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Californian electricity market reform

An Australian perspective

Recent developments in California's electricity market have drawn into question the expectation that markets can deliver electricity more cheaply and more efficiently than regulation can

The introduction of a wholesale electricity market in California on 1 April 1998 was expected to deliver lower electricity prices to Californian consumers while maintaining adequate reliability of supply.

In contrast, wholesale electricity prices increased more than tenfold during 2000 and, since January 2001, Californian consumers have faced rolling blackouts across the state.

As a consequence of the price increases, the total cost of wholesale electricity purchases in the state increased from less than US$6 billion in 1998 to US$33 billion in 2000 and was predicted to reach US$70 billion in 2001 in the absence of remedial action in the market (CAISO 2001a).

The rapid increase in wholesale prices created major financial difficulties for California's largest two utilities responsible for retailing electricity to consumers. The utilities could not insure against such increases in wholesale prices as regulation had effectively capped retail prices for four years.

With wholesale prices rising well above the capped retail price, one utility has been declared bankrupt and the other is effectively insolvent. This exacerbated the problem because many generation firms refused to sell electricity into the market in fear of not being paid.

In response, California's state government committed up to US$50 billion in long term contracts with generators to ensure continued supply.

As a consequence, Californian residents are now locked into high priced electricity for up to twenty years (Smith and Emshwiller 2001).

Australia, like California, has also opened its electricity supply to market forces. The 'national electricity market' in Australia has not encountered problems of the magnitude of those in California. However, California's difficulties highlight the need to understand the fundamental workings of an electricity market.

Important lessons to be learned include the importance of identifying and mitigating the exercise of market power, the need for demand-side participation in the market and the detrimental impact on investment of overly complex or uncertain regulatory environments.

The path to reform

The decision to undertake reform of the Californian electricity industry in 1996 came when the cost of electricity in the state was around 50 per cent higher than the nation's average (CPUC 1995).

At that time, the industry was structured around three privately owned and heavily regulated utilities: Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas and Electric Company. These three utilities accounted for around 80 per cent of all electricity delivered in the state. The utilities were responsible for the monopoly provision of generation, transmission and distribution of electricity to consumers in their franchise region.

The prices charged by the utilities to consumers were required by the

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Californian Public Utilities Commission (CPUC) to reflect the cost of supply they incurred. However, this regulation provided poor incentives for the utilities to minimise long run supply costs. Consequently, consumers ended up paying for the utilities' poor decisions, such as investment that led to excess generating capacity in the state before electricity reforms were implemented.

The introduction of a market for electricity services was seen as the best way in which to improve the performance of the industry. In creating this market, the utilities agreed to divest at least half of their electricity generation assets and transfer operational control over their transmission assets to an independent system operator. In the end, the utilities sold around 80–90 per cent of their generation assets.

As part of this agreement, the utilities were allowed to recover the costs of earlier investments that they were entitled to recover under the old regulatory regime. This was to be achieved by having consumers pay a retail price for electricity that was fixed at 90 per cent of the 1996 retail price — around US$60 per megawatt hour (MWh). The difference between the fixed retail price and the wholesale market price was to defray the stranded costs incurred by the utilities.

This regime was to be in place until 2002 or when stranded costs were recovered, whichever came first.

A

The Western Systems transmission network

The California electricity market

From when the CPUC endorsed specific market based principles for the new electricity market in 1994, regulators, stakeholders and interest groups took four years to agree on specific market design issues. The outcome of this process was a unique market design that even the CPUC later described as being extraordinarily complicated (Kahn and Lynch 2000).

The Federal Energy Regulatory Commission, which has jurisdiction over interstate trade in electricity, required little change to the reform package presented to it. The commission is required by the *Federal Power Act* (1935) to ensure electricity prices are 'just and reasonable'.

The California electricity market lies within a transmission network known as the Western Systems. This network ranges from Canada (through British Columbia and Alberta) through thirteen states of the United States and into the north of Mexico (figure A). It combines the large hydroelectric resources in the Pacific north west with large coal fired and nuclear plants in the south west of the United States.

However, within this network, California is unique in having the only fully market based system and, as such, does not have the ability to control or direct any in-state generators to meet state needs as a priority — that is, generators are entitled to sell electricity to other states in the transmission system.

The characteristics of the Western Systems, along with certain physical and economic properties of electricity supply, were explicitly incorporated into the design of the California electricity market. Central to this design was the establishment of two

independent, not-for-profit organisations — the California Power Exchange (CalPX) and the California Independent System Operator (CAISO).

CalPX operated an hourly day-ahead (forward) market that was to function as a clearing house for the bulk of financial electricity trades between generators and electricity retailers. This market took the form of a uniform price auction, whereby generators (retailers) of electricity submitted a schedule of how much they were willing to supply (buy) at particular prices. However, obtaining a forward contract in this market did not oblige parties to trade physical amounts of electricity.

Although there were other private exchanges, the three largest utilities were compulsorily required to use CalPX.

CAISO is responsible for managing the operation and reliability of the transmission network. This requires the continuous balance of electricity supply and demand in real time — a result of the high costs involved in storing electricity, and the nature of electricity demand, which varies widely and is highly insensitive to price changes in the short run.

CAISO provides nondiscriminatory access for all generators to the transmission network and determines the dispatch of electricity based on an hourly physical market for electricity. This market uses an auction system similar to that used by the CalPX, but also accounts for the real time conditions of the transmission network, such as congestion and reliability.

The introduction of the California electricity market was also complemented by the deregulation of the electricity retail sector. The role of electricity retailers is to purchase electricity from the wholesale market and compete to supply retail services to consumers. The CPUC required the utilities to continue to retail electricity to their consumers who did not switch to an alternative electricity retailer.

Rapidly escalating prices

Prices in the wholesale market averaged around US$30/MWh in the first two years of its operation, which was within the range of pre-reform expectations.

Average monthly prices from April 1998 to May 2001 are shown in figure B.

In summer 2000 prices increased sharply, with CAISO prices averaging around US$140/MWh for the three months — almost five times higher than the market average since its introduction.

Electricity prices continued to increase even after the summer temperatures had subsided. By winter 2000-01, when electricity demand is usually at its lowest annual level, CalPX prices were averaging around US$330/MWh.

During the late 1990s the supply–demand balance in the Californian electricity sector had become increasingly tight. The excess capacity that led to reform pressures had been eroded as demand grew steadily and no new generating capacity was completed during the decade — in part, a result of the four years of uncertainty over the market rules that would emerge.

With little excess capacity, a concurrence of a number of factors led to reduced supplies and increasing costs. Electricity prices rose strongly, revealing the seriousness of the tight supply conditions and the seriousness of the market design problems.

Increasing supply costs, reduced availability from import supplies and, most importantly, the exercise of market power by generators withdrawing capacity resulted in a significant decrease in the total supply necessary to meet demand and created serious economic difficulties in summer 2000 in California (Joskow and Kahn 2001a,b).

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B California Power Exchange monthly average price [a]

[a] CAISO as-bid-prices from February 2001.

A number of studies have demonstrated that generating companies in California exercised significant market power, contributing to the market price increases

By January 2001, CAISO was required to order rolling blackouts across the state to balance supply and demand, despite the peak electricity demand at the time (30 000 MW) being around 14 000 MW below California's summer peak demand six months earlier.

Increased supply costs

In spring 2000 the cost of natural gas in California increased by 188–280 per cent above prices in the previous year, depending on delivery location within the state. More than 30 per cent of generation capacity in the state is fired by natural gas, so higher fuel costs provide a partial explanation for the increase in electricity prices.

Hydroelectric generation satisfies around 25 per cent of annual electricity consumption in the state. However, hydroelectricity generated within California and imported into the state was significantly reduced in spring and summer 2000 as a result of unusually low reservoir and river flow levels. In addition, unusually hot weather throughout the entire western United States resulted in significantly increased demand across the region, further reducing import availability.

In various districts of California, generators are required to conform to air quality standards. In particular, emissions of nitrous oxides are restricted through the use of a tradable permit system. In 2000 the price of nitrous oxides permits rose by a factor of nearly ten (Joskow 2001). Although important, the increase alone was not a significant factor in increasing electricity prices.

However, the increasing price for nitrous oxides permits reflected the increasing scarcity of the permits and, eventually, certain plants had to cease operating or exceed their legally permissible emissions. This further reduced the supply of electricity.

In a competitive market, these impacts are estimated to have increased the average wholesale electricity price in summer 2000 to between US$63/MWh (Wolak 2001a) and US$73/MWh (Joskow and Kahn 2001b), compared with US$32/MWh in the same period in 1999 (Wolak 2001a). However, because the average of actual prices in summer 2000 was US$155/MWh, the increase in supply costs represents only around half of this average.

The exercise of market power

If the underlying supply and demand conditions in a competitive market accounted for around half of the actual market price, then what accounted for the remaining half?

A number of studies have demonstrated that generating companies in California exercised significant market power from May 2000, contributing between US$82/MWh and US$92/MWh, on average, to the market price increases over the summer (CAISO 2001b; Joskow and Kahn 2001a,b; Borenstein, Bushnell and Wolak 2000).

Generators are defined to have market power if they can profitably increase the price they receive for their supply by reducing the amount of electricity on offer to the market or by raising the minimum price at which they are willing to offer electricity.

This behavior is profitable for the generator if the increase in the market price is sufficient to more than offset any reduction in revenue from units that are not dispatched despite having a production cost below the market price.

In particular, generators withholding generation capacity from the market, or bidding prices into the market substantially in excess of production costs, were observed in virtually all hours during May–November 2000 (Wolak 2001b).

By winter 2000, prices were estimated to have been up to US$100/MWh above estimated competitive levels — that is, the levels at which prices would have been in the absence of the exercise of market power (CAISO 2001d).

The components of average monthly prices, estimated competitive levels and price markups through market power, between April 1998 and June 2001, are shown in figure C.

Electricity wholesale markets are particularly susceptible to the exercise of market power, given the economic

and physical characteristics of electricity production and delivery.

First, electricity cannot be stored economically. Demand varies widely and, in the short run, is highly insensitive to price changes (partly reflecting the lack of facilities for real time pricing for most electricity consumption, resulting in consumers facing average prices).

Second, the production of electricity is characterised by binding capacity constraints that limit the ability of competing generators to increase supply in the short run in response to high prices.

Third, electricity is delivered through an open access transmission network, which in California is often subject to congestion. When demand is high and the network is congested, generators can be reasonably confident that they will be able to exercise market power.

Even before the market developments of 2000 a Market Surveillance Committee (1999) study had found evidence of price-raising market power in the California market as early as 1998. The committee is an independent body within CAISO.

The committee's market monitoring over the period since 1999 indicated that the potential to exert market power had increased significantly (Market Surveillance Committee 2000).

CAISO estimated that the exercise of market power raised the cost of electricity supply by almost US$9 billion between May 2000 and April 2001.

In addition, this work has demonstrated that not only do generators within the control area of the California Independent System Operator have significant market power, but that other large suppliers located outside of the control area in the Western Systems grid also possess, and have exercised, substantial market power in California. These include generators located as far away as Canada, Washington State and Oregon (Wolak 2001b).

Inadequate demand-side participation

In well functioning markets, market prices act as the signal that brings demand and supply into balance. When supply is short, consumers are able to respond to high prices by reducing their consumption. However, in electricity markets most consumers do not have meters that signal real time prices or record when electricity is consumed. Thus, consumers tend to face retail prices that reflect an average of wholesale electricity prices over time. As wholesale electricity prices are highly volatile, this average may be a poor reflection of the cost of electricity supply at any point in time.

Between January and March 2001, when supply of electricity in California was limited, the imbalance caused by generators facing market prices and retail customers facing average prices substantially below those market prices resulted in the demand for electricity exceeding the available supply.

However, in an electricity network, aggregate supply and demand must be continuously balanced to meet certain physical electricity supply quality requirements — namely, frequency, voltage and stability of network operations. The only way to achieve this balance, in the absence of a functioning market was to introduce widespread rolling blackouts during this period, imposing further economic costs on the Californian community.

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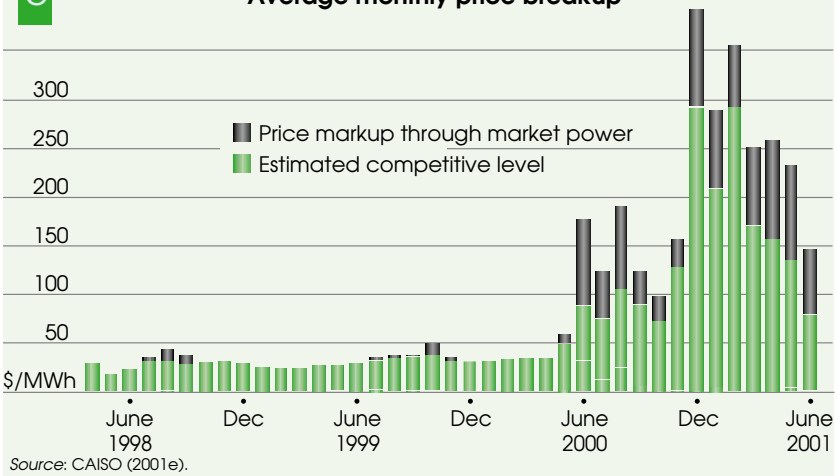
C **Average monthly price breakup**



Source: CAISO (2001e).

Only an emergency federal government order in the early months of 2001 requiring generators to supply electricity saved the market from collapse

Regulations led to greater instability

The culmination of high electricity prices and the failure of the CPUC to sufficiently deregulate the operations of the utilities resulted in a chain of events in early 2001 of critical proportions.

CPUC regulation imposed on the utilities restricted their use of forward contracts to only the day-ahead contracts provided by CalPX. This restriction had important consequences because only 3 per cent of consumers decided to switch from their utility to an alternative electricity retailer, leaving the utilities with 97 per cent of the retail customers, or some 87 per cent of total consumption (Joskow 2001).

The utilities were obliged to purchase electricity for most of the state's electricity needs at the CalPX determined price, but could sell the electricity to their consumers only at a fixed retail price of around US$60/MWh. Consequently, utilities found themselves without a means of managing the risk of price volatility in the wholesale market.

By the time wholesale electricity prices increased well above US$60/MWh in summer 2000, San Diego Gas and Electricity had already recovered their stranded costs. This allowed them to pass on the higher cost of wholesale electricity to consumers — monthly electricity bills in summer 2000 for the company's customers increased by 200–300 per cent compared with the previous year's.

However, the other two utilities — Pacific Gas and Electric, and Southern California Edison — had not yet recovered their stranded costs and were required to continue to charge a fixed retail price for electricity. These utilities came close to insolvency as they soon incurred debts of billions of dollars.

With the credit worthiness of major electricity purchasers in doubt, the shortfall in supply was compounded by a number of generation firms that refused to sell electricity into the market in fear of not being paid. Only an emergency federal government order in the early months of 2001 requiring generators to supply electricity saved the market from collapse.

In response to the utilities' credit problem, CalPX ceased trading on its day-ahead market on 31 January 2001. The exchange later filed for bankruptcy in March 2001. On 6 April 2001, Pacific Gas and Electric filed for chapter 11 bankruptcy protection, with reported debts of around US$9 billion.

Regulatory and government responses

By the end of 2000 the Federal Regulatory Commission implemented a range of measures in response to the developments. These measures included a relaxation of the requirement restricting the utilities to purchase electricity from CalPX. The commission also imposed a US$150/MWh 'soft' price cap on supply into the CAISO real time market.

Generators could only receive a price higher than US$150/MWh if they could prove that their supply costs genuinely exceeded this amount. However, this price cap proved largely ineffective. The average wholesale price in the first few months of 2001 remained around US$300/MWh as generators found ways to justify costs greater than the soft cap.

In June 2001 the commission extended the price cap to restrict electricity prices both in California and in other states that were connected to the Western Systems.

In particular, electricity prices in the Western Systems cannot exceed the Californian price during a CAISO declared emergency shortfall in supply. In periods of adequate supply, prices are restricted to be within 85 per cent of the price set in the previous emergency.

The main response of the California state government was to purchase electricity on behalf of the utilities and to ensure supply in the longer term by entering into financial contracts with electricity generators that span up to twenty years. These contracts lock in prices of around US$70/MWh to more than US$200/MWh for supply by many existing generation plants as well as future plants as they come on line. The cost of these contracts to consumers is

expected to be nearly US$50 billion in total.

California entered the summer months of 2001, where annual electricity demand is at its highest, with an unexpectedly low price in the CAISO spot market of US$50/MWh for peak power. Although prices may not be sustained at that level for a long period of time, the fall in prices coincided with a significant increase in online generating capacity. In addition, demand has been lower than expected because of widespread energy conservation measures in the short term.

Lessons for the Australian electricity market

The potential for similar developments in Australia is small; fuel costs are low and relatively stable compared with those in California. The process of creating the 'national electricity market' in Australia and determining the rules that govern its operation were less complex and more rigorous than the reform process in California.

The result of the process in Australia was an electricity market that has delivered electricity more cheaply and more efficiently than the regulated electricity supply industry did prior to reform.

Even in the event of spiralling wholesale prices, the financial difficulties experienced in California are unlikely to occur because retail prices are not fixed, but are related to the costs incurred by retailers in the wholesale electricity market (although subject to regulatory oversight by jurisdictions).

Both retailers and generators can manage price risk through financial contracts (although the viability of these contracts may be limited in regions, such as the South Australian market, that have limited ability to import power because of insufficient interconnections to other states).

Nonetheless, the Californian experience highlights the need to understand the basic workings of a well functioning electricity market.

In particular, it has highlighted two areas of policy concern: the need for appropriate monitoring and mitigation of generators' market power, and the importance of having demand-side responsiveness in the market.

As discussed, electricity markets are particularly susceptible to the exercise of market power by electricity suppliers. Evidence of the exercise of market power has been found in many markets, including the United Kingdom, California, Pennsylvania – New Jersey – Maryland, New York and Australian markets.

Australia, like California, has no provision for mitigating market power, although the agency responsible for administering the National Electricity Code recently increased its monitoring of generator behavior in the market place.

Recognising the economic costs associated with market power, both the Pennsylvania – New Jersey – Maryland, and New York markets have rules for assessing and penalising the exercise of market power, although these rules are not always effective (CAISO 2001c).

A feature of Australia's market that is similar to the California electricity market is the lack of demand-side participation in the market. In electricity markets around the world, the supply side has been restructured, but not the demand side. Without some form of real time pricing for consumers, consumers have little incentive to shift consumption patterns away from periods when demand is greatest.

Further, the benefits of restructuring electricity come in three main effects.

First, the discipline of competition increases capital and labor productivity.

Second, with investment decisions being market driven, rather than having an engineering or political focus, additional capacity is not added until needed, resulting in lower investment costs.

ABARE recently estimated the net benefit of these two effects to have resulted in an increase in gross domestic product of $1.5 billion in 2000 (in 2001 prices), compared with the reference case of no reform (Short et al. 2001).

The third long run effect occurs through demand responsiveness. With real time responsiveness, the necessary capacity to meet demand will be lower

The California state government purchased electricity on behalf of the utilities and ensured supply by entering into financial contracts with electricity generators that span up to twenty years

Without some form of real time pricing for consumers, consumers have little incentive to shift consumption patterns away from periods when demand is greatest

as higher prices reduce consumption. This will result in the need for less investment in the electricity supply industry.

Another important effect of having real time pricing is the impact on mitigating market power. As consumption is reduced in response to higher prices, generators have less incentive to either withhold capacity or increase prices as the likelihood of being able to increase revenue sufficiently to offset the reduced output is decreased.

Even though there may be costs from addressing these issues, these costs must be considered against the benefits of an efficient market that minimises the total cost of electricity supply.

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