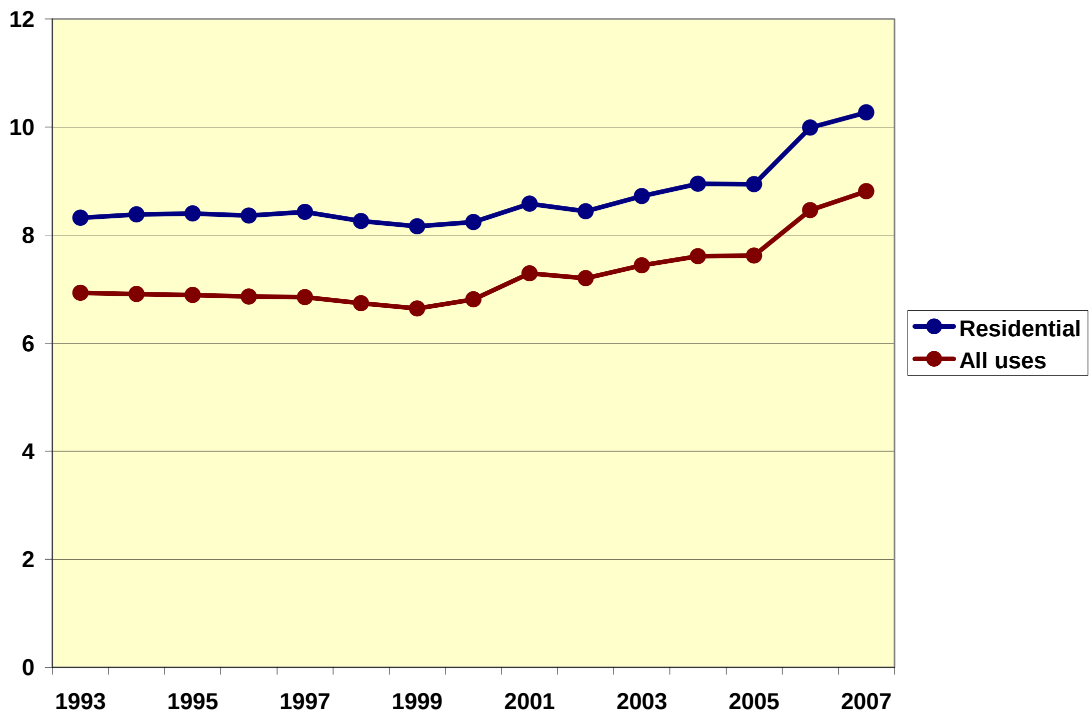
Does Opening the Market Lower Electricity Prices?

A common complaint about opening electricity markets is that competition is supposed to lead to falling prices, when in fact prices have risen substantially in recent years. Since 1996, when the Federal Energy Regulatory Commission (FERC) issued its first major rules opening wholesale markets and states began opening retail markets,[27] average prices overall and prices to

[27] Authority over the electricity sector is divided between the federal government and the states, with the former overseeing interstate transmission and wholesale power markets, and the latter having authority over intrastate sales and retail markets. *Source:* Federal Energy Regulatory Commission (FERC), "About FERC: What FERC Does" (2005), available at http://www.ferc.gov/about/ferc-does.asp.

residential consumers have not fallen (Figure 4). As the figure also shows, these prices have recently risen.

Figure 4. Average Electricity Prices, cents/kilowatt-hour (kWh), 1993–2007[28]



This graph is not a perfect representation of the situation because it reflects national averages, when both prices and the degree of competition vary among states and regions in the United States. In general prices did not fall with the opening of markets, but until 2005, prices had not risen much and had fallen when adjusted for inflation.[29] Some jurisdictions, such as

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The federal government promulgated rules for opening wholesale markets in electricity in Federal Energy Regulatory Commission, "Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities," Order No. 888 (Apr. 24, 1996), 18 CFR Parts 35 and 385, available at http://www.ferc.gov/legal/maj-ord-reg/land-docs/rm95-8-00w.txt. The first state to open retail markets was California, in its unanimously passed Assembly Bill 1890. *Source:* Brennan, *supra* n. 10 at 18–19.

[28] EIA, "Average Retail Price of Electricity to Ultimate Customers by End-Use Sector" (2006), available at http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html. Residential prices are typically higher than commercial and industrial (C&I) prices. C&I users are willing and able to buy in bulk (sometimes directly from the transmission grid) and more willing to accept service interruptions. Large users may also have advantages in petitioning regulators for price breaks. *Source:* Brennan, Palmer, and Martinez, *supra* n. 9 at 29–30.

[29] EIA, "Electricity InfoCard 2005" (2006), available at http://www.eia.doe.gov/neic/brochure/elecinfocard.html.

Maryland, have seen dramatic price increases of more than 50 percent in recent years, when utilities had to purchase dramatically more expensive energy after long-term contracts expired.[30]

This, in and of itself, does not prove that competition failed. The relevant test is whether prices are higher or lower than they otherwise would have been. Many other energy commodities have seen dramatic price increases, particularly in recent years. From June 2000 to June 2007, unleaded regular gasoline prices per gallon almost doubled, rising from $1.62 to $3.05.[31] Over roughly the same period, May 2000 to May 2007, natural gas "city gate" prices, as delivered to distribution utilities, have just about doubled, rising from $4.15 to $8.35 per thousand cubic feet (albeit with considerable volatility).[32] These prices reached a low of $3.67 in August 2002 and a high of $12.16 in October 2005. Even in markets that seem reasonably competitive, then, we can see that energy prices have risen considerably, more than electricity costs over the same period. The natural gas price change is particularly relevant because natural gas plays a significant role in setting wholesale electricity prices. This is particularly true during peak-demand periods because most of the plants used to produce the marginal energy demanded are fueled by natural gas.[33]

Peak pricing of electricity provides a strong reason why performance in electricity markets might be somewhat disappointing. Because storage costs are prohibitive, electricity must be produced when it is used. If demand is at its greatest level for only, say, the top 1 percent of the hours in the year,[34] power plant capacity must be in place to generate that energy even if it is unused the other 99 percent of the time. To recover the cost of producing that capacity in such a short time, the plant must charge much higher prices for the electricity it generated. Peak prices

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[30] Public Service Commission of Maryland, Order No. 81423, "In the Matter of Baltimore Gas and Electric Company's Proposal to Implement a Rate Stabilization Plan Pursuant to Section 7-548 of the Public Utility Companies Article and the Commission's Inquiry into Factors Impacting Wholesale Electricity Prices," Case No. 9099 (May 23, 2007). More information available at http://webapp.psc.state.md.us/intranet/Casenum/CaseAction.cfm?CaseNumber=9099.

[31] EIA, "Table 9.4. "Motor Gasoline Retail Prices, U.S. City Average," *August 2007 Monthly Energy Review (*August 2007), available at http://tonto.eia.doe.gov/merquery/mer_data.asp?table=T09.04.

[32] EIA, "An Analysis of Price Volatility in Natural Gas Markets" (August 2007), available at http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2007/ngprivolatility/ngprivolatility.pdf.

[33] Consumer Energy Education Group, "Managing Your Energy Costs" (2006), available at http://manageenergycosts.com/ManagingCosts.html.

[34] As noted *supra* n. 13 and accompanying text, one does not work on electricity issues long without memorizing the number of hours in a year: 8,760. A plant operating 1 percent of the time would thus be operating for about 90 hours. We can imagine this as the hottest 3 hours on the hottest 30 days of the year.

that exceed the average price of electricity by 20 or 50 times are not uncommon. In an open market, unlike in a regulated setting, every supplier gets to charge the high price. This is reasonable economics, as the marginal value of electricity is the same regardless of who produces it. But it can lead to contentious politics, in that a significant redistribution of wealth from users to electricity generators can result. Politicians and the public may not patiently accept reassurances from economists that entry by generators[35] to reap high peak-period profits will reduce off-peak prices sufficiently to leave consumers better off overall.

This impatience contributed in no small measure to the California energy debacle in 2000 and 2001.[36] The initial problem arose in the spring of 2000 when retail electricity rates were deregulated for the utility that serves San Diego customers. As demands began to reach seasonal peaks, electricity bills increased substantially. The state government reacted by re-regulating rates. At the same time, reduced supplies from hydroelectric plants (because of light rain), combined with growth in the rest of the West (e.g., Las Vegas), meant that the cost of meeting peak demands rose significantly. Faced with high wholesale prices but retail price controls, the California utilities teetered on the brink of bankruptcy, and one, Pacific Gas and Electric, fell into the abyss. With prospects for payment from buyers uncertain, sellers of wholesale electricity raised prices further, until demand abated and governments intervened with conservation measures, contract purchases, and price controls.

How Do We Deal with Inherently Incomplete Deregulation?

The problem in California and perhaps for the market as a whole may be the persistence of regulatory involvement. Unfortunately, not all of the electricity sector lends itself to competition among multiple sellers trying to attract consumers through price, service quality, and other product characteristics.

First and perhaps most importantly, the “wires” parts of the electricity sector—long-distance transmission and local distribution—remain monopolies.[37] The local distribution monopoly is relatively obvious; one network of lines running down streets and through neighborhoods can carry all of the electricity that customers use. Adding more local providers

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[35] Entry of new generators assumes that the firms can overcome NIMBY barriers to plant construction transmission line installation. See *supra* n. 14 and accompanying text.

[36] For a more detailed discussion of these California electricity market difficulties, see Brennan, *supra* n. 10.

[37] For more, see Brennan, Palmer, and Martinez, *supra* n. 9.

would incur enormous fixed costs for the wires themselves and for tearing up streets or erecting poles to carry them, without adding any useful capacity to the system. Such entry would not be profitable, which is why we have seen virtually none.

The monopoly in long-distance transmission is less obvious. In the telephone sector, one of the first parts to become competitive was long-distance calling. The level of traffic between metropolitan areas was, early on, sufficient to justify adding resources, especially as technological change (microwave transmission) reduced scale economies. This allowed multiple firms to offer telecommunications service at competitive costs. Competition in long-distance telephone service followed because calls can be and are cheaply routed onto a particular company's facilities.

In contrast, electricity cannot be routed onto a specific physical line. Like water in a set of pipes without valves, it takes all routes to travel from where it enters the system to where it is eventually withdrawn. If A and B are transmission line owners, and A expands its facilities, the cost to B of providing service is reduced because electricity nominally transmitted by B will go over A's lines as well. This effect—known as "loop flow" or "parallel flow"—essentially makes interconnected transmission over a wide area a single entity, even if different utilities own different lines.[38] With no effective competition from separate transmission operators, transmission is regulated, largely by FERC.[39]

Continued regulation of the wires side of the business has created continuing problems for promoting competition among generators and retail marketers, as well as for efficient operation of the electricity grid. A long-standing principle of regulatory policy is that in partially regulated sectors such as electricity, promoting competition in the unregulated parts requires that they be operationally separated from the regulated parts. If not, the operators of the regulated

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[38] In the continental United States,. there are three such regions, the Eastern Intertie, the Western Intertie, and Texas. The first two are separated in the Great Plains just east of the Rocky Mountains, and the electricity system in Texas is essentially unconnected to that in the rest of the country. *Sources:* FutureGen Texas, "Electric Markets," available at http://www.beg.utexas.edu/futuregentexas/pdf/FGT_electric.pdf; North American Electric Reliability Council (NERC), available at http://www.nerc.com/regional/NERC_Interconnections_color.jpg.

[39] "About FERC: What FERC Does," *supra* n. 27.

monopolies may be able to exploit that market power and subvert regulation.[40] In the electricity sector, the primary concern has been that owners of monopoly transmission services would use control over those lines to discriminate in favor of generators they owned and impede the ability of rival generators to compete, thus keeping electricity prices above competitive levels. For this reason, federal regulators have adopted guidelines for establishing independence of competitive generation from monopoly transmission.[41]

Does Separation of Regulated from Competitive Sectors Work?

How well functional independence has performed remains an open question, on both theoretical and practical grounds. For example, we can ask whether the "functional" unbundling in federal regulations is strict enough.[42] On the other hand, observers have questioned whether vertical separation is consistent with efficient operation of the electricity sector, in terms of both short-run power delivery and long-run capacity investment and expansion.[43] In the short run, effective regulation normally implies that regulated prices be stable. This stability gives customers incentives for making entrepreneurial decisions about how to use the service, and allows regulated firms to control costs and add capacity.[44] But in the electricity sector, efficient

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[40] This theory justified AT&T's divesture of its regulated operating companies, to prevent anticompetitive conduct in competitive telephone equipment and long-distance markets. *Source:* Brennan, Timothy, "Why Regulated Firms Should Be Kept Out of Unregulated Markets: Understanding the Divestiture in *U.S. v. AT&T*," *Antitrust Bulletin* 32 (1987): 741–793. Whether antitrust enforcement could still protect unregulated sectors from similar anticompetitive abuses, at least when there is a regulator nominally in place to prevent such abuses (as there was in the AT&T) case, is doubtful. *Sources: Verizon v. Trinko,* 540 U.S. 398 (2004); Brennan, Timothy, "*Trinko v. Baxter:* The Demise of *U.S. v. AT&T*," *Antitrust Bulletin* 50 (2006): 635–664.

[41] FERC Order 888 (1996), *supra* n. 27; FERC, "Regional Transmission Organizations," Order No. 2000 (Dec. 20, 1999), 15 CFR Part 35, available at http://www.ferc.gov/industries/electric/indus-act/rto/iss-2000/order-2000/2000.pdf. The need for reorganizing the vertically integrated electricity sector into functionally (if not fully) separate generation and transmission sectors is why the common term "restructuring" is used to refer to opening electricity markets. *Source:* Brennan, Timothy, "Making Electricity Markets Competitive: How Fast and By Whom," in Portney, Paul, and Richard Morgenstern (eds.), *New Approaches on Energy and the Environment: Policy Advice for the President* (Washington, DC: RFF, 2004): 38–43, esp. 39.

[42] Moss, Diana, "Competition or Reliability in Electricity? What the Coming Policy Shift Means for Restructuring," *Electricity Journal* 17 (March 2004): 11–28; Brennan, Timothy, "Alleged Transmission Inadequacy: Is Restructuring the Cure or the Cause?" *Electricity Journal* 19 (May 2006): 42–51.

[43] *Id*.; Kwoka, John, "Vertical Economies in Electric Power: Evidence on Integration and its Alternatives," *International Journal of Industrial Organization* 20 (2002): 653–671; Michaels, Robert, "Vertical Integration: The Economics that Electricity Forgot," *Electricity Journal* (December 2004): 11–23; Taylor, Jerry, and Peter Van Doren, "Rethinking Electricity Restructuring," Policy Analysis No. 530. (Washington, DC: Cato Institute,November 30, 2004).

[44] Brennan, Timothy, "Regulating by 'Capping' Prices," *Journal of Regulatory Economics* 1 (1989): 133–147.

mitigation of transmission line congestion entails rapidly varying (as often as hour-by-hour) location-specific transmission prices.[45] Congestion-based pricing thwarts independent decisionmaking by generators and transmission companies and also creates opportunities to evade regulation and exercise market power by keeping lines congested and charges high.[46]

Difficulties arising from vertical separation may be more important over the long run. In a typical setting where regulated firms offer services used by producers of competitive services (e.g., local telephone companies granting access to long-distance providers), the regulatory process that set the monopoly's rates and the entrepreneurial process that led to expansion, entry, and development of new services could act largely independently. But this may not be the case in the electricity sector, where new investments are highly expensive, indivisible, and consequently interdependent. New transmission lines are not worth building without new generators to give them energy to transport, and new generators are useless without new lines to carry their energy to distributors and eventually consumers. If these very large investments require collective planning, the entrepreneurship that might bring the full benefits of competition to the generation sector is muffled, if not stifled, by the need to coordinate efforts with the transmission utility and, thus, with competitors.

Accordingly, having participants on the competitive side of the electricity sector make their business judgments and entrepreneurial initiatives without prior approval of the regulator of the monopoly side may be inconsistent with time-varying prices and a need to run entry and expansion decisions by a central planner with the implicit authority to substitute its judgment for the "markets" as to who builds what and when. Monopoly distribution, monopoly transmission, and centralized coordination affecting short-run generation operations and long-run entry decisions, may impede the ability of electricity markets to provide the kind of redundancy that may promote energy security. Even if these operational obstacles to competition can be overcome, opening electricity markets to competition will still leave us with monopoly transmission and distribution systems that may be vulnerable to system failure and perhaps terrorist attack.

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[45] Hogan, William, "Contract Networks for Electric Power Transmission," *Journal of Regulatory Economics* 4 (1992): 211–242.

[46] Borenstein, Severin, James Bushnell, and Steven Stoft, "The Competitive Effects of Transmission Capacity in a Deregulated Electricity Industry," *RAND Journal of Economics* 31 (200): 294–325.

Other Complications

Factors other than restructuring concerns may prevent electricity markets from developing the capacity and flexibility to mitigate energy security concerns. Here, I focus on three—consumer resistance to entry and efficient pricing, residual market power, and environmental effects.

Would Residential Consumers Prefer Regulated Monopoly to Choosing Among Competitors?

We base our belief that markets are generally beneficial on two predicates: (1) that prices follow cost and (2) that, given those general prices, consumers prefer being able to choose among alternatives. Particularly for residential users, neither predicate may apply to electricity. On the pricing side, electricity bills typically reflect how much a customer uses per month at a constant rate per kilowatt-hour. In Maryland, for example, most residential consumers—more than 90 percent of the total—purchase "standard offer service" from the local distribution utility at rates ranging from 8.46 cents/kWh for one of the small utilities to 10.18–10.89 cents/kWh for the three largest suppliers in the state.[47] These rates fail to reflect the high costs of on-peak energy and the much lower costs of energy at times of the day and year when demand is much lower than system capacity.[48]

One remedy proposed for the latter is greater use of real-time pricing, which requires two crucial components. The first is a meter capable of recording how much electricity is used at a particular time, not just how much is used cumulatively (which is how standard meters operate). Without such real-time meters, charging for electricity at the time of its use is impossible. In addition, we must have a mechanism for letting customers know when electricity is acutely expensive. Armed with such information, consumers might use less air-conditioning or defer electricity-intensive tasks (such as laundry and dishwashing) to times of the day when electricity is less expensive. Otherwise, billing for peak power at prices reflecting those high costs p will have no effect on demand, and costly capacity will still be needed. Even if real-time meters were

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[47] *Sources:* Maryland Office of the People's Counsel, "Utility Supplier Offers," available at http://www.opc.state.md.us/assets/documents/Supplier_Prices_Web_page_5.pdf; Public Service Commission of Maryland, "Ten-Year Plan (2006–2015) of Electric Companies in Maryland," December 2006, available at http://www.psc.state.md.us/psc/Reports/2006-10YrPlan.pdf.

[48] See *supra* n. 34-35 and accompanying text.

available, neither conveying information to consumers nor automating appliance responses to higher temperatures may be feasible.[49]

The inability to communicate prices in an operationally relevant manner may be the tip of the iceberg in inducing residential consumers to participate in electricity markets. In Maryland, only 2.5 percent of residential electricity (measured by obligations to deliver peak loads) is supplied by competitors to the incumbent distribution utilities.[50] Such reluctance is typical. Even in jurisdictions judged among the best at promoting retail electricity competition, residential switching to new suppliers has been meager.[51] One suggested reason is that retail prices continued to be regulated, especially where rates were held down as part of a political bargain with states that opened retail electricity markets to new entry. But despite extensive efforts to educate consumers on how to shop for electricity, they clearly have difficulty making choices among their alternatives. This suggests another reason for consumers' lack of participation in the electricity market—they simply would rather not be bothered.[52]

This need not imply that opening markets is not worthwhile. Residential use comprises only about 37 percent of nationwide electricity use.[53] Commercial and industrial (C&I) customers, with more at stake financially, may be more likely to find shopping for new suppliers worthwhile. In Maryland, for example, more than 69 percent of peak nonresidential (C&I) loads are met by new suppliers.[54] These larger customers may also prove more willing to adopt and use metering technologies to mitigate peak demands. If five-eighths of the market responds to competition, much of the potential benefits of competition—particularly in creating a more secure grid at peak periods—will accrue despite residential reluctance to participate.

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[49] The value of having real-time meters need not imply that policy is necessary to induce buyers and sellers to adopt them. Other than potential blackout externalities created by overuse of energy, buyers and sellers themselves have incentives to adopt technologies if the benefit of more efficient, cost-based use exceeds the cost of the metering technology. *Source:* Brennan, Timothy, "Market Failures in Real-Time Metering," *Journal of Regulatory Economics* 26 (2004): 119–139.

[50] Public Service Commission of Maryland, *supra* n. 47 at 5.

[51] Brennan, Timothy, "Consumer Preference Not to Choose: Methodological and Policy Implications," *Energy Policy* 35 (2007): 1616–1627.

[52] *Id*.

[53] Calculated from data at EIA, Table 2. Sales to Bundled and Unbundled Consumers by Sector, Census Division, and Stete, 2005, available at http://www.eia.doe.gov/cneaf/electricity/esr/table2.xls.

[54] Public Service Commission of Maryland, *supra* n. 47 at 5.

What Role Does Residual Market Power Play?

For markets to perform efficiently, they must perform competitively. Individual suppliers should act in the belief that their supply decisions have no significant effect on market prices. If they hold that belief, their profit-maximizing decisions will match the socially efficient decisions—to produce up to the point where the market price just covers the marginal cost of production. In contrast, if they believe that their decisions affect prices, sellers will have an incentive to withhold in order to increase prices and profits. This may conflict with the security virtue of markets, which derives from offering multiple and willing options to obtain supply.

Because the wires portions of the electricity sector will remain monopolies for the foreseeable future, expectations for competition rest primarily with the generators. In most times and places, when demand is not at its peak, the generation sector likely performs competitively. Any generator considering withholding output can expect that others, with excess capacity, will be more than willing to take up the slack. This, however, may not be the case during peak-demand periods when rivals are close to capacity. A generator may expect that in acting alone, its withholding could drive up prices because its rivals could not increase supplies in response. The situation is made worse by rigid demand for electricity, as retail price regulation and the absence of real-time pricing insulate consumers from higher peak wholesale power prices. Simple calculations suggest that a firm with as little as 10 percent of the market may be willing to set prices at double competitive levels.[55] The profitability of unilateral withholding is important because raising prices violates U.S. antitrust law only if done in concert with one's competitors.[56]

Numerous potential remedies for market power all have serious shortcomings. Some suggest more long-term contracting, citing arguments that the more sellers sell in advance, the less incentive they will have to reduce output and raise prices when markets are tight.[57] This

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[55] Brennan, *supra* n. 10 at 38. Lee Friedman points out that the profitability of exercising market power will be greatest when demand is not quite at its peak. If demand is sufficiently high, the monopoly level of output will be no less than the capacity available in the market, so no individual generator would have the option to withhold. *Source:* Friedman, Lee, "The Long and Short of It: California's Electricity Crisis" (September 2007) available at https://webfiles.berkeley.edu/~lfried/Long%20and%20Short907.pdf.

[56] *Copperweld Corp. v. Independence Tube Corp.*, 467 U.S. 752, 770-72 (1984); *Texaco, Inc. v. Dagher et al.*, No. 04-805, *slip. op.* (Feb. 28, 2006), available at http://www.supremecourtus.gov/opinions/05pdf/04-805.pdf.

[57] *Id.*, citing Allaz, Blaise, and Jean-Luc Vila, "Cournot Competition, Forward Markets and Efficiency," *Journal of Economic Theory* 59 (1993): 1–16.

may help, but the supporting analytical framework relies on a narrow and perhaps unrealistic expectation that utilities compete through output commitments rather than sales prices. A second problem with contracting is that its main benefit—providing insurance against price variations—may stand in the way of exposing consumers to high prices which, as we saw above, can reduce demand stresses that render the system less secure.

A second potential remedy, which might also enhance security, is to impose reserve requirements on those who sell electricity. Having reserve capacity in place would limit the ability of individual firms to increase prices through withholding. Such reserves could be required through "capacity markets" in which, unlike virtually any other sector, electricity purchasers would be obligated to buy capacity to produce separately from the product itself. It is as if when one bought gasoline, one had to pay a separate fee to cover the cost of the refinery used to make it. Crucial to whether these requirements increase efficiency and security is how they are implemented. The structure of requirements affects how the extra costs of capacity are passed on to the consumers who, one way or another, have to pay for them, just as they would pay through higher prices at peak-demand periods.[58]

How Does the Environment Fit In?

Fossil fuel emissions, nuclear disposal concerns, and hydroelectric dam effects have made the electricity generation industry a prime subject for environmental regulation for decades.[59] Because energy security involves an environmental dimension, the effect of opening markets on environmental concerns and on policies to deal with those concerns merits a brief discussion.

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[58] Brennan, Timothy, "Electricity Capacity Requirements: Who Pays?" *Electricity Journal* 16 (October 2003): 11-22. It is also important to point out that for any commodity, the competitive price at peak periods will typically be substantially in excess of average variable cost of production, because this is the point at which capital costs are recovered. A good example is the resort hotel market, where on-season prices typically and substantially exceed off-season rates. Much of the published estimates of market power in electricity is, unfortunately, based on average variable cost and thus erroneously overestimates the severity of the market power problem in electricity. *Sources:* Brennan, Timothy, "Mismeasuring Electricity Market Power," *Regulation* 25 (Spring 2003): 60–65; Brennan, Timothy, "Preventing Monopoly or Discouraging Competition? The Perils of Price-Cost Tests for Market Power in Electricity," in Kleit, Andrew N. (ed.), *Electric Choices: Deregulation and the Future of Electric Power* (Lanham, MD: Rowman and Littlefield, 2006): 163–179.

[59] Brennan, Palmer and Martinez, *supra* n. 9, ch. 15.

Since the 1990 Clean Air Act Amendments of 1990, the innovative method for coping with environmental externalities has been a "cap-and-trade" system. In such a system, polluters (e.g., electric power plants) are issued (or purchase at auction) permits to emit a given quantity of tons of a pollutant. If a polluter emits less than its permitted amount, because of reduced overall production or improved abatement, it can sell its excess permits to those who find reducing emissions more expensive. This system provides economic incentives for reducing pollution and allows reductions to be achieved at the lowest overall expense to the economy. The system may also have a political benefit, in that if the permits are given away, those who receive them obtain a valuable asset, which may lead them to become supporters of emissions reductions.

Permits are likely to work better in industries that are open to competition instead of regulated. In open markets, firms bear the cost of emitting more, either by having to buy more or sell fewer permits. Similarly, if a firm reduces emissions, it pockets the profits from reduced purchases or greater sales of permits. If a firm is regulated, the costs of added permits and the savings from reduced need for permits may be automatically passed on to consumers as part of the administrative process of tying prices to costs. This reduces the incentive to participate in permit programs, lessening their effectiveness as an environmental protection tool.

A closely related policy context involves the use of renewable fuels to generate electricity. Which fuels count as "renewable" is itself a matter of policy, but in this context we can define them as fuels that are not burned (unlike fossil fuels) or do not create other salient environmental risks (unlike nuclear and perhaps hydroelectric plants). From an economic perspective, the optimum policy would be to impose taxes or permit programs on the pollutants that impose costs on society, then let industry and consumers react to those appropriate prices. If the prices are not right (e.g., because taxing emissions is politically infeasible or administratively impractical), we might justify substituting policy to encourage use of renewables, as high prices from taxes or permit purchases otherwise would. As with permits, a leading method for promoting renewable fuels use involves a marketable requirement, in which utilities with relatively less expensive access to renewable energy can sell the ability to meet their obligations to others. The purchasing utilities, in effect, meet their requirements in part by paying those selling utilities to do so. As it does with permit programs, competition will make these renewable portfolio policies less expensive and more effective.

A related topic involves conservation through policies to reduce demand (e.g., by requiring or subsidizing the use of more energy efficient appliances). Like renewable portfolio requirements, these "demand-side management" programs may be seen as using policy instead of prices to induce efficient energy conservation. Competition may render such policies less necessary. Energy needs to be conserved because it is too cheap. If it is too cheap because prices do not reflect costs at peak periods, opening markets should allow for more pricing flexibility and give buyers and sellers the opportunity to cut deals in which they pay higher prices on peak—conserving use—in exchange for lower prices off peak—when electricity is relatively inexpensive to produce. Electricity could be too cheap because environmental degradation costs are not reflected in its price, but improvements in environmental policies with open markets may alleviate that problem as well.[60] In sum, markets are likely to promote the environmental dimension of energy security by setting policies that make that security more efficient and effective.

The Central Security Issue: Reliability

The overarching energy security issue arising in considering electricity markets involves the reliability of the electricity grid. Reliability is important in many settings; we all want our cars to start, our furnaces to come on, and our computers to boot up. With that noted, reliability is particularly acute in this context because as a commodity, electricity has a unique combination of three attributes:[61]

- First, it is crucial to the economy and to society at large. Virtually every sector on which we depend cannot function without electricity to power lighting, heating, cooling, computing, and communicating, along with all types of C&I equipment.
- Second, because it cannot be stored, electricity is vulnerable to imbalances between supply and demand. Too little electricity relative to loads causes outages; too much relative to loads can cause equipment failures in the grid. Together, these factors require that supply equal demand virtually minute by minute. They also explain why electricity is so expensive to produce to meet extreme demand peaks. It cannot be economically stored for future demand; it must be produced in real time.
- This vulnerability becomes a general reliability problem only when combined with a third feature of the electricity sector—interconnection. The grid is interconnected to promote efficiency and reliability; more links provide a greater number of means by which energy

[60] Brennan, Timothy, "Demand-Side Management Programs under Retail Electricity Competition," RFF Discussion Paper DP 99-02 (1998), available at http://www.rff.org/Documents/RFF-DP-99-02.pdf.

[61] Brennan, Palmer, and Martinez, *supra* n. 9 at 195.

can reach consumers and a greater number of alternatives with which users can obtain energy. The linkages are irreversible in the sense that electricity cannot be economically directed into a particular physical pathway. Unlike telecommunications, where routing traffic can be accomplished through switches, the high energy levels in electricity transmission preclude such directions.

These three factors combine to create a situation in which reliability is, in economic terms, a "collective good." Failures of my car, furnace, or computer to start may be serious problems, but they are ones largely between me and the firms I choose to supply and repair those items. If my electricity supplier fails to meet my demand, it is not just my problem; everyone on the grid is blacked out as well.

Numerous factors make assessing the need for investment and policy to enhance reliability difficult. One such factor is deciding how much we should spend to ensure reliability. In the wake of the August 2003 blackout, some called for spending up to $60 billion on new transmission lines.[62] On the other hand, DOE estimated the cost of this massive blackout at about $6 billion.[63] If this is an accurate estimate, we might still need to avoid roughly one blackout of this magnitude every year or two to make such an investment worthwhile. Moreover, the intergovernmental task force charged with investigating the causes of the blackout listed numerous failures in imposing and adhering to reliability standards and practices, although it did list transmission capacity itself as a significant cause.[64] Most fundamentally, the cost of a blackout is not unlimited, and thus does not warrant unlimited expense to eliminate any possibility of a power outage. Careful attention needs to be given to estimating the cost of blackouts because they differ in location, duration, scope, and advance notice, and in the effect of expenditures on reducing the likelihood of blackouts along those various dimensions.

The nature of reliability as a collective good implies some degree of central control. The Energy Policy Act of 2005 authorized FERC to delegate control over reliability to "electricity

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[62] ICF Consulting Perspectives, "The Blackout of 2003: Viewpoints from ICF Consulting" (Fall 2003), available at http://www.icfi.com/Publications/doc_files/Perspectives-blackout-F03.pdf.

[63] Electricity Consumers Resource Council, "The Economic Impacts of the August 2003 Blackout" (Feb. 9, 2004): 2, available at http://www.elcon.org/Documents/EconomicImpactsOfAugust2003Blackout.pdf.

[64] U.S.-Canada Power System Outage Task Force, *supra* n. 11 at 139.

reliability organizations" that FERC certifies.[65] As a practical matter, the North American Electricity Reliability Council (NERC) exercises this control, subject to FERC review.[66]

In considering the effect of markets on security, the key question is the degree to which such centralized control is consistent with the decentralized decision processes essential to entrepreneurial competition. At one extreme, we might need no more central planning than air traffic controllers exercise in the airline industry. Air space can be policed to avoid collisions without precluding competition among carriers to transport passengers and freight. At the other extreme, a central controller may need to control dispatch of generators in the short run and investment in generation over the long run to ensure reliability (as well as efficiency, as I noted previously). If so, there may be little left over to make competition worthwhile, particularly if the restructuring necessary to ensure competition is itself costly.[67] Looking through the lens of energy security reveals another perspective on the question of whether "markets have met their match" when it comes to electricity.[68]

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65 Energy Policy Act of 2005, *supra* n. 15 at Sec. 1211.

66 FERC, Order Certifying North American Electric Reliability Corporation as the Electric Reliability Organization and Ordering Compliance Filing, Docket No. RR06-1-000 (July 20, 2006), available at ftp://www.nerc.com/pub/sys/all_updl/docs/ferc/20060720_ERO_certification.pdf.

67 See *supra* n. 42-46 and accompanying text.

68 Brennan, Martinez and Palmer, *supra* n. 9 at 197.