Death Star et al.: The California Electricity Crisis of 2000 and its Impact on the Regulation of the U.S. Electric Utility Industry

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Introduction

Technology, economics, and politics have interacted over time to create the present structure of the electric utility industry in the United States. Energy “crises” also have played a critical role in shaping the industry. Today, the industry is composed of 202 large, investor-owned utilities that provide 60% of sales to final consumers, 2,008 mostly-small, municipally-owned utilities that provide 15% of sales to final consumers, 877 rural co-operatives that provide 11% of sales to final consumers, 9 large federal power agencies that contribute 7% of total power generated but provide only 1% of sales to final consumers, and 173 power marketers that provide 13% of sales to final consumers. “Non-utility” power producers now control 42% of generating capacity, compared to 37% for traditional utilities.[1] The industry thus is a mixed bag of large and small, publicly- and privately-owned firms. Most privately-owned firms are subject to regulation at both the state and federal levels through state utility commissions and the Federal Energy Regulatory Commission (formerly Federal Power Commission). Fundamental changes in the regulatory structure often occurred after significant economic events. State regulation began after utility consolidation in urban areas around the turn of the 20th century led to the rise of monopoly providers. The movement for state regulation was aided by the political reaction to municipal corruption and was eventually welcomed by most industry leaders.[2] The holding company movement of the 1920s, and its spectacular collapse in the Great Depression, led to reforms under the Public Utility Holding Company Act of 1935, giving the federal government a greater, but still circumscribed, role in the regulatory process. The economic and energy crises of the mid to late 1970s contributed to demands for electric utility restructuring and deregulation, which gained momentum in

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[1] *Annual Directory & Statistical Report, 2010-11*, Washington, DC: American Public Power Association, 2011, 22-26.

[2] John L. Neufeld, "Corruption, Quasi-Rents, and the Regulation of Electric Utilities," *The Journal of Economic History* 68, no. 04 (2008); William J. Hausman and John L. Neufeld, “The Market for Capital and the Origins of State Regulation of Electric Utilities in the United States,” *Journal of Economic History*, 62 (December 2002), 1050-73.

the 1980s and 1990s. That movement has now been severely blunted, stymied by events that occurred in a single state, California. This paper examines events that led up to the dramatic California energy crisis of 2000-2001 and the aftermath of that energy market meltdown.

Following four decades (roughly 1900-1940) of nearly continuous controversy in the electric power industry over issues such as regulation and public versus private ownership, World War II itself and the following two decades brought relative political and economic calm to the industry.[3] Electricity usage was increasing at a rapid rate, and technological advances allowed prices to fall almost continually. This situation, however, changed dramatically in the 1970s. Increasing environmental concerns had caused many utilities to switch from coal-burning to cleaner oil- and gas-burning generation when the 1973 OPEC embargo and U.S. price controls created a petroleum shortage that resulted in policies designed to force utilities to convert away from oil use. The “energy crisis” became a matter of enormous political concern. At the same time, the industry continued to project rapid growth in the demand for electricity, which mandated significant increases in the capacity of electricity production.

A fateful technological decision with huge economic implications also was made around this time. The industry turned to nuclear power as the most promising technology for new production, a decision that turned out to be quite unfortunate.[4] Environmental and safety concerns energized movements that were actively opposed to the use of nuclear technology. Rapid inflation resulted in historically high nominal interest rates. Nuclear power is the most capital-intensive technology for producing electricity

[3] The Tennessee Valley Authority, established during the Great Depression, remained a lightning rod for those opposed to government ownership of utilities, partly because the Authority had to receive Congressional appropriations for funds to construct new facilities and partly because its service area had not been clearly defined. This largely abated in 1959 as a result of a law that both enabled TVA to issue bonds to finance its projects and defined its service area. For an example of a political battle caused by the controversy over TVA, see Aaron Wildavsky, *Dixon-Yates: A Study in Power Politics*, ed. David Horne, Yale Studies in Political Science (New Haven, CT: Yale University Press, 1962).

[4] Lewis Strauss, Chairman of the Atomic Energy Commission, in a speech in 1954 prophesied that electricity produced with nuclear power would be “too cheap to meter.” It is doubtful whether he was serious, but these now infamous words have come to represent the false prospects of nuclear power in its earliest manifestations. See Canadian Nuclear Society, http://www.cns-snc.ca/media/toocheap/toocheap.html.

and interest costs on capital comprise a major portion of total costs. Furthermore, the industry began to experience construction delays as well as significant cost overruns as it grappled with its attempt to implement a new technology on a scale beyond the experience of any U.S. electric utility. Environmental and safety concerns sometimes forced changes in plant design after construction had begun, further adding unexpected costs. The price of electricity, for the first time in the history of the industry, began to increase faster than the rate of inflation, but not fast enough to cover rapidly increasing costs.[5] Even worse, the predictions of the growth in electricity demand, on which the industry had been relying, proved excessive. Many of the nuclear plants under construction were not going to be needed and were cancelled despite the enormous sunk costs the projects already had absorbed.[6] The regulatory system generally had enabled the capital costs of plants brought into service to be passed on to consumers, but a major controversy arose over whether regulators should allow utilities to recover the sunk costs of abandoned plants from customers, or whether the companies (stockholders) should be forced to bear those costs.[7] The argument for forcing the utilities to bear the costs was based on the position that the cause of the wasted construction was the industry's failure to devote adequate resources to predicting future demand. Failing to hold them accountable for those errors (as would be the case for unregulated firms) would increase the likelihood such errors would be repeated. Only the industry itself could possibly have had the resources and expertise necessary to implement the kind of sophisticated investment planning that seemed absent in the decisions to construct too many nuclear power plants. The companies argued that a "regulatory compact" existed that essentially had been designed to result in lower electricity rates in return for shifting some risks off the companies and onto consumers. Every

[5] This statement is based on data found in Moody's Investor's Services, *Public Utility Manual, 1991*, pp. a2, a15.

[6] For example, in May 1982, Duke Power cancelled its Cherokee plant, in which it had already invested $633 million (roughly $1.4 billion today, adjusting for inflation). Those sunk costs were over 30% of the company's net worth before the cancellation. Douglas Hearth, Ronald W. Melicher, and Darryl E. J. Gurley, "Nuclear Power Plant Cancellations: Sunk Costs and Utility Stock Returns," *Quarterly Journal of Business and Economics* 29, no. 1 (1990).

[7] Evidence for this concern exists in an event study finding that plant cancellations resulted in a fall in the price of the stock of the company involved, indicating investor concern that the costs would be borne by stockholders. Ibid.

demand forecast and all of the construction projects had been explicitly approved by regulators before any construction was undertaken. The rate of return regulators allowed utilities to receive on invested capital was relatively low—comparable to a nearly risk-free investment. In retrospect, ad the utilities been expected to absorb significant risks, they should have been allowed the higher rates of return appropriate for risky investments. The controversies surrounding this issue brought to light a flaw in traditional rate regulation and simultaneously made utilities hesitant to undertake new investments.

This was the context in which President Jimmy Carter presented his 1977 National Energy Plan, parts of which were directed at electric utilities.[8] Under the plan, utilities that had only recently been required to switch from coal to cleaner energy sources were to be required to bear large costs to switch back. The licensing of nuclear plants was to be streamlined in an attempt to lower costs. Utilities were to be required to offer customers help in finding ways to reduce their use of electricity (demand management). Anachronistic rate structures were to be changed to bring prices more closely in line with marginal costs, a change that would have increased the efficiency of electricity use, and that had long been used in France. This last provision, unfortunately, was ultimately dropped in the face of opposition from state regulators, who had existing authority to reform rates and who remained fearful of federal co-optation of their authority, as well as from large industries for which electricity was a major input and which feared basing rates on marginal costs would result in higher rates for them.

The features of Carter's proposal that survived Congressional debate were enacted into five separate laws. A little-noticed provision in one law, the Public Utility Regulatory Policies Act (PURPA), was to have a dramatic effect on the industry and on its regulation. That provision required utilities to purchase electricity from certain Qualifying Facilities (QFs) that either generated electricity from renewable resources or that generated electricity as a by-product of some other production (co-

[8] Richard F. Hirsh, *Power Loss: The Origins of Deregulation and Restructuring in the American Utility System* (Cambridge, MA: MIT Press, 1999), 73-88.

generation). The prices paid by the utilities were not to be based on the costs of production but on the utilities' "avoided costs," which would be determined by state regulatory commissions. The investment risk undertaken by these generators would be entirely their own responsibility.

The problems faced by the industry were particularly acute in California. In 1981, reserve margins had fallen to 6%. Rates were high. Efforts to encourage the development of alternative energy sources by public utilities had not been successful. The levels of "avoided costs" set by the California commission in response to PURPA were high and were guaranteed for years to come. They elicited a strong supply-side response. By 1991, 32% of Southern California Edison's total energy requirements came from QFs, as did 24% of San Diego Gas & Electric's.[9] The regulatory commission continued to adopt policies designed to insulate the privately owned utilities from risk, and their economic health improved substantially.[10] PURPA, however, had demonstrated the feasibility of an electric power system in which there was separation between the ownership of generation and that of transmission and distribution.[11] Movement in this direction accelerated with Energy Policy Act of 1992, which created a whole new class of generators called "exempt wholesale generators" (EWGs), who, like QFs, would bear the risk of investment decisions. These generators could sell power to different wholesale customers and compel the resident utility to transmit that power between them and their customer (wheeling), even if those customers had previously been served by the utility's own generators. These new firms were able to take advantage of falling gas prices and technological improvements in gas-fired generation to offer prices that undercut those of the established utilities, whose regulated rates included costs associated with nuclear plant overruns and cancellations and with the high prices many were forced to pay QFs for

[9] Both firms were venerable, investor-owned utilities. Some utilities themselves were investing in the unregulated QFs. Roughly half the energy supplied by QFs to Southern California Edison came from an affiliated company. On some of the perverse results of PURPA in California, see Paulette Barclay, Douglas Gegax, and John Tschirhart, "Industrial Cogeneration and Regulatory Policy," *Journal of Regulatory Economics* 1, no. 3 (1989)

[10] Jeff Dasovich, Bill Meyer, and Gigi Coe, "California's Electric Services Industry: Perspectives on the Past, Strategies for the Future,"(1983), http://docs.cpuc.ca.gov/Published/Report/3822.htm.

[11] England had had experience with separation of generation and transmission since the 1920s, but this was a new experience in the United States.

power. These costs came to be referred to as "stranded costs," and they were not included in the prices charged by EWGs. The result was a clamor for greater access to EWG power and transmission by existing wholesale customers such as municipalities and by large industries who lobbied for the right to purchase power from EWGs.

The system emerging from this mishmash of independent generators and existing utilities was unsustainable. By avoiding paying the stranded costs, wholesale customers were able to shift the costs to the regulated utility's retail customers. In addition, management of the transmission system was becoming increasingly complicated and could no longer be reasonably handled by utilities whose interests were at odds with many of those using the system. One solution attracting increasing attention was to restructure the electric power industry in a way that made the generation of electricity a separate, unregulated industry. Political acceptance of a general policy of deregulation had grown in the United States. During President Carter's administration, airlines and trucking had been completely deregulated. In addition, partial deregulation had come to telecommunications, natural gas, cable television, and others.[12] The impetus for extending deregulation to other economic activities increased in President Reagan's administration. The type of restructuring envisioned in the creation of a competitive generation industry requiring that transactions that previously had occurred within vertically integrated firms now had to be conducted between firms in markets necessitated a whole new set of economic institutions. This turned out to be more complicated than was originally expected. In 1989 Britain had privatized its electric power industry with ownership of generation separated from that of transmission. Elements of the market structure created there had enormous influence on developments in the United States. A system adopted in the United States, among other things, would

[12] See Richard H.K. Vietor, *Contrived Competition: Regulation and Deregulation in America* (Cambridge, MA: Harvard University Press, 1994).

have to address the problem of stranded costs. The magnitude of these sunk costs was such that their handling was bound to absorb a great deal of attention in the efforts to create the new institutions.

Restructuring in California

The first state to enact substantive restructuring of electric utilities was California, where the new system went into effect on the first day of 1998. The state had a large problem with stranded costs, resulting in its having very high electricity prices, 9.7¢ per kWh compared to the national average 6.9¢.[13] It demonstrated the difficulty in devising a new institutional framework where one had not existed before. Corrections were made to the system as problems were discovered, but even these had unintended consequences and failed to prevent a major crisis whose impact was to halt the move toward electric utility restructuring for the entire country. The most serious flaws were the freezing of retail rates and the prohibition of long-term supply contracts. In part, these flaws had been incorporated in an effort to deal with the problem of stranded costs. Existing utilities were required to divest much of their generating capacity. The California Independent System Operator (ISO) was created with responsibility for operating much of the transmission grid in California and for such real-time operations as continually balancing load and managing transmission congestion. A separate set of institutions, certified scheduling coordinators, were created. The latter were responsible for generation and load. Each certified scheduling coordinator was required to submit to the ISO a balanced schedule of load and generation for the following day. Although there were a number of these coordinators, including Enron, the largest by far was the California Power Exchange (PX), responsible for as much as 90 percent of the load on the ISO grid. The PX operated two markets: a day-ahead and day-of market on which energy was

[13] In addition to the costs arising from nuclear plants, California's stranded costs also included the costs the utilities had to pay for electricity from QFs. The utilities commission had pressured utilities to enter into long-term contracts with the QFs, and the prices specified in those contracts turned out to be higher than would have been necessary to purchase or generate the same amount of electricity from others. Severin Borenstein, "The Trouble with Electricity Markets: Understanding California's Restructuring Disaster," *Journal of Economic Perspectives* 16, no. 1 (2002): 192. On political process of restructuring, see Carl Blumstein, Lee S. Friedman, and Richard Green, "The History of Electricity Restructuring in California," *Journal of Industry, Competition and Trade* 2:1/2 (2002).

traded on an hourly basis. The ISO also operated multiple markets: a real-time market for making any necessary adjustments to maintain equality between generation and use, and markets for various ancillary services such as stand-by capacity. Stand-by capacity was generating capacity that was ready to begin generation at an instant, but only if needed.[14] The price paid by the ISO was capped, unless the ISO was forced to purchase power from out of state.

All existing utilities were required to sell their generation and purchase electricity for their customers through the PX's spot markets. Retail rates were frozen at a level 10% lower than that prevailing prior to restructuring. This provision was adopted both to gain consumer acceptance and to deal with the problem of stranded costs.[15] By requiring all purchases to be made on the spot market (rather than through long-term contracts), the prices paid by utilities for the electricity sold to retail customers were transparent. Those prices were expected to be less than the frozen retail price, and the differences, adjusted for distribution costs, were to be applied to the stranded costs. Once those costs were paid off (or March 2002, whichever came first), retail prices would be unfrozen, at which time they were expected to fall.[16] Prices under this system were quite volatile from the beginning. During the first two years there were days when there was a shortage of generation and the ISO was forced to purchase electricity at the capped price, which was raised in October 1999 to $760 per MWh, although average wholesale prices were generally below $50 per MWh.[17] In 2000 the ISO price cap was lowered to $500 and then $250 per MWh.[18]

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[14] Federal Energy Regulatory Commission, "Final report on price manipulation in Western markets, Part 2, Docket No. PA02-2-000," (2003), VI-4,VI-28.

[15] The Public Service Commission had recommended freezing rates; the legislature added the reduction. Carl Blumstein, Lee S. Friedman, and Richard Green, "The History of Electricity Restructuring in California," *Journal of Industry, Competition and Trade* 2, no. 1 (2002): 18.

[16] San Diego Gas and Electric was the only utility that succeeded in paying off its stranded costs.

[17] Borenstein, "The Trouble with Electricity Markets: Understanding California's Restructuring Disaster," 195.

[18] Severin Borenstein et al., "Inefficiencies and Market Power in Financial Arbitrage: A Study of California's Electricity Markets," *Journal of Industrial Economics* 56, no. 2 (2008): 353, footnote 11.

Progress towards restructuring was occurring in other states. Besides California, by spring 2000 three other areas in the U.S. had competing generators selling in spot markets operated by ISOs.[19] In many other states, restructuring was receiving active consideration. Beginning in the summer of 2000, wholesale power prices in California soared, resulting in the bankruptcy of one of the nation's oldest and largest utilities, PG&E, and threatening to destabilize the financial standing of the entire state. The inability of California's restructured system to handle this problem froze the entire restructuring movement. Thus some areas in the U.S. that had already restructured electric utilities had competing firms providing generation, while many others maintained their traditional vertically integrated utilities subject to state commission regulation that had been used for decades.

The problems in California resulted, in large part, from flaws in the market design adopted there. In addition, however, the events in California exposed some problems that are likely to be present in any similar system. In the typical day-ahead market, the agency operating the market accepts bids from generators for power on an hourly basis. A bid consists of the minimum price for which a generator would be willing to supply power and the amount of power the generator would be willing to supply at that price. In California, the PX required distributors (primarily the former integrated utilities) to submit forecasts of their hourly needs, and these determined the amount of power the PX would contract for. The power is purchased from generators in order of bid price—lowest to highest—but all generators receive the highest price for power purchased. In a competitive market, this should encourage generators to bid their short-run marginal cost. This price then establishes (with a transmission markup) the system-wide wholesale price paid by those distributing power to the final retail customers.[20] Actual demand for electricity likely will differ from even the best day-ahead forecasts. In addition, unexpected

[19] New England, New York, and the PJM area, which included parts of Delaware, District of Columbia, Maryland, New Jersey, Pennsylvania, and Virginia.

[20] The process is more complicated when there are transmission constraints, as frequently happened in California. In California there was a separate bidding process for handling transmission congestion.

outages may cause expected supply to be unavailable. This was handled by a second market operating in real time. The prices set by that market applied to the power sold in that market only. When the system was created, it was expected that the amounts of electricity transacted on the real-time market would be relatively small, and the market was designed to handle less than 5% of the total amount of energy.[21] This turned out to be grossly wrong.

One problem with this bidding system is that it can give even relatively small producers market power—the ability to affect the system price by restricting output or by bidding above short-run marginal costs.[22] This problem is particularly likely when capacity is tight. This market power creates the incentive and the opportunity for firms to engage in strategic behavior to the detriment of electricity users. This strategic behavior involved actions that were illegal under the rules adopted in California.[23] Enron became infamous for having engaged in strategic behavior and for having developed memorable names for the various strategies the company employed. A major reason for the existence of market power is that the short-run elasticity of demand for electricity is essentially zero because the price paid by final consumers does not track the hourly wholesale price changes. This problem was especially bad in California where retail price caps meant final users were unaffected even by average changes in electricity prices across many hours. Even in the absence of such caps, few retail customers face “real-time” prices where changes in wholesale prices are immediately reflected in retail prices. Rapid growth

[21] Federal Energy Regulatory Commission, "Final report on price manipulation in Western markets, Part 2, Docket No. PA02-2-000," VI-22. During some hours the ISO market accounted for 33% of electricity usage. Borenstein et al., "Inefficiencies and Market Power in Financial Arbitrage: A Study of California's Electricity Markets," 351.

[22] This point has been made in Borenstein, "The Trouble with Electricity Markets: Understanding California's Restructuring Disaster."; Severin Borenstein, James B. Bushnell, and Frank A. Wolak, "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market," *The American Economic Review* 92, no. 5 (2002). If supplies are plentiful, there is also the possibility that generators with the highest marginal costs will be unable to cover their total costs even if their capacity is needed to meet demand.

[23] The illegal actions in some cases involved filing false reports including those that appeared to create a congestion problem where there actually was none. There were also provisions designed expressly to prohibit the exercise of market power including the prohibition of “gaming” that operated to the detriment of the efficiency of the market and its customers or that sought to manipulate prices. Federal Energy Regulatory Commission, "Final report on price manipulation in Western markets, Part 2, Docket No. PA02-2-000," VI-6 - VI-10.

in the West increased demand, low levels of rainfall reduced supply from hydropower, and an inadequate transmission system hampered the movement of electricity across long distances. Even if California's market had operated perfectly, the wholesale price of electricity most likely would have risen substantially between the summers of 1998 and 2000.[24]

As mentioned above, the price paid by the ISO in the real-time market was capped. Although the price paid in the PX was uncapped, arbitrage made the cap effective there as well, and resulted in it playing a smaller role than designed. Essentially, once the price of electricity in the PX hit the cap, retail distributors would stop buying, expecting to be able to purchase from the real-time market at the capped price. This caused the three major distributors to chronically underestimate the load they reported to the PX to ensure that they wouldn't be paying a higher price in the PX than they would in the real-time market. This led to too little generation being arranged in the PX, and, consequently, more to be bought and sold in the ISO market. One profitable strategy (*Ricochet*) took advantage of the price disparities that could arise between the PX and ISO market, and the fact that the price cap did not apply to energy that was imported from other states. Essentially, this strategy involved converting in-state California electricity to out-of-state electricity so that it could receive the higher price. As a result of under scheduling, there was excess generation in day-ahead PX market. This would be committed to an out-of-state (export) sale. When the ISO market became saturated, the out-of-state buyer could then turn around and sell it at the higher, uncapped price prevailing in the ISO market. This was one of the strategies Enron engaged in, although it needed an out-of-state partner who would receive a fee for this service. Those knowingly profiting from this arrangement included Powerex (the marketing arm of BC

[24] Borenstein, Bushnell, and Wolak, "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market," 1377.

Hydro), several out-of-state utilities, a California city (Los Angeles), and a federal agency, the Bonneville Power Administration.[25]

One of the Enron strategies (*Fat Boy* or *Load Inc'ing*) appears to have been done with the knowledge and even encouragement of the ISO, and enabled out-of-state producers to receive payment from the ISO market even if the ISO would otherwise not have purchased that power. A purchaser in California contracts with an out-of-state generator based upon a scheduled load that does not take place. The out-of-state generator, nevertheless, generates the power and transmits it to the ISO. Since the generation had been scheduled, the producer was entitled to be paid.[26] The Federal Energy Regulatory Commission's (FERC) staff concluded that since a major concern of the ISO was that enough energy be available in its real-time market to meet the large demands on that market, it was unconcerned that deliberately false information was being given. The staff received some reports that the ISO facilitated this by providing some companies that only had generation with fictitious load to enable them to provide electricity to the system.

Some of the strategies employed by Enron and others involved manipulating the mechanism designed to handle congestion. If a transmission line became congested, charges were applied to transmission that aggravated the congestion. Transmission on the same line, however, that flowed in the opposite direction would actually reduce congestion and could receive a payment. Essentially the *Death Star* strategy involved creating two transactions that exactly balanced. One was scheduled in the opposite direction on a congested transmission and was thus entitled to a congestion payment. The other transaction was carried out by purchasing transmission rights on lines not controlled by the ISO.

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[25] The Los Angeles Department of Water and Power, a utility owned by the municipality, had the same status as an out-of-state utility.

[26] Michael DeCesaris, Gregory Leonard, and Douglas Zona, "Energy trading strategies in California—Market Manipulation?," in *Obtaining the best from regulation and competition*, ed. Michael A. Crew and Menahem Spiegel (New York: Kluwer Academic, 2005), 166 - 67.

The two transactions cancelled out so that no electricity actually was generated or used, but a congestion payment was received.[27]

The three strategies discussed above (*Ricochet, Fat Boy, Death Star*) are all types of arbitrage and would not have affected the total amount of power in California. *Ricochet* had the potential of circumventing a price cap; otherwise it was a pure arbitrage between the PX and ISO markets, and had the potential to lose money. *Fat Boy* was a reaction to a market flaw that encouraged the shift of energy purchases from the PX market to the ISO market. Since it increased the availability of energy in the ISO market, it may have been beneficial. It is not clear how it could have resulted in price manipulation, and it also carried some risk since the price received by the producer could have been low. *Death Star* is a type of transmission arbitrage. If it actually shifted the flow of electricity from congested lines to less congested lines outside the control of the ISO, it had a positive effect on the efficiency of California's electricity system. More likely, it can be seen as exploiting a market inefficiency resulting in pricing variation between alternative but equivalent transmission paths, and actually had no effect on electricity flows. Although all three strategies may have been illegal, it is not clear that they involved the exercise of market power, which would have consisted of withholding electricity to drive up its price. These strategies were aggressive market responses to flaws in the California system.

Some of Enron's strategies were blatantly illegal. In one strategy (*Load Shift*) Enron tried to increase the congestion price over transmission lines on which it held transmission rights that would have enabled it to collect a significant portion of all congestion revenues associated with those lines. Enron deliberately scheduled load and generation in a way that would have contributed to that line's congestion. Enron made considerable profit on its transmission rights because of congestion affecting

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[27] Ibid., 169 - 70.

those lines, and a former Enron employee claimed Enron's actions caused some rolling blackouts.[28] The FERC staff concluded, however, that although Enron had tried to move prices, they had been unsuccessful and the strategy would not have affected actual power flows.[29] In another scheme (*Get Shorty*), Enron contracted to provide reserve generation capacity to the ISO when it actually did not have that reserve. Enron's strategy was to purchase the reserve generation capacity on the spot market. Although selling short is acceptable in many markets, and creates the risk of losses, it was specifically prohibited in California. The stability of the entire system depended on access to reliable reserve generation, and sellers of that service were required to identify the specific generating units providing that reserve. Enron simply submitted false information. In another blatantly illegal scheme, for which there does not appear to have been a cute name, Enron sold non-firm power as if it were firm, a clear case of fraud. Firm power comes with its own reserve capacity, and reduced the need of the ISO to contract separately for reserve. Thus firm power received a higher price than non-firm power. Although it was unlikely that Enron would have been unable to supply the non-firm power when needed, and such a shortfall would have incurred a penalty, this fraudulent behavior could have adversely affected the stability of the entire system.

Enron's strategic behavior violated the rules of the California market, but does not indicate evidence of market power. Much of what Enron did amounted to arbitrage between the PX and ISO markets. This was profitable because of a persistent gap between the PX and ISO prices beginning in spring 2000 in the northern zone (NP15) of California, where most of the purchase of wholesale electricity was by PG&E. The persistent price difference is a puzzle. Borenstein, et al, offer the explanation that the

[28] The rolling blackouts were not caused by excess demand on the system and occurred at times when there should have been ample capacity.

[29] Federal Energy Regulatory Commission, "Final report on price manipulation in Western markets, Part 2, Docket No. PA02-2-000," VI-12 - VI-15.

difference was the result of the exercise of monopsony power by PG&E.[30] Its power enabled it to reduce the price in the PX market by reducing the amount it purchased in that market. This, of course, required that it purchase more power in the ISO market. Since the total supply and demand of electricity was unaffected, this behavior did not increase the ISO price beyond what it otherwise would have been, but it enabled PG&E to obtain electricity from the PX at a discount. This explanation does, however, raise some new questions. The other major utilities appear not to have engaged in this practice. Arbitrage by Enron (and others) should have closed the gap between the two markets. Borenstein and his co-authors acknowledge these problems and offer some tentative explanations. Enron's behavior was ultimately judged criminal under the rules of the California market; these rules may have inhibited similar behavior by others, although many who did employ the same strategies as Enron avoided prosecution. Arbitrage by entities without physical generation or load was forbidden, preventing the entry of pure financial arbitragers. Enron appears to have tried to create a cartel of those engaged in arbitrage; had this cartel been able to exercise market power in arbitrage, it would not have been in their interest to completely close the price gap.

Although Enron may not have been able to exercise market power, the California markets seemed to have been characterized not only by the monopsony power discussed above, but also by producer market power. This type of market power may have accounted for 59% of the price increases in California between 1998 and 2000.[31] A major contributor to this problem could be found in flaws in the California market. Concern over stranded cost led to the creation of some unfortunate market features, such as the prohibition by existing utilities to engage in long-run contracting and the retail price freeze. The crisis ultimately was resolved when the state made long-term contracts for electricity supply at very

[30] Borenstein et al., "Inefficiencies and Market Power in Financial Arbitrage: A Study of California's Electricity Markets." The design of the California market allowed for retail competition, but few retail purchasers of electricity opted for a supplier other than the existing utility, including PG&E.

[31] Borenstein, Bushnell, and Wolak, "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market." Although the empirical work deals with California, the authors identify a number of sources of market power that would likely appear in all wholesale electricity markets.

high prices, creating a burden California's electricity users will bear for years. A shortage of generating capacity, connected to an imperfect transmission system, was the likely primary cause of California's problems, but the perverse behavior induced by the market environment prevented even the capacity that did exist from being fully utilized. California showed that the design of electricity markets can be done very badly; it is unclear, however, exactly how much could have been avoided by better design.

Conclusion

Electricity has proven resistant to the design of institutions aligning the interests of industry decision makers with public interests. The importance of electricity is so great, and the consumer surplus from its use so high, that even the inefficient production of electricity provides enormous benefits. As flaws in existing institutional structures have become clear, public policy has intervened to introduce reforms on many occasions. Those reforms, however, have always introduced unanticipated new problems that again raised public concern and led to new regulations. The nascent industry suffered from corruption; state regulation was introduced to deal with that problem while ensuring that consumers were charged "fair" prices. That system introduced a set of new inefficiencies arising from two unintended consequences. Regulation reduced the incentives faced by decision makers to operate in the most efficient manner. In addition, it proved to inhibit the ability of the industry to fully realize the advantages of increasing scale economies, particularly of larger integrated networks. Holding companies provided a way of restoring the incentives to take advantage of these scale economies, but they also enabled utilities to exploit flaws in the system of regulation to the detriment of consumers, and they created a financial bubble that hurt investors as well. The Public Utility Holding Company Act of 1935 corrected many of these problems but reinstated the disincentives to increase the size of integrated networks. The problem of regulation's interference with investment incentives led to massive waste associated with the construction of unneeded plants. The "stranded costs" resulting from these decisions distorted ensuing reforms. Policies designed to encourage alternative sources for electricity production ultimately created an unsustainable system with wholesale electricity prices that encouraged inefficient behavior. Restructuring the industry promised to correct these problems, but required the design of complex new institutions whose design proved daunting, and introduced new problems with market power. These became distilled with the California crisis in 2000-2001, which resulted in a bifurcated system in the U.S. with some areas operating with competitive markets for generation and others retaining the existing system of regulation, both of which were flawed in ways that undermine the efficient production and distribution of this vital commodity, a problem that persists to this day.

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