The California Electricity Reform Debacle

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Abstract

In 1998, California launched a dramatic reform of its electricity sector, vertically de-integrating its major utilities and establishing a competitive generation market, with separate entities responsible for grid control and power exchange. After two uneventful years, wholesale prices rose dramatically in the summer of 2000 and have remained high into 2001. An imbalance between the high wholesale prices and frozen retail rates caused a financial crisis for the electric utilities and power shortages have been a chronic threat. Several factors contributed to this crisis: capacity has not expanded in step with demand either in California or its larger trading region; extreme weather and poorly timed plant outages further increased demand and decreased supply; market design flaws allowed significant suppliers to influence the market while frozen retail rates limited the demand response that would have mitigated the supply-demand imbalance. State and federal agencies have taken corrective action but the situation may remain critical for some time. Longer term solutions involve recognizing the special characteristics of electricity in designing market reform. Because electricity supply and demand must be instantaneously balanced at all times, market reform must ensure that someone has the responsibility and effective tools to ensure that this occurs, in spite of unforeseen circumstances, and to prevent the exercise of market power. Because a competitive commodity market must work in concert with a monopoly delivery system, someone must be responsible and have the means to develop and operate the grid in ways that are amenable to effective competition. Finally, reform design must ensure that the cyclical investment and price patterns of normal commodity markets are minimized in the electricity market and that when they do occur, market volatility does not compromise reliability and price stability for those who value these highly and would pay a premium for them.

1. Introduction

In a reversal of roles that evokes centuries past, electricity market reforms of the Thatcher government in 1990 positioned England as an economic policy leader among Anglo-

Saxon countries. England was not the only country to undertake such reforms, but it provided the most noteworthy example.[1] As a consequence, English experts (economists, lawyers, regulators, politicians) toured the globe, especially the U.S., as missionaries of the growing movement for competitive electricity markets.

By the mid-1990s, California stated its intention of being the first North American jurisdiction to emulate the English and quickly drew up proposals for market reforms. The competitive market was launched in one leap in April 1998 and performed roughly as expected for the next two years. But in the summer of 2000, dramatic price increases and price volatility signalled a crisis. California is currently unable to meet peak demand in a hot summer or cold winter, even as prices have risen to extremely high levels. These high prices have created a financial crisis for the state's major investor-owned utilities who have been required to retail electricity at a rate far below the wholesale price at which they purchase it.

California's crisis has slowed or halted reform movements elsewhere while experts, politicians and interest groups try to understand what happened and how to prevent its embodiment in their own reform initiatives. The goal of this paper is to contribute to that understanding.

In section 2, I outline the international, political and economic context of the California electricity market reform. I present key details of the reform in section 3 and then describe the crisis in section 4. In section 5, I summarize the causes of the crisis. In section 6, I explore the options for resolving the crisis. In the conclusion, section 7, I reflect on the implications of the California experience for the broader question of the public benefits of reforming electricity markets and make some suggestions for those jurisdictions that might continue down the path of reform.

2. International and Economic Context

The electricity market reforms in England were dramatic.[2] The vertically-integrated, state-owned electricity monopoly was privatised and broken up, vertically and horizontally in 1989-91. Generation was separated from transmission and distribution, and split into two large private companies with the nuclear units remaining in public ownership (some have since been privatized). The separated distribution entity was split into 12 regional electricity companies, each with a monopoly of distribution in its geographic area, each regulated by the newly-created utility regulator. To increase competition in generation, these distribution companies are allowed to self-generate up to 15 percent of their customers' electricity demand; mostly this has led to the development of small, affiliated power generators. The transmission entity was sold to the 12

[1] In Great Britain, England and Wales reformed their market together. Norway and Chile enacted somewhat similar reforms about the same time, and several other jurisdictions followed soon after with different variations.

[2] I use the terms *reform* or *restructuring* instead of *deregulation* to describe electricity market changes and thus avoid the unhelpful debate over whether regulation increases or decreases in reformed jurisdictions.

distribution companies to ensure its independence from the generators; it is also under the control of the utility regulator. An independent system operator was established with the responsibility to ensure cost-minimizing market operation, including the provision of system support services. It operates a mandatory pool for matching supply and demand. The independent regulator applies a hands-off, price cap regulatory method to the transmission and distribution monopolies and a threat of an anti-trust complaint to discourage price manipulation in the generation market.

To the surprise of many, the English reforms unfolded relatively smoothly. Sceptics had argued that electricity is too special to be treated like other commodities because: (1) it requires instantaneous balancing of supply and demand, (2) it has an essential-service character in a modern economy (implying an inflexible demand response to price change), (3) effective competition is unattainable because of the unique characteristics of electricity generation, and (4) there are major challenges to operating a competitive commodity market in conjunction with a natural monopoly delivery system. This combination, it was argued, would diminish reliability, degrade customer service, lead to massive layoffs, cause price instability, and allow for rising prices that generate windfall profits. While some of these effects have been detected in small measure, most observers admit that the overall experience has been benign if not beneficial. There were substantial job losses in the coal mining industry, but these mines had been uneconomic for some time, kept alive by the above-market, politically-determined prices paid by the former electricity monopoly. After reform, electricity prices fell by 30% in real terms through the 1990s, although significant profits were earned by some of the new private companies. New capacity investments were substantial, especially in natural gas-fired plants. Reliability was not compromised and aspects of customer service (e.g., response time to complaints) improved. The regulatory process and the mandatory pool had their detractors but major problems did not materialize. While there have been ongoing debates on fine-tuning the system, there is no support for reverting to the past.[3]

The reforms in England and elsewhere piqued the interest of those who believe that markets will generally outperform central planning in allocating society's resources and especially struck a chord in jurisdictions with high generation costs. Countries as diverse and distant as Norway, Chile, New Zealand and Argentina became early adapters of electricity sector reform in various guises for various reasons.

By the early 1990s, California's electricity prices were 50% higher than the U.S. average, about 11¢/kwh for residential customers. California also possessed an excessively legalistic regulatory process with layer upon layer of detailed procedures and public hearings for assessing resource investment options (integrated resource planning), implementing energy efficiency programs (demand-side management) and setting rates

[3] Green, R. 1999. "Draining the Pool: the reform of electricity trading in England and Wales", *Energy Policy*, V.27: 515-525.

(rate review and rate design). Not surprisingly, California stepped to the fore of the North American initiatives to follow the English lead.[4]

In 1993, the California Public Utility Commission initiated a statewide debate on electricity sector reform. During this time, the U.S. Federal Energy Regulatory Commission issued orders and fostered cooperative arrangements to open transmission systems in the U.S. to fair and unrestricted access, resulting in a substantial increase in wholesale electricity trade. In 1996, California passed legislation, Assembly Bill 1890, that set early 1998 as the date for a complete transformation to a competitive electricity market, including direct access to retail customers for electricity generators.

California's market reform occurred without major incident. In the following two years, wholesale prices fell somewhat and it looked as if California would repeat the generally uneventful pattern of a growing number of reforming jurisdictions throughout the world. However, by the end of 1999, a tightening market led to rising wholesale prices. Then, in the summer of 2000, a substantial, weather-related jump in demand revealed how volatile wholesale prices could be and how unstable and perhaps unsustainable the California electricity market had become. Even the high prices could not induce sufficient supply, forcing the ISO to schedule controlled blackouts for some customers. At the same time, utilities were unable to pass high wholesale costs on to final consumers, leading to a threatening financial imbalance. This "California electricity crisis" caught the attention of the world as prices rose out of control, unable to trigger the price-induced reductions in demand that are characteristic of properly functioning commodity markets.

The California electricity crisis has led many observers throughout the world to question the wisdom of even attempting to create competitive electricity markets. The debate has become increasingly polarized as those who favour a centrally-planned electricity sector claim vindication by the California experience and those who advocate competitive electricity markets claim that California is simply a case of market reform that failed because it only went halfway in failing to remove retail price controls. This polarized debate is significant because many jurisdictions throughout the world are caught in the middle of electricity market reform initiatives. They are now unsure whether to continue or to stop.

Many organizations are now examining the California experience. Key agencies in California and with the U.S. government are conducting investigations. Jurisdictions that are part way along the reform path are trying to learn more. But in this rapidly changing context, it is difficult to see the larger picture.

3. California Electricity Reform[5]

[4] California would be the first with such a full-scale transformation, but the province of Alberta in Canada preceded it with substantial reforms in 1993. Some U.S. states have enacted comparable reforms to California at almost the same time.

[5] The description of the California reform, crisis and subsequent developments (sections 3, 4 and 5) is based on information available on the websites of the U.S. Federal Energy Regulatory Commission

Prior to reform, the California electricity industry was dominated by three large, vertically-integrated, investor-owned utilities, centred on the major urban agglomerations of San Diego, Los Angeles and San Francisco. These are, respectively, San Diego Gas and Electric, Southern California Edison and Pacific Gas and Electric. There are also, however, some important municipal utilities, notably in Sacramento and Los Angeles.

California represents roughly 10% of the U.S. electricity market. In the 1990s, annual consumption was about 250,000 GWh, with gross revenues of $25 billion, although these numbers changed dramatically at the end of the decade. California-dedicated[6] electricity production capacity is about 50,000 MW, including large hydro (20%), nuclear (16%), coal (20%), natural gas (31%), renewables (12%) and other (1%). In the last few years, the state has relied on about 10,000 MW of imports from neighbouring states, Canada and Mexico.

While California has been at the forefront of electricity reform in the U.S., it has not acted alone. Figure 1 shows that almost every state in the U.S. is somewhere along the reform path, with 24 states having enacted significant reform legislation by 2001.

Figure 1: Status of U.S. State Electricity Restructuring

A critical component of moving to competitive electricity markets in the U.S. is for reforming jurisdictions to have access to as many electricity providers as physically possible. In this respect, the reforms initiated by the Federal Energy Regulatory Commission played a critical role in market reform. In 1996, the Commission issued Orders 888 and 889 that required all holders of transmission facilities to provide non-discriminatory access and fair tariffs for transmission systems across the country for the wheeling of wholesale power. Systems with significant interconnection were also encouraged to create regional organizations that would establish common rules of access and common tariff principles. This policy alone had a substantial efficiency effect on the U.S. electricity system as wholesale traders exploited the synergies in the production capabilities and demand patterns of interconnected jurisdictions.

Authority over the electricity market within California ultimately resides with the state legislature, but it delegates substantial responsibility to the California Public Utilities Commission (CPUC), an independent regulatory body. The California reform involved coordination of state legislation with CPUC directives to ensure that the regulated utilities complied with the spirit of the reform: vertically de-integrating their companies to

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(www.ferc.fed.us), the U.S. Energy Information Administration (www.eia.doe.gov) the California Public Utilities Commission (www.cpuc.ca.gov), the California Independent System Operator (www.caiso.com) and the California Power Exchange (www.calpx.com). See also, Sioshansi, F., 2001, "California's dysfunctional electricity market: policy lessons on market restructuring," *Energy Policy*, V.29: 735-74.

[6] Some facilities, notably the coal plants, are located in a neighbouring state but dedicated to the California market.

separate generation, transmission, system operation and distribution functions; transferring control of transmission assets; and divesting themselves of most of their generating assets.

The California reform involved the following key components.

- It created an Independent System Operator (ISO). This is a non-profit corporation responsible for efficient and reliable use of the state's transmission systems, including day-to-day operation, system planning and setting transmission tariffs as regulated by FERC.

- It created a Power Exchange (PX). This is a non-profit corporation that provides an open, non-discriminatory power pool (or spot market) for electricity sellers. Participation in the PX is voluntary for all suppliers except the generation still owned by the major utilities, for whom the pool is mandatory over a four-year transition period. The PX operates under FERC regulation.

- It created an Oversight Board, with representation from utilities, consumers, producers and retailers of power, responsible for overseeing the activities of the ISO and the PX, including serving as an appeal body.

- It established the Competitive Transition Charge (CTC) for the three major utilities, a non-bypassable wires charge on utility customers. CTC revenues were to compensate utility shareholders for costs that would be unrecoverable under competitive markets (*stranded costs*) because of expected lower prices. These utility costs included liabilities for some of their own nuclear plants and some mandated, fixed price contracts with non-utility suppliers. The CTC was given a sunset date of 2002; any stranded costs not recovered from customers by that date would be absorbed as utility shareholder losses.

- It provided for immediate full retail access for all customers. Customers were given the option to keep the distribution utility as their commodity purchasing agent, but could select any alternative provider (called energy service providers – ESPs) from the first day of the reform. Municipal distribution utilities were not required to allow full retail access for their customers. For those customers who retained the utility as their purchasing agent, the utility was required to purchase all electricity from the PX at the spot market price. The utilities were not allowed to sign fixed price contracts or price hedging contracts, thus exposing all of their power cost to the hourly PX prices. There were no controls on this price as the wholesale spot market was intended to operate as a fully deregulated commodity market.

- For those purchasing from the utilities, the retail rates for the commodity were reduced by 10% immediately for residential and small commercial customers and frozen for industrial, agricultural and large commercials customers. Since it was assumed that wholesale purchasing rates for the utilities would fall by more than 10%, this reduction was a compromise that would give utilities a fair chance of

recovering up to 90% of their stranded costs before the CTC sunset date. If wholesale supply purchase prices for the utilities fell dramatically, the utilities might recover all of their allowed stranded costs; if not, they might recover only a little. If the allowed stranded costs were recovered before the sunset date, the utility could then set its rates to reflect the wholesale spot price. The assumption was that this would lead to even lower retail rates.

- It established a second non-bypassable wires charge to support public purpose programs: $248 million for the Public Interest Energy Research Program, $540 million for the Renewable Technology Program, and $912 million for the California Board for Energy Efficiency – a new entity to oversee the independent administration of energy efficiency programs.

- In January 1998, the CPUC ordered the transfer of control of designated transmission lines and facilities of the three main utilities to the ISO. This gave the ISO control of about 70% of the state's transmission grid. The utilities retained ownership of their transmission facilities as well as control and ownership of their distribution facilities.

- In accordance with CPUC directives to divest themselves of at least 50% of generation assets, the three large utilities sold a large number of generating plants in competitive bidding processes, sometimes receiving much more than asset book values.[7] Remaining utility capacity must be sold into the PX and bought out of it at the PX spot price; utilities were not allowed to sign long-term, fixed price contracts or hedging contracts for any of their supply.

- In March 1998, the CPUC issued the order opening the electric industry to competition for all consumers in IOU service territories.

Figure 2 shows the new structure of the California electricity market. While independent generators have the option of bidding through the PX it was mandatory for the utilities to purchase all power from the PX.

Figure 2: Restructured California Electricity Market

4. The Crisis Unfolds

In both 1998 and 1999, California's reformed market appeared to be functioning as well or better than planned. Institutional and regulatory aspects of the transition went

[7] San Diego Gas and Electric sold all of its generation assets except for retaining a 20% share in the San Onofre nuclear plant.

relatively smoothly. Wholesale prices established in the PX bidding process were as low or lower than expected, hovering at about 3¢/kwh.[8]

Because the IOUs divested themselves of some of their generating assets above book value and because their wholesale purchases of electricity through the PX were at lower than anticipated prices, the utilities were recovering their allowed stranded costs quickly, hastening the day when the Competitive Transition Charge could be eliminated. In July 1999, San Diego Gas and Electric achieved its allowed recovery of stranded costs, meaning that its retail rates were freed from the legislated rate and could henceforth adjust to reflect the utility's wholesale supply costs.

Independent energy service providers were successful in attracting many industrial and large commercial customers.[9] But almost all residential customers stayed with the distribution utilities as their commodity purchasing agent; the legislated rate decrease and customer familiarity with the utilities made it difficult for energy service providers to make quick inroads into this low margin market.

Then, in the summer of 2000, the PX wholesale price spiked up dramatically and stayed at high average levels throughout the summer. The price started to come down in September but by November it rose again and stayed at high average levels. Some price spikes were over 50 ¢/kwh and the average summer price hovered near 20 ¢/kwh. Figure 2 shows the PX wholesale prices in 1999 and 2000.

Figure 3: PX Wholesale Spot Prices: 1999 and 2000

These high prices have created a financial crisis for the three major utilities. On the one hand, they are required to meet all of their customers' power demands with purchases from the PX. Every kwh is purchased at the high PX price.[10] On the other hand, they are required to sell the power to customers at much lower retail rates fixed by legislation. This imbalance results from the common assumption, at the time of designing the reform, that wholesale rates would only move in a downward direction. Because San Diego Gas and Electric was free of the legislated rate, it quickly raised its rates in order to pass through to customers its higher commodity acquisition costs; its residential rates increased from 11 ¢/kwh to 16 ¢/kwh in July 2000. However, under pressure from irate customers, the California legislature established a ceiling of 6.5 ¢/kwh for the commodity portion of the electricity bills of residential and small commercial customers (resulting in rates capped at about 13 ¢/kwh). Therefore, all three utilities found themselves paying

[8] However, some analysts expressed concerns based on early observations. One study, for example, expressed concerns about market power and the efficiency of the ancillary services market: Earle, R., P. Hanser, W. Johnson, and J. Reitzes. 1999. "Lessons from the first year of competition in the California electricity markets", *The Electricity Journal* (October): 57-76.

[9] By October 1999, they had captured about 35% of industrial load.

[10] For that generation still owned by the utility, it was at least receiving the same revenue from the PX that it was paying to the PX. But for all non-utility generation, there was a large gap between revenue and expenditure.

producers much more for power than they received from customers; this started in the summer and continued right through the year and into 2001. For the year 2000, the estimated unrecovered power costs of the three utilities are in the order of $12 billion. This financial imbalance has continued into 2001 and in April Pacific Gas and Electric filed for bankruptcy protection.[11]

With suspicions rising that independent power producers were making windfall profits from the crisis, the CPUC regulated a price cap in the PX. This was set at 50 ¢/kwh in June and reduced to 25 ¢/kwh in August of 2000.

By the end of 2000, the ISO – with the responsibility to ensure adequate supply at any cost – was warning about supply shortages in critical areas. In early 2001, the ISO issued an increasing number of emergency notifications. These require voluntary curtailment by some customers and in a few cases the ISO implemented rotating blackouts (involuntary curtailment) in some parts of the state.

In December 2000, the U.S. Secretary of Energy applied a rarely used emergency authority to order independent generators to supply the ISO in order to help avert power outages. This was used several times in the ensuing months.

Also in December, the Federal Energy Regulatory Commission eliminated the requirement for utilities to buy and sell through the PX and indefinitely terminated the PX's authority to operate. Then, in February 2001, the California government authorized California's Department of Water Resources to purchase power under long-term contracts for supply to the utilities. The role of the PX in setting prices is over for the time being.

Thus, California finds itself in 2001 in a chronically tight power market in which state and federal governments, and their agencies, have intervened to address supply shortfalls and to mitigate dramatically high market prices. At this stage of the crisis, the initial market reform goals of lower prices, less regulation, greater customer choice and reliable supply appear far away. The various emergency measures have, by necessity, focused largely on the symptoms of the California crisis. A longer term resolution requires an understanding of its principal causes.

5. Causes of the Crisis

Sustained economic growth over the 1990s and an exceptionally hot summer in 2000 pushed California electricity demand to new levels. If the industry were still dominated by a monopoly, the utility would have responsibility to ensure sufficient acquisition of new supply (investment and purchases) to meet both the short-term contingencies of abnormal weather and the long-term upward trend in demand. Even if unforeseen circumstances caused market tightening, the utility would supply power at cost, earning

[11] According to its bankruptcy filing, Pacific Gas and Electric had accumulated an unrecovered power cost liability of $9 billion between June 2000 and April 2001.

no more than a normal rate of return. In the reformed California market, this supply-side response did not materialize. When markets tightened, the price to suppliers increased. But there was no quick increase in supply. At the same time, prices to consumers did not increase to reflect cost, so there was little demand reaction. How did various factors combine to create this situation?

One key factor is that capacity did not keep pace with demand, either in California or in its trading region, during the period 1990 - 2000. Energy demand grew by about 60,000 Gwh, up to almost 300,000 Gwh in 2000, while capacity demand grew by about 10,000 MW. During this same period, net generating capacity in the state remained basically static. This is not alarming in itself; an increase in long-term imports may be optimal for economic, environmental and other reasons. However, during the same period, peak demand dramatically outgrew capacity in the western interconnected system, which includes all of California's potential trading partners. Peak requirements increased by 26,000 MW while capacity increased by only 10,000 MW.

These imbalances were tolerable during most of the decade as the region reaped the benefits of the emerging wholesale market. Without investing in new capacity, producers in states and provinces throughout the interconnected region were able to improve the capacity use of existing facilities through increased trade. For example, the hydropower-dominated systems of Bonneville Power Authority (primarily in Washington and Oregon) and British Columbia Hydro can have substantial excess capacity during California's summer peak periods. They can also use their considerable storage capability to purchase low cost thermal power in off-peak periods and then sell it at peak periods, limited only by the size of the transmission interconnections.

While expansion of interstate wholesale trade has been an impediment to new capacity investment in California, there are other important factors. One is that California's relatively strict environmental regulations hinder facility siting and permitting. Another is that the widely-held assumption of falling prices discouraged investors. Indeed, some analysts believe that a competitive electricity market would exhibit the cyclical investment and price patterns typical of other commodity markets. In fact, a concern for lags in capacity investment, and consequent price instability and deteriorating reliability, led the English to include in their reform a guaranteed payment to all available capacity, even when not dispatched.[12] A special capacity payment was not included in the California reform.

By the end of the 1990s most of California's neighbours found their markets tightening as demand continued to grow. This long-term trend was compounded by a combination of short-term weather conditions in California and its supplying regions. In California, the summer of 2000 was one of the 10 hottest summers in 100 years, causing an 8% jump over 1999 in peak air conditioning demand. This was followed by a colder than average winter, leading to a greater use of electricity for heating. At the same time, the Pacific northwest was experiencing one of its driest periods on record, dramatically reducing the

[12] The size of the payment is determined by the amount of the excess capacity; the payment increases as the market tightens.

energy capability from the large hydropower facilities throughout the interconnected area.

A second short-term factor is the increasing maintenance requirements of in-state facilities, an important percentage of which (60% of in-state thermal) is more than 30 years old. In both the summer of 2000 and the winter of 2001, over 5,000 MW of in-state capacity was out of service for maintenance and/or refueling (nuclear).

A third short-term factor is the link between natural gas and electricity prices. In part because of surging California demand in late 2000, natural gas prices in western North America rose dramatically. Some independent power producers had fixed price contracts to supply the distribution utilities; these contracts had been part of the stranded costs when they were considered high price. With high PX prices, these became the cheapest supply sources for the utilities. However, facilities fueled by natural gas found themselves losing money when buying high cost natural gas in order to sell at the now comparatively low electricity price. Some of these stopped operating, although the special order from the Secretary of Energy in December 2000 forced them back into service.

These short- and long-term factors all contributed to a tight balance between supply and demand in the California power market. In other commodity markets, these conditions result in rising prices and then reductions in demand. However, in the California market consumers would not see rising prices; these could occur in the wholesale market but they would not materialize in retail rates.[13] In effect, demand responsiveness to wholesale price change (elasticity) would be close to zero. Figure 4 illustrates this situation. In a normal market, an outward shift in demand (D_1 to D_2) would push consumption outward (Q_1 to Q_2) if price remained constant. However, a simultaneous price rise, as higher cost supplies (S) are acquired, limits the increase in demand (Q_1 to Q_3) which also limits the price increase (P_1 to P_2). In the case of California's electricity market, short-term supply constraints created, in effect, a vertical supply curve (S). At the same time, consumers of electricity saw no change in their retail price no matter what happened in the wholesale market. Thus, the demand curve was completely inelastic (unresponsive) to changes in the wholesale price, which is depicted with a near vertical demand curve. Because an outward shift in demand (D_1 to D_2) fails to trigger the normal supply-price-consumption response, the market wholesale price can rise very quickly to extremely high levels (P_1 to P_2).

Figure 4 Price Effect of Inelastic Supply and Demand

In a recent report, the ISO argues that under these conditions influential suppliers discovered that they could exercise market power and raise the PX price by withholding

[13] The exception is the short-lived effort of San Diego Gas and Electric to raise rates.

supply.[14] Exercising market power may be undesirable, but it is only illegal if it involves collusion, a conspiracy to coordinate action by two or more suppliers. Specialists in this area claim that individual suppliers, if they are significant enough, can learn from trial and error in the bidding process if they have market power and then experiment to find that bidding strategy that maximizes their net returns. Other influential suppliers may follow the same process, leading to an even greater combined effect.

According to the report, suppliers bidding into the PX discovered this power and then engaged in economic withholding and physical withholding. Under economic withholding, a supplier offers power in the PX auction at a rate above its marginal cost of production.[15] There should be little of this in a competitive market because suppliers would fear pricing themselves out of the market and having demand decrease. But with market power, it can lead to dramatic windfall profits. Under physical withholding, a supplier does not bid all available capacity into the PX's day-ahead auction. If there is supply shortage, prices for balancing capacity can be very high in the PX's day-of auction. This seems to have occurred frequently.

While the analysis is contentious, the ISO claims that there clear evidence that economic withholding was widely practiced, physical withholding only rarely, and that this lead to over $500 million in windfall, monopoly profits for these suppliers during the period May to November 2000. This strong suspicion that the PX price was being manipulated was a key factor in the FERC decision to stop its operation in January 2001.

6. Efforts to Address and Resolve the Crisis[16]

Efforts to address the crisis have been complicated by the diffusion of responsibility for the reformed electricity sector. Just as the realization of market reform required negotiation and cooperation between several entities, dealing with the crisis presents the same challenge, only over a compressed time scale because of the emergency conditions. Thus, while FERC has regulatory authority over the PX, it has generally allowed California to take the lead in designing the reformed system. With the PX malfunctioning, confusion arose as to whether federal or state authorities should intervene.[17] A similar situation developed between the state government and the CPUC with respect to changing the rules for utility purchasing and adjusting retail rates. Under the mounting pressure of the crisis, several short-term steps have been taken to address

[14] Sheffrin, A., 2001, *What Went Wrong With California's Electric Utility Deregulation?* (www.caiso.com).
[15] This overbidding can be estimated using crude information about normal operating costs for the technologies in question.
[16] See, in particular, the following reports. Federal Energy Regulatory Commission, 2000, *Order Directing Remedies for California Wholesale Electric Markets* (www.ferc.fed.us). California Public Utilities Commission and Electricity Oversight Board, 2000, *California's Electricity Options and Challenges: Report to Governor Gray Davis* (www.cpuc.ca.gov). Sheffrin, A., 2001, *What Went Wrong With California's Electric Utility Deregulation?* (www.caiso.com).
[17] Political commentators suggest that this was complicated by differing political and regional interests as the newly elected Republican federal government interacted with the Democratic government of California.

the immediate crisis. The state government is now leading the development of a longer-term strategy for resolving the situation; this is still under development.

Interim steps include, as already noted, the suspension of PX operation and the intervention of the California Department of Water Resources as purchasing agent for the utilities. Further steps in the spring of 2001 include approval by the CPUC of a 3 ¢/kwh average rate increase for the customers of Pacific Gas and Electric and Southern California Edison, and an agreement for the state government to purchase, above book value, transmission assets from Southern California Edison.

Then, in April both the state government and FERC released longer-term plans to rectify the situation. Key elements of the plans are:

- accelerate the development of new generation and transmission facilities by streamlining state permitting and siting procedures;
- create additional incentives to develop new capacity and ensure adequate reserve margin over the long-term;
- allow utilities to sign long-term supply contracts;
- change the bidding procedures of the PX to prevent the exercise of market power (e.g., charging penalties for under-scheduling);
- empower the ISO to control the timing of scheduled power plant outages;
- increase state-coordinated energy efficiency programs;
- develop extensive programs for price-responsive demand reduction by large customers (demand-side bidding); and
- install time-of-use meters and establish time-of-use tariffs for smaller customers.

While some of these elements can improve the immediate situation, capacity expansion takes more time. California is likely to remain in a chronic situation of undersupply for the coming year or so. Depending on weather and other difficult-to-control factors, supply emergencies may continue. However, the actions to change purchasing procedures and PX operation should prevent or at least significantly reduce the dramatic transfers of wealth that characterized the first eight months of the crisis.

7. Broad Lessons from California

Electricity reform is driven by emerging cost advantages of smaller plants over large, monopoly generators. Smaller plants, combined with open wholesale electricity trade, can provide the usual benefits of competition - lower long-run prices. This is because consumers can switch their purchases from unsuccessful, high-cost generators to successful generators. In a monopoly world, they cannot. If their monopoly misinvests, consumers must pay – or taxpayers if the monopoly is publicly owned. In the competitive model, investors mostly pay for their misfortune.[18]

[18] Consumers may temporarily pay for part of the mistake as they endure higher prices until the market is dominated by low cost suppliers.

In future, energy markets will continue to be highly uncertain. First, price instability will remain, given that supply and demand developments are rarely in sync. Second, environmental harm from fossil fuels (air pollution, greenhouse gases) exacerbates uncertainties about future regulations, technological change and costs. The only certainty is that misinvestments in electricity generation will continue to occur, resulting in the usual mix of winners and losers. In this situation, it is prudent for society to allow private investors to assume a significant share of the risk. This is the rationale for reform toward a competitive electricity market. A growing number of jurisdictions throughout the world have now carried out reforms in this direction, most with considerable success thus far.

However, the electric sector presents special challenges for achieving a consistently effective competitive market. These challenges must be understood and addressed with great caution, as California has painfully learned.

First, electricity is a special commodity in the way in which supply and demand must be instantaneously balanced throughout the grid at all times. This reduces the opportunity for normal, short-run, supply-demand responses to new market information. It also increases the opportunities for significant market participants to influence the market, as the system operator has reduced time to counter such behaviour. In designing a competitive electricity market, it is very important to assume the worst possible conditions and construct participation rules and controls that can prevent this outcome. California was much too optimistic about achieving effective competition. Perhaps, with technological advances, this unique characteristic of electricity will diminish in importance. Indeed, California might now foster the accelerated development of information and control technologies that enable decentralized, instantaneous responses of demand and supply to price change, with a stabilizing effect on price and market behaviour. If California becomes, by necessity, the leader in this area, there may yet be a silver lining to its current dark cloud.

Second, electricity is relatively unique in belonging to the set of commodities for which a potentially competitive component (generation) must be meshed with a monopoly component (delivery).[19] This creates special challenges for ensuring that the monopoly component does not hinder effective operation of the competitive component and of the market as a whole. This requires special structures and responsibilities to ensure independent operation of the delivery system and optimal investment in that system's development. Electric sector reform still being relatively new, the risks of design flaw are substantial. At great cost, California has provided valuable information to others of the importance of starting with a cautious design for grid operation that is robust under worst case scenarios. Its experience may also serve as an advertisement for continued central planning in transmission investment, although it is too early to draw definitive conclusions.

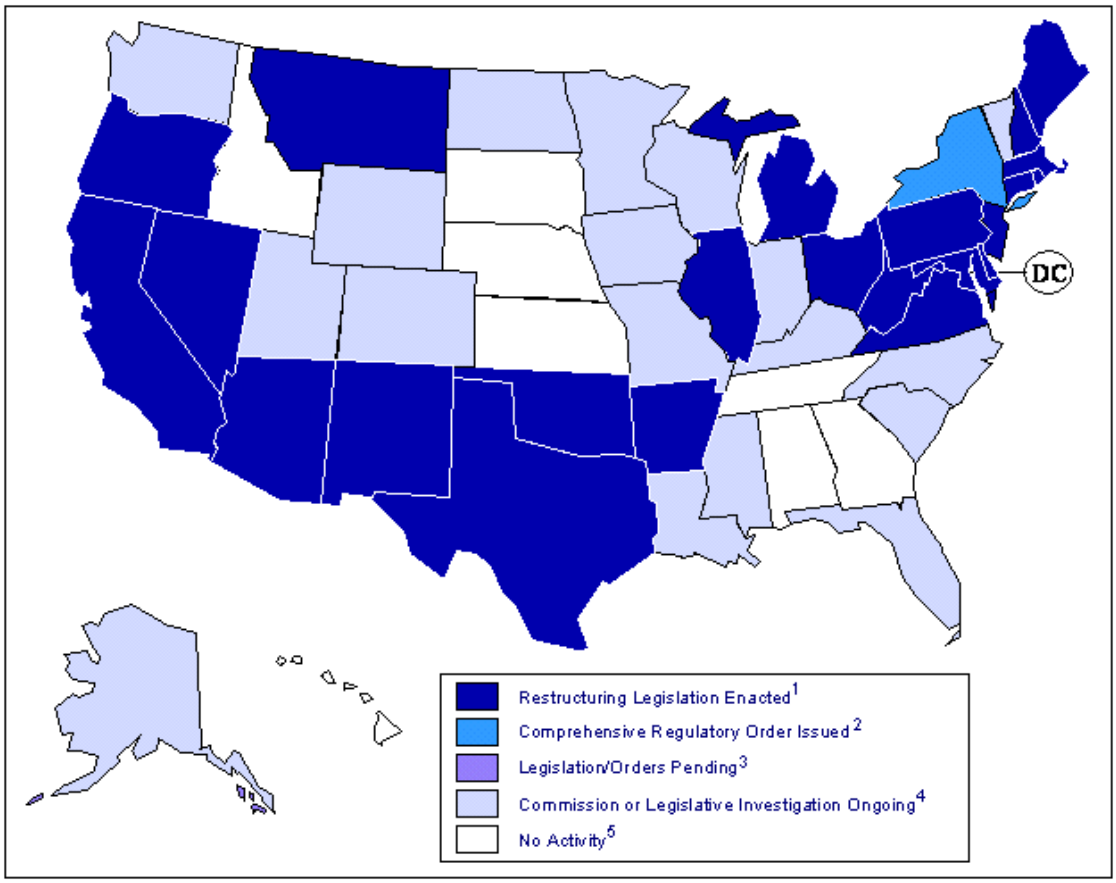
Third, electricity is relatively unique in being a commodity that has no substitutes for many of the services it provides in advanced economies. However, there is no reason

[19] Natural gas is the same.

why a competitive electricity generation market would not exhibit similar cyclical price and investment patterns of other commodities. But such fluctuations in the electricity sector are intolerable to most businesses and practically all consumers. This puts an onus on market reformers to include mechanisms that reduce the tendency toward cycles of over- and under-investment and that protect consumers from the sometimes brutal but necessary price signals to investors, all of this while ensuring a very high reliability of service. California will be doing more design work in this area. On the investment side, one candidate mechanism is the capacity charge in England that pays generators for being available, even if they are not called upon. On the price side, decisions must be as to whether utilities or government or someone should have responsibility for price hedging for small consumers. There are some costs to doing this, but they may be worth it. At issue in a competitive market is who would take this responsibility.

The California reform was not sufficiently cautious about these special characteristics of electricity. This is easy to criticize in hindsight, but there had not been a great deal of experience with competitive electricity markets. If we were unsure before, there is little doubt now about just how special electricity is.

Figure 1
Status of State Electricity Restructuring: May 2001



1Arizona, Arkansas, California, Connecticut, Delaware, District of Columbia, Illinois, Maine, Maryland, Massachusetts, Michigan, Montana, Nevada, New Hampshire, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Virginia, and West Virginia.
2New York.
3 None
4Alaska, Colorado, Florida, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, North Carolina, North Dakota, South Carolina, Utah, Vermont, Washington, Wisconsin, and Wyoming.
5Alabama, Georgia, Hawaii, Idaho, Kansas, Nebraska, South Dakota, and Tennessee

Source: Energy Information Administration, Department of Energy

Figure 2
Restructured California Electricity Market

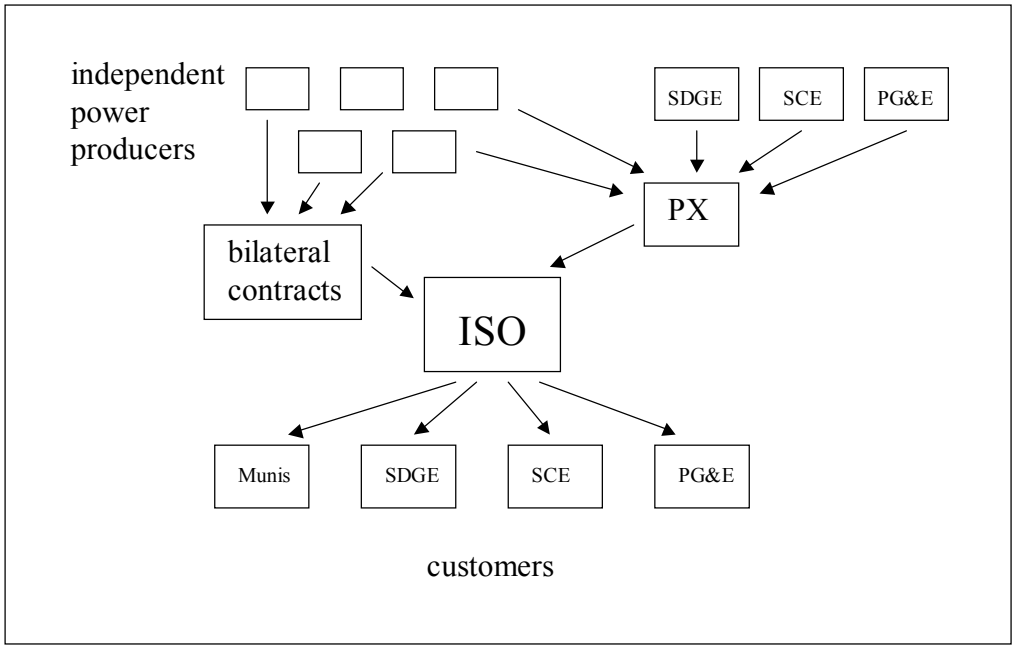


Figure 3

PX Wholesale Spot Prices: 1999 and 2000

Source: California Power Exchange

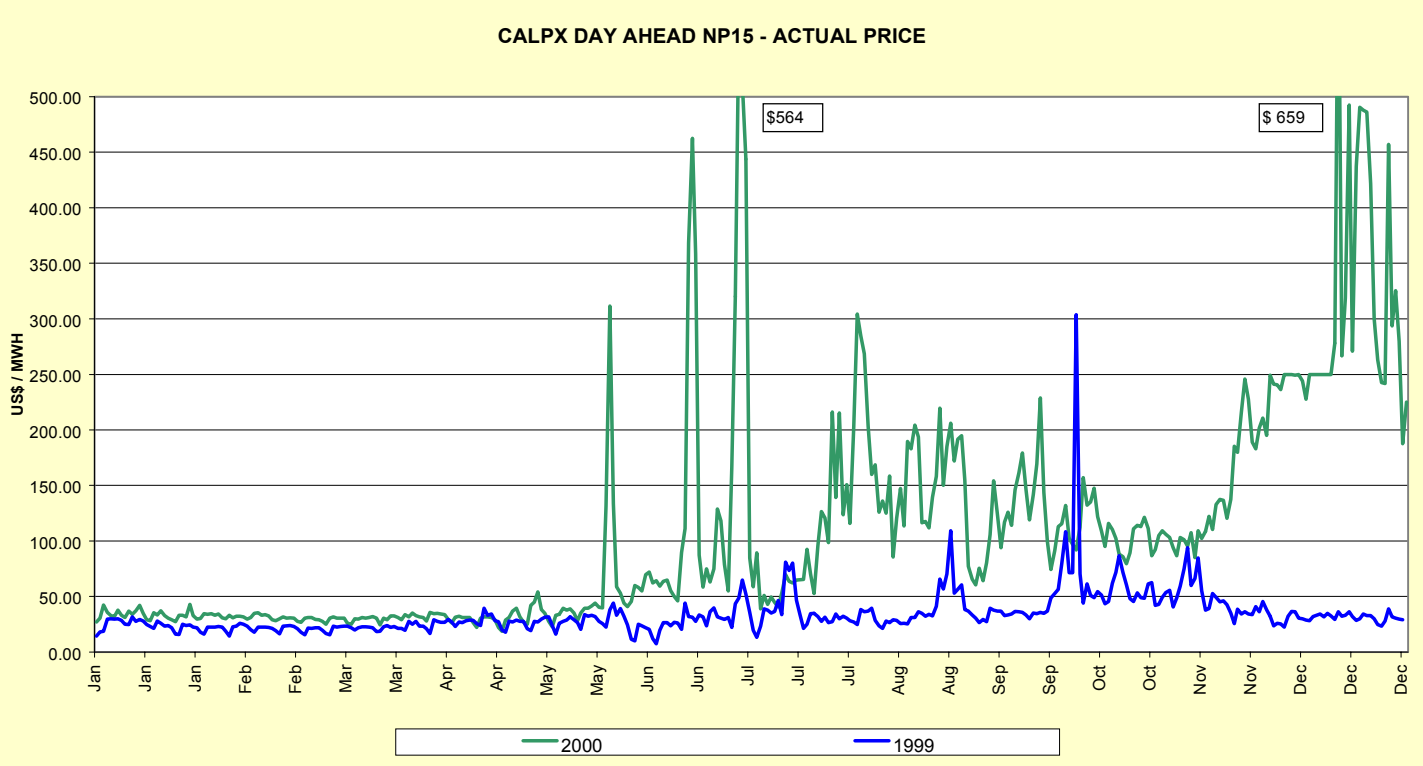


Figure 4
Price Effect of Inelastic Supply and Demand

Source: F. Sioshansi, 2001.