Not Invented Here: What California Can Learn From Elsewhere About Restructuring Electricity Markets[1]

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"The fact that this arrangement (the features of California's restructured electricity sector) worked without major trouble for the first two years indicates how easy it was to fall into a false sense of security while market fundamentals were heading for a crisis." (Besant-Jones and Tenenbaum, p. 37)

1. The Purpose of this Study

Almost two decades have passed since Chile began its pioneering effort to restructure its electricity sector, followed by Argentina and England and Wales about a decade later. In almost all of the countries that have undertaken restructuring, the results have been at least a qualified success – and often a resounding success. California's results, however, have been an unmitigated disaster. This study seeks to determine the differences in the policies of the different states and countries to develop a perspective on how California might proceed in the future.

At the time that California launched its restructuring efforts, Chile, Argentina, and England and Wales already had accumulated relevant experience. However, much of what could have been learned from this experience was either ignored or discarded. As Paul Joskow (2001, p. 11) has observed, "Ideological rhetoric played a bigger role than serious analysis or practical experience drawn from other countries. In the end, the ultimate design of the wholesale market institutions represented a series of compromises made by design committees including interest group representatives…."

California now has its own history to learn from, and others have thoroughly documented its mistakes and have proposed remedies; but it is also important to know what actually has and has not worked elsewhere. It would be folly to ignore the experience of others who have successfully restructured their electricity sectors.

This study selects four states/countries for comparison with California. They were selected on the basis of their prominence and/or their success. Pennsylvania, in conjunction with PJM Interconnect, which operates the grid and conducts wholesale transactions for the Middle Atlantic states from Pennsylvania to Virginia, was selected because of its importance in the U.S. Also, together with California, it was one of the pioneers of restructuring in the U.S. Argentina was selected because it seems to have hit on a combination of restructuring elements that have been successful and stable over

[1] Richard Green, Geoffrey Rothwell and Gregory Rosston offered valuable comments, for which I am grateful.

a relatively long period of time. As mentioned above, Chile was the first to restructure. However, Argentina was selected instead because its government observed the Chilean experience closely and avoided a number of its neighbor's mistakes. The England and Wales system was selected because it is the largest system to undertake radical reform and is therefore best known, even though its success until recently has been mixed.[2] Victoria/Australia was selected because they began the restructuring process some time after the other countries and attempted to learn from them – first in Victoria and then in Australia as a whole.

To provide some perspective for the ensuing discussion, there seem to be six main lessons from comparing California to these other states/countries:

(1) Restructuring of the electricity sector, with deregulation of the generation and retailing elements and continued regulation of the natural monopoly "wires" elements, has worked elsewhere. There is no reason it cannot work in California.

(2) There must be complete deregulation of generation and retailing if there is to be any at all. Jumping half-way across an abyss is not a healthy option.

(3) A clear element of deregulation of generation and retailing, and one that is crucial to a workable restructuring, is that retailers must be able to buy power under long-term and intermediate contracts as well as on spot markets.

(4) It may be better to sell power that is sold on spot markets under a pay-as-bid auction rather than a uniform-price auction.

(5) The advantages of retail competition, compared an integrated distribution and retail function under regulation, have not yet been demonstrated.

(6) "Not invented here" is not an acceptable principle for a new try at restructuring California's electricity system. There are important lessons to be learned from elsewhere.

2. California's Big Issues

This section presents a brief, general description of California's electricity imbroglio in order to put the rest of the discussion in context. For more thorough descriptions of the current state of affairs and how it got there, see Besant-Jones and Tenenbaum (2001), Borenstein (2001), Joskow (2001), Taylor and VanDoren (2001), and Wolak (2001b).

California's problems surfaced to public attention in the summer of 2000, as SDG&E (serving San Diego and environs) met the statutory requirements for freeing its retail prices, as set by California's basic restructuring legislation, AB 1890. Facing rapidly escalating wholesale electricity prices, it passed them on to retail customers. The result was retail prices at least double the previous levels.

[2] Often, discussion of restructuring refers to the United Kingdom. In fact, however, Scotland and Northern Ireland maintain fairly traditional vertically integrated utility structures.

It was only then that most Californians first realized that the state was short of generating capacity and that wholesale prices were escalating rapidly. To a major extent, this was simply a product of bad luck – rapidly escalating natural gas prices (natural gas is the dominant prime mover in California electricity), poor hydroelectric years in both California and the Pacific Northwest, and unanticipated demand growth.[3] The bad luck, combined with policy failure, produced blackouts, extremely high and volatile retail prices, utility bankruptcy, the collapse of competitive retail markets, and the collapse of the power exchange that was to be the hub of the wholesale market.

This study compares other states/countries with California's electricity sector as it emerged from AB 1890 and from subsequent decisions of the California Public Utility Commission (CPUC). It stops short of looking at the sector as it has emerged from state government intervention in the wake of the failure.

In the sections that follow, comparisons are in terms of the parameters that public decision makers can control in structuring the electricity sector. Section 3 compares general restructuring that cuts across generation, transmission and distribution. Section 4 compares how the various states/countries restructured generation. Section 5 does the same for transmission, and Section 6 covers distribution/retail service. Section 7 summarizes the conclusions about lessons learned in Sections 3 through 6.

3. Comparison of General Restructuring

This section examines the motives for electricity sector reform and describes the situation before reforms took place. It also describes the control parameters for overall structural reform and the actions that were taken by the various states or countries.

Table 1
Comparisons of Motives for Reform and Pre-Reform Structure

	Motives for Reform	Pre-Reform Situation
California	Lower electricity prices through wholesale and retail competition.	75% of electricity supplied by IOUs, rest by munis. IOUs under conventional RoR regulation. Surplus generating capacity and high prices.
PA/PJM	Lower electricity prices through wholesale and retail competition.	Dominated by IOUs under conventional RoR regulation. High prices.
Argentina	Provide incentives for adequate capacity, increase efficiency, reduce subsidies.	State-owned, integrated utilities. Political pricing. No incentives for efficiency. Distorted tariffs.
England and Wales	Free-market ideology, Lower electricity prices through wholesale and retail competition.	National government ownership of generation and transmission plus semi-autonomous regional distribution boards in England and Wales, two vertically-integrated companies in Scotland, and one in Northern Ireland.
Victoria/	Lower electricity prices through	Vertically-integrated, publicly-owned state

[3] See Joskow, 2001, pp. 27-30, for a concise but comprehensive account of the roles of these factors, as well as policies relating to California's electricity sector.

Australia	wholesale and retail competition, reduce public expenditure.	utilities. Weak interstate grid connections.

3.1 Motives for reform

California and Pennsylvania

In 1996, the average revenue per kWh (which is used as a proxy for price) of electricity sold in California was 9.48 cents, the tenth highest rate among the 50 States and the District of Columbia. In Pennsylvania, it was 7.86 cents, the eleventh highest. (U.S. Energy Information Administration, 2001b, Chapter 8) Competition was regarded to as the best way to bring costs down.

Argentina

Prior to reform, in the 1980s, Argentina had chronic electricity shortages – due in large measure to poor maintenance of existing equipment. Also, the electricity sector was overstaffed and ran a deficit, which exacerbated a sovereign debt problem that was already serious. Moreover, electricity was expensive and frequently stolen. (U.S. Energy Information Administration, 1997, Chapter 4) Remedy of these difficulties, plus the need to attract private investment to expand capacity, led to reforms that would encourage competition and enhance efficiency.

England and Wales

Electricity privatization in England and Wales occurred in the larger context of the privatization of much of the formerly state-owned UK industries and the reduction of the central government's role in the national economy.

According to Steven C. Littlechild, (1999), who was the Director General of Electricity Supply in the Office of Electricity Regulation, UK, 1989-1998, "The main motivations for privatizing the British electricity sector were as follows:

- Reduce the role of government in industry. An underlying aim in privatizing the British electricity sector was to reduce the role of the government in industry.

- Increase the role of the customer. A parallel aim was to increase the role of the customers, so that their voice should determine what happens.

- Increase efficiency. The electricity industry was not considered particularly inefficient for a nationalized industry, but it was widely believed that nationalized industries were not as efficient as the private sector, nor as efficient as they could be.

- Privatization. Privatization was becoming increasingly popular among those many citizens who were able to participate by buying shares, watching their shares grow in value, and believing rightly that they had a stake in the development of the economy.

- Proceeds for treasury. The privatization programme brought in significant financial proceeds for the treasury, which could be used to reduce government borrowing, or to spend in other areas, or to reduce taxation, which was important to encourage initiative.

o Efficient regulation of monopoly. Finally, with the development of effective ways of controlling monopolies, particularly by incentive regulation, it was now possible to consider privatizing electricity."

Australia

The "over-capitalized investments" made by the state governments in the electricity sector (generation capacity, transmission systems, and distribution) had resulted in "high levels of reserve plant margins combined with high debt levels with minimum returns." Financial restraints and debt placed pressures on the federal and state governments to reduce expenditures and increase efficiency while still providing service for the public. The objective of reform in Australia was to "deliver more efficient and sustainable use of capital infrastructure and energy resources and to improve Australia's domestic and international economic performance." In addition, the state governments estimated that electricity reform would add an estimated $5.0 billion annually to the Australian Gross Domestic Product (U.S. Energy Information Administration, 1997, Ch.3)

3.2. Pre-Reform Structure

California

Three traditional investor-owned integrated utilities – Pacific Gas and Electric (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE) – served about 75 percent of the load in the state. Their scope is now limited to retail operations. The remainder of load is served by Los Angeles Department of Water and Power, Sacramento Municipal Utility District, other publicly owned utilities, cooperatives, and small investor-owned utilities.

The three major investor-owned utilities had high costs, largely because of investments in nuclear power. Also, however, mandated contracts for renewables under the Public Utilities Regulatory Policy Act of 1978 -- as interpreted by the California Public Utility Commission -- resulted in high prices for these sources. Rates were set under conventional rate-of-return (RoR) regulation.

California has strong transmission interties to other states in the western United States.

Pennsylvania/PJM

Much of Pennsylvania's reform was in the context of wholesale generation and transmission reform for the PJM region, comprised of Delaware, New Jersey, Maryland, Pennsylvania, Washington, DC and Virginia. Prior to reform, PJM Interconnect, which operates the current power pool, was a regional dispatch center, focusing on reliability and least-cost dispatch. However, unlike its current pool structure, it did not participate in making a market for power. Most of the utilities that used PJM prior to 1997 were integrated entities that used the power they produced, contracted with each other, or contracted with independent power producers (IPPs).

In addition, Pennsylvania undertook to reform its retail sector by introducing competition at the retail level. Prior to reform, Pennsylvania was characterized by integrated investor-owned utilities, conventional rate-of-return regulation and high retail prices.

Argentina

In 1991, just prior to the beginning of privatization, Argentina's electricity industry included four federal utilities, one Argentina-Paraguay agency (controlling a large hydroelectric plant owned jointly by the two countries), one Argentina-Uruguay agency (also controlling a large hydroelectric plant owned jointly by the two countries), provincial utilities, and several electricity cooperatives. One of the four federal utilities generated and distributed electricity to the greater Buenos Aires and La Plata area, one served the balance of the country's needs for power generation and transmission, one operated the hydroelectric power generators of southern Argentina, and one operated nuclear power generation plants. At the time of privatization, the non-nuclear utilities accounted for about 80 percent of the approximately 15,000-megawatt generation capacity of the system.

Argentina's electricity industry suffered from recurring power outages, substantial and regular unavailability of power generators, and weak finances. Moreover, it was constantly threatened with the possibility of blackouts, a threat that worsened during periods of relatively little rainfall because of reliance on hydroelectric capacity. Electricity was also expensive and often stolen by end users, either through illegal hook-ups or by failure to pay bills. (U.S. Energy Information Administration, 1997, Chapter 4)

United Kingdom

The Electricity Act of 1957 established the nationally-owned Central Electricity Generating Board (CEGB) whose responsibilities included control over the operation of electricity generation and transmission facilities and all related investment decisions. There were twelve semi-autonomous regional distribution boards in England and Wales, two vertically-integrated companies in Scotland, and one vertically-integrated company in Northern Ireland. Some observers, at least, found the former system to be “inflexible, bureaucratic, secretive and largely out of political control.” (Newberry and Green, 1996, p. 58)

Price regulation employed an inexact and controversial measure of long-run marginal cost in order to construct a wholesale price charged to the distribution companies by the CEGB. Often governmental electricity policy directives were guided by some overriding macroeconomic or industry policy objective, such as controlling inflation or sustaining the coal industry. (U.S. Energy Information Administration, 1997, Ch. 2)

Victoria/Australia

Prior to the reforms of recent years, the supply of electricity in Australia was provided by vertically-integrated utilities owned by individual states and territories. The electricity industry had never operated on a national or even on a regional basis. Interstate grid connections were weak, and electricity trade had been limited between a few interconnected states. Victoria has pursued the most aggressive electricity reform measures in Australia, while other states pursued reform more slowly. (U.S. Energy Information Administration, 1997, Ch. 3) Most, however, are now approaching the depth and breadth of Victoria’s reforms.

In reforming the electricity sector, there are three basic control parameters that cut across its vertical structure: the form of restructuring (de-integration and privatization/divestiture), the form of regulation, and the sequence of actions to be taken with respect to structure and regulation. These parameters and a summary of the actions undertaken by the states/countries are shown in Table 2.

Table 2
General Control Parameters to Implement Reform

	De-Integration and Privatization/ Divestiture	Regulatory Reform	Sequence of Reform
California	IOUs forced to sell generation, give up dispatch control to the CAISO, buy power only through the PX, and compete in retail markets. IOUs retained operational control of distribution only.	CPUC retained oversight of IOU distribution, including the terms and conditions of power purchases from the wholesale market. Also, it influences the CAISO, despite federal jurisdiction over transmission.	De-integration in one step, Only twelve months to implement an extremely complex structure and infrastructure.
PA/PJM	Pennsylvania IOUs were allowed, but not required, to sell facilities. It was required that they unbundle services. They were required to compete in retail markets.	PPUC retained oversight over transmission and distribution. T&D charges passed through to retail customers.	Retail choice implemented over three years.
Argentina	State-owned utilities de-integrated in a single step. Gradual sell-off of generation and distribution. Transmission privatized.	Independent, five-member regulatory body.	Simultaneous de-integration into state-owned companies and establishment of a strong regulator. Then privatization of generation, transmission and distribution.
England and Wales	State-owned utility became three generation companies, a power pool, and distribution/retail companies. Then privatized by auction.	Establishment of a one-person, independent regulator. Price regulation for transmission and distribution. Competition for generation and retailing.	First de-integration. Then privatization. Deregulation of retail markets was in three stages, covering 1990-1998.
Victoria/ Australia	National power pool. Victoria further de-integrated generation, distribution and retail supply.	National regulator replaces state regulators for wholesale power supply. Regulation to be driven by efficiency concerns.	Victoria first de-integrated the state-owned system and then privatized the units on an auction basis over several years.

3.3. De-integration and Privatization/Divestiture

The United States

In the United States, the federal government has jurisdiction over generation and transmission, inasmuch as transmission networks typically cross state lines. States are responsible for distribution and retail sales. They also have claimed jurisdiction of the basic organization of the electricity sector with the borders of states.

De-integration of generation in the Unites States began with the Public Utility Regulatory Policy Act of 1978 (PURPA). This legislation mandated IOUs to buy power from non-utility generators if the energy source used in generation met certain environmental and conservation standards and if it was less than a given IOU's "avoided cost." The state public utility commissions (PUCs) were permitted to define avoided cost as they deemed appropriate.

PURPA was sufficiently successful in producing reliable, competitively-priced energy that the Energy Policy Act of 1992 (EPAct) opened the generation market further to permit non-utility generators to enter the wholesale market on a competitive basis. Moreover, it mandated that owners of transmission provide access to the grid for non-utility generators on a non-discriminatory basis. FERC Orders 888 and 889 laid out the specific legal framework for wholesale competition in 1996.

California

California's IOUs were forced to divest themselves of most generating assets, others (primarily hydro and nuclear) being retained by entities that are operationally independent. The nuclear power plants and the long-term contracts signed as a result of PURPA cost the utilities much more than they could hope to recover. Therefore, a special provision was made in AB 1890 for a retail Competition Transition Charge to be applied to each kWh consumed in order to help the utilities recover costs that they had undertaken in good faith under cost-of-service regulation.

The utilities were also forced to give up control of the transmission system to the Independent System Operator (CAISO). Thus, they became utility distribution companies (UDCs), retaining ownership of distribution facilities that they operate as regulated common carriers. It was originally contemplated that the UDCs would compete with other entrants for retail business. However, the competition has collapsed; and the UDCs effectively have reverted to being regulated monopoly providers.

Pennsylvania

Pennsylvania's Electricity Generation Customer Choice and Competition Act became law on December 3, 1996. It basically separates the generation of electricity from the services of transmitting and distributing it. Electric utilities are permitted to divest themselves of facilities or to reorganize their corporate structures, but unbundling of services is required. The law also permitted and encouraged new entrants into a competitive retail market

Argentina

Argentina's restructuring began in 1992 with the creation of a national regulatory body, ENRE. It then restructured the federal electricity companies, and the electricity industry in general, into separate state-owned generation, transmission and distribution companies. These companies were then privatized. Privatization thus followed the creation of an effective regulatory structure.

Generation and distribution companies are competitive, for-profit entities. However, by law, no company is allowed to control more than ten percent of all generation capacity or have cross-holdings with transmission companies. Transmission is owned and operated by private, regulated companies. Another company, CAMMESA, runs the pool, is responsible for scheduling and dispatch, and conducts settlement of transactions.

CAMMESA is a non-profit corporation, jointly owned by the government and stakeholders.

United Kingdom
The Electricity Act of 1989 restructured the electricity industry along functional lines. Guiding the government's restructuring was the idea that electricity generation and retail sales could be made competitive industries, while transmission and distribution needed to be treated as natural monopolies for the indefinite future.

Victoria/Australia
Victoria de-integrated and then privatized its electricity sector beginning in 1994. The formation of the National Electricity Code provides a framework for other states to follow and provides a mechanism for interstate wholesale power transactions.

3.4. Regulatory reform

The United States
The basic regulatory structure in the United States has stayed intact. FERC is responsible for regulating wholesale rates and for enforcing access to the transmission system. It has a legislative mandate under the Federal Power Act to ensure that wholesale prices are "just and reasonable." From the summer of 2000 through the spring of 2001 in California, when spot market prices soared in the face of generation and transmission capacity shortages, serious questions arose about whether and how generators exercised market power and the extent to which FERC could or should exercise regulatory control. These questions remain unresolved.

State regulatory commissions are responsible for the form of organization of the electricity sector within the states and for regulating distribution and conditions of retail sales.

California
The CPUC implemented several crucial policies that have affected California's electricity markets. One was to require that the IOUs separate the generation that they own from their distribution businesses. A second was to order the IOUs to divest themselves of most of their thermal generating assets. A third was to first forbid the IOUs to participate in forward markets and later to permit such participation, but only under onerous conditions.

Pennsylvania
The major changes in Pennsylvania have been through legislation. Regulatory responsibilities have remained intact, and the Pennsylvania PUC has not made landmark decisions.

United Kingdom
For England and Wales, the goal has been to deregulate generation and retail sales. For transmission and distribution, a new form of regulation (based on a price cap) was introduced--along with a new regulatory authority, the Office of Energy Regulation (OFFER), later merged with the Office of Gas Supply to create the Office of Gas and Electricity Markets (OFGEM).

However, OFFER/OFGEM has not kept a completely hands-off policy with regard to regulation of generation. In February 1994, it responded to concerns that the only two generators at that time exercised undue influence in electricity supply. Thus, it proposed a cap on pool prices which was implemented for the 1994/1996 fiscal year period. Also, it proposed partial divestiture of the dominant companies' generating assets. The actions were implemented simultaneously, in agreement with the generators.

Also, there has been continued regulation of the retail electricity business with respect to service standards. Although services provided by the electric industry in England and Wales were generally considered reliable prior to reform, higher quality of service standards were mandated by OFFER during the initial privatization phase. These standards were later tightened in 1993 and 1994. The twelve Regional Electricity Companies (RECs) are required to offer various special services to the elderly and disabled. Service standards also were set for bill payment, meter reading, and responses to complaints.

The Director General of OFGEM is the sole regulator, unlike the commission structure favored in the United States. A one-person regulatory structure may make the UK electricity policy decision-making process more arbitrary than that of the United States, in that it has "tended to personalize both the OFFER (OFGEM) and the decision-making process, possibly causing the UK regulatory regime somewhat of a credibility problem." (U.S. Energy Information Administration, 1997, Ch. 2) However, a single regulator rather than a commission provides some inherent advantages with respect to speed and flexibility. The Electricity Act 2000 created the Gas and Electricity Markets Authority to oversee the work of OFGEM. (Department of Trade and Industry, 2001) It is headed by a commission of eleven. This structure, although it adds a layer of management and administration, has the apparent advantage of retaining the flexibility of OFGEM while protecting market participants from "personalization" of OFGEM decisions.

Australia

The National Electricity Code outlines the objectives, roles, and functions of two national regulatory bodies, the National Electricity Market Management Company (NEMMCO) and the National Electricity Code Administrator Limited (NECA). These bodies were established by the participants of the national electricity market (state and territory governments).

NECA has been established by the participating jurisdictions in the national electricity market: the states of New South Wales, Queensland, South Australia and Victoria; and the Australian Capital Territory. It supervises, administers and enforces the Code and is governed by an independent board.

There are four groups that participate in the wholesale power generation market: participants, NEMMCO itself, transmission and distribution service providers, and regional system operators. Participants include contestable customers, generators, marketers, and brokers. They are required to become participant members of NECA and are subject to all Code rules. Initially, only contestable customers (defined as those with an annual electricity peak demand of at least 10 megawatts) were eligible to participate in the market. However, as the market has matured, all customers have become constestable and – through representatives – have the option to participate. All generators with a net export in excess of 30 megawatts are required to participate in the

wholesale power generation market. Smaller generators can also participate on a voluntary basis.

In Victoria, the Office of the Regulator General was created to promote competition in the generation and marketing sectors; to maintain an efficient and economic system; and to protect the rights of customers.

3.5. Sequence of reform

United States
Wholesale market regulation in the U.S. is under federal jurisdiction. The first steps in reforming the wholesale market were PURPA and EPAct, as described in Section 3.3.

California
In California's restructuring of the electricity system, only twelve months were allowed for establishment and implementation of sophisticated market rules and complex hardware, software and communications systems, with no transition period to test how the systems would work and whether there were loopholes. This was done independently of market participants and their experience. (Besant-Jones and Tenenbaum, p. 39) The Power Exchange and CAISO were new entities, assuming responsibilities that had previously been in the hands of the IOUs.

Pennsylvania/PJM
Pennsylvania took three years to phase in full retail competition. In addition, it had a pilot program that enabled distribution companies to work out problems before full implementation. Moreover, PJM itself had many years of experience in transmission system operations.

Argentina
Restructuring began in 1992 with the Electricity Law, which stipulated the creation of a national regulatory body, ENRE. Argentina first restructured the federal electricity companies, and the electricity industry in general, into separate generation, transmission and distribution companies and then privatized them. Privatization of generation began in 1992 and was largely completed by 1995. Privatization of the six transmission companies began in 1993 and was largely completed in two years. Privatization of distribution began in 1992 and was largely completed by 1997. (Gomez, 2001)

United Kingdom
One of the first acts of electricity reform by the Thatcher government was passage of the Electricity Act of 1983. Similar to PURPA and EPAct, it was designed to encourage the growth of independent power producers by providing open access to the national grid. Prior to 1983, entry to the electricity sector was prohibited. The Act required the Central Electricity Generation Board to purchase electricity from private producers at avoided costs, that is, at a price equal to the costs the Board would have incurred to produce the same quantity of electricity itself.

In the Electricity Act of 1989, one of the most important elements of privatization was the restructuring of the industry prior to its sale. Initially, the former Central Electricity Generating Board was restructured into two fossil power producers, one nuclear power

producer, and a transmission company. All segments were to initially remain under government ownership, and privatization was to proceed in stages.

The Central Generating Board's non-nuclear power units were assigned to two companies, National Power and PowerGen, both slated to be privatized, as was the nuclear power generator. National Power was the larger of the two fossil generation companies and accounted for 46 percent of electricity supplied in England and Wales in the 1990/1991 fiscal year. PowerGen accounted for 28 percent of generation output.

Ownership of the national grid was initially transferred to the RECs upon their privatization. However, in December 1995, divested their shares in the national grid, at which time it became a separate publicly-traded company, the National Grid Company.

The twelve RECs underwent a separation between the wires (distribution) side of the business (which was to be continually regulated) and the retail sales function (which was to be gradually deregulated). The RECs were also the first segment auctioned off to the public by the UK government. These were sold in December of 1990.

Shares in National Power and PowerGen were sold to the public in March of 1991. Most of the nuclear generating company was also privatized as British Energy Company in 1996, with the government retaining ownership in older plants that were not commercially attractive.

Large users of electricity were allowed to choose their suppliers, as opposed to being required to purchase electricity from their REC. The RECs were allowed to retain their franchise for small industrial and commercial companies until 1994 and for the remaining franchised end users (primarily residential) until 1998.

Victoria/Australia

Seven years of discussion and planning took place before the first step in restructuring Australia's electricity sector. This was the creation of a "national" power pool, consisting of Victoria, New South Wales, South Australia, and the Australian Capital Territory. Other states are being integrated as transmission links are completed.

Victoria first separated generation, transmission and distribution into three state-owned segments in 1994. Privatization of the five distribution companies took place in 1995. Privatization of generation took place between 1992 and 1997. The transmission company was also sold in 1997.

The National Electricity Code was first published in November 1998, about the same time as the "national" market for wholesale supply and purchase of electricity. It sets out the objectives and rules of the national electricity market, and the rights and responsibilities of market participants, the market manager, and the regulator. The objectives of the National Electricity Market are that:

- it should be competitive;
- customers should be able to choose which supplier (including generators and retailers) they will trade with;

- any person wishing to do so should be able to gain access to the interconnected transmission and distribution network;

- a person wishing to enter the market should not be treated more favorably or less favorably than if that person were already participating in the market;

- a participating energy source or technology should not be treated more favorably or less favorably than another energy source or technology;

- the provisions regulating trading of electricity in the market should not treat intrastate trading more favorably or less favorably than interstate trading of electricity.

Retail customers were freed to choose their own suppliers between 1996 and 2000 -- large users first and residential customers last.

3.4. Lessons Applicable to California

De-Integration

De-integration of generation, transmission and distribution/retailing has been a basic, common theme of restructuring everywhere. This does not seem to be the cause of California's problems, inasmuch as it seems to have worked well in other places.

Regulatory Reform

Federalism is a key issue with respect to regulatory reform. California, PJM and Victoria all operate in federal systems with separate state and federal jurisdictions. California seems to have had the most trouble in coordinating state and national regulatory policies. One possibility that might be considered is a national electricity code, such as Australia's NEC, the sets out basic principles that the federal government and the states can agree.

Sequence of Reform

Even allowing for the time necessary for privatization in Argentina, England and Wales, and Australia, all of the entities investigated here took significantly longer than California in implementing restructuring. This enabled them to discover and remedy mistakes before they became serious. In moving forward, although California has learned a great deal from the past five years, it would make sense to take one step at a time and make sure that each element of the restructured industry is working before introducing the complications of the next one.

4. Comparison of Generation Restructuring

In this section, the control parameters for restructuring generation are examined. The responses of the various entities are set forth, and lessons are derived for California.

Table 3
Comparison of Control Parameters for Generation Restructuring

	Ownership	Conditions of Supply and Pricing	Capacity Expansion
California	IOUs forced to divest ownership to IPPs. Some ownership retained by utility holding companies.	Sales to Power Exchange and CAISO only on a price-based spot market. UDCs still had some PURPA contract obligations. Structure permitted exercise of market power.	Competitive, non-discriminatory entry. Significant barriers to entry w/r siting permits and regulatory uncertainty.
PJM	Utilities retained ownership of their generation.	PPUC set a high cap on wholesale prices. Transactions on power exchange or bilateral contracts. Long-term purchase contracts were allowed.	Competitive, non-discriminatory entry.
Argentina	IPPs, except for some state-owned hydro and nuclear. By law, no single generator can serve more than 10% of the market.	One-year contracts and hourly bid energy market with price caps are supplemented by regulated seasonal purchases and bilateral long-term contracts. Capacity payments to available and scheduled units. Prices are largely cost-based.	Concessions controlled by Secretary of Energy, apparently non-discriminatory.
England and Wales	Initially three private companies after reform, too few for effective competition. Opened up since.	Sole reliance on a uniform-price auction market has been replaced by flexible bilateral contracts of varying terms.	Competitive, non-discriminatory entry.
Victoria/ Australia	Initially five generation companies in Victoria	All generators who export more than 30 mW must participate in the wholesale market. Long-term, short-term and spot-market contracts.	Competitive, non-discriminatory entry.

4.1. Ownership.

California

IOUs were forced to sell most of their thermal capacity to IPPs. Hydro and nuclear were spun off into separate new generation companies owned by the UDCs' parent companies to prevent self-dealing. These sell to the wholesale market on the same terms as other generators.

Pennsylvania/PJM
There was no requirement for utilities to sell generation they already owned. IPPs can enter freely.

Argentina
The Argentine regulators have established restrictions to prevent reintegration of the electricity industry. There is complete separation of ownership of generation and transmission. Also, no single owner can provide more than ten percent of the national generation capacity.

U.K.
Originally, generation was split into three companies – two fossil (National Power and PowerGen -- 80 percent of the market) and one nuclear. Since privatization, the nuclear utility has doubled its output with essentially the same facilities, and other generators have come into the market as a result of some divestiture of the original two fossil utilities and from greenfield IPPs. The divestiture, in which OFFER negotiated an agreement whereby National Power and PowerGen divested about 15 percent of their combined capacity, was prompted by a rising trend in electricity pool prices in 1993 and 1994. (Communication with Richard Green) Its objective was to reduce market concentration.

Since privatization, the distribution companies have been allowed to acquire generation assets with the restriction that no single REC's generation accounts for more than 15 percent of peak demand (kW). (As Richard Green pointed out, this may mean that an REC's generation may account for significantly more (and conceivably less) than 15 percent of its kWh sales.) This action was taken in order to introduce more competition in generation. Most of the RECs' investment has been through joint ventures in new IPPs.

Victoria/Australia
Victoria sidestepped the concerns in England and Wales over a lack of competition in electricity generation by creating five generation companies instead of three, even though its population is much smaller. Moreover, competition will be enhanced further by future interstate transmission ties and potential new entrants into generation.

Unlike the United Kingdom (where electricity assets were sold at prices set by the national government), Victoria auctioned its four state-owned generation companies. Moreover, they were sold intact to other companies or consortia of companies. No restrictions were placed on foreign investors.

4.2. Conditions of Supply and Pricing

California
Beginning in April 1998, the Power Exchange operated day-ahead and hour-ahead auctions, conducted on an hourly basis. All transactions with UDCs were mandated to take place on the Power Exchange, including generation (hydro and nuclear) still owned by UDCs' parent companies. Others could participate on a voluntary basis.

The CPUC focused on the Power Exchange as the primary market for power in California. It was organized as a uniform-price auction. That is, the most expensive (last) bid accepted set the price for the entire market. The logic of this structure is that it

would mimic the marginal cost structure of the entire system, with price being determined by the price of the "marginal" bidder, who presumably would bid when the price reached the bidder's marginal cost.

However, it is widely held that the reliance of California's UDCs on the spot market led to situations in which the market could be manipulated by generators in such a way as to violate FERC's "just and reasonable" standard for wholesale rates. Moreover, Besant-Jones and Tenenbaum (p. 32) have suggested that in addition to contributing to price volatility, the lack of forward markets may also have suppressed price signals that would have indicated a need for new generation investment.[4]

Also, generators could bid each of their generating units separately rather than being required to bid all as a single entity. This enabled multi-plant generators to withhold small units in hope that they could set a high price for all, with relatively little risk that the bulk of their generation would not be dispatched. (Taylor and Van Doren, 2001, p. 13)

One of the most controversial aspects of California's restructuring efforts was the CPUC refusal and then reluctant approval of forward contracts between generators and the UDCs, including "vesting" contracts between IPPs and the UDCs that formerly owned the power plants. In other restructuring contexts, vesting is often for five years or more.

Even after forward contracts were allowed by the CPUC, the UDCs were still subject to a "prudency" review. If the result of this review was that spot prices turned out to be below the forward prices, the CPUC would force the UDCs to absorb the difference. Thus, the UDCs were placed in a no-win situation and had little incentive to engage in forward transactions, even when they were allowed. (Besant-Jones and Tenenbaum, 2001, p. 38)

High spot market prices combined with frozen retail prices (see Section 6.3) led to PG&E (the largest of the UDCs) to declare bankruptcy and to SCE being on the brink. Thus, some generators refused to sell to the Power Exchange for fear that they would not be paid (since the Power Exchange funds were limited to their sales revenues). The result was that in early 2001 the Power Exchange collapsed, and CAISO took over all short-term transactions. Also, the state government entered the market as a single buyer under long-term contracts.

CAISO manages the ancillary services, real-time imbalance, and congestion markets. Moreover, it is obligated to buy power on an emergency basis if demand threatens to exceed the supply contracted on the day-ahead markets. CAISO real-time transactions are settled every five minutes on the basis of bids 45 minutes ahead of time. While price caps were placed on the spot market in the Power Exchange, the CAISO is obliged to buy emergency power regardless of price in order to avoid outages. This apparently led some generators to withhold power from the normal day-ahead market on the chance that they could sell it at a higher price on the emergency market.

[4] Problems with uniform-price structure of the auction were exacerbated by rapidly escalating natural gas prices and expensive nitrogen-oxide emissions permits. This combination caused a severe "rotation" of the supply curve because the highest-marginal-cost plants were also those which had the least thermal efficiency and the highest levels of pollution per kWh. See Borenstein (2001, pp. 9) An open question is why natural gas prices got so high. Exercise of market power has been put forth as one possibility.

Transactions on the CAISO are monitored by the Market Surveillance Committee. It is required by FERC and investigates issues related to the structure and rules of the wholesale market and the potential exercise of market power. It reports and advises enforcement agencies on its findings but has no enforcement power.

Pennsylvania/PJM

Pennsylvania's utilities were not required to divest their power plants and were permitted to enter into long-term contracts with generating companies. Some 80% of the power supplied over PJM's grid is either generated by the utilities or provided through long-term contracts. In addition, market participants can purchase power either through the pool or through bilateral contracts with financial hedging through "contracts-for-differences" (CfD) provisions.[5] Also, there is a market for capacity as well as a market for energy.

PJM allows power generators to charge special fees for delivering electricity to areas where demand threatens to exceed transmission capacity. Because they can earn higher profits by supplying power to such congested zones, generators have an incentive to add generation capacity in these areas.

An independent Market Monitoring Unit operates like California's Market Surveillance Committee, reporting and advising relevant agencies on issues related to the functioning of the PJM wholesale market

Argentina

Generators can sell electricity either through the spot market or through contract. The buyers are distribution companies, large end-use customers (over 1 mW demand), and other generators (who must occasionally buy power to meet contractual obligations). The coordination of hourly demand and supply is done through seasonal and spot market prices. CAMMESA -- a nonprofit, independent operating agency jointly owned by the government and an organization of generators, transmitters, distributors and large users -- administers the wholesale market.

There are three types of prices, contractual prices, seasonal prices and spot market prices. Contractual prices are negotiated between generators and distribution companies and large users. The length of these contracts is typically a year, and they are unregulated. The seasonal prices are paid by distribution companies that purchase power in excess of their contracted levels. CAMMESA sets these prices using information based on demand forecasts, availability of reactive power, weekly load curves, availability restrictions, equipment information from transmission companies etc. To a large extent, seasonal price determination is influenced by Argentina's dependence on hydroelectric power. Spot prices are determined hourly in CAMMESA by the interaction of buyers and sellers.

[5] In CfD markets, generators and electricity purchasers can hedge prices by committing to a contract with an agreed-upon price, (the strike price). Contracts for differences are purely financial contracts and may take many different forms. For example, the strike price may be set at an average of expected daily pool prices. If the strike price turns out to be higher than the daily average pool price, then the purchaser pays the generator for the difference. Conversely, if the strike price turns out to be lower than the daily average pool price, the electricity generator reimburses the purchaser for the difference.

Sellers in the spot market include generators, distributors who have contracted to purchase more electricity than they can use, large users of electricity, and foreign producers of electricity. The buyers consist of distributors, large users, generation companies and foreign buyers.

In order to set the spot market price, CAMMESA determines the marginal cost of electricity produced by each generator and then dispatches the generators in the order of increasing cost until demand is satisfied, with the last (most expensive) plant dispatched setting the price, which includes the costs of reserve capacity and transmission costs. This is an important distinction from spot markets such as that of California and England and Wales, where wholesale prices are set on the basis of demand and supply, not costs. Under the basic theory of competitive markets, the results would be the same, as the prices would equal marginal costs. However, in an excess demand situation – one in which demand cannot be met by fixed capacity – the assumption of competition breaks down: the marginal supplier has no competition and can extract a price that has no relationship to costs.

England and Wales

Prior to March 2001, England and Wales prices were set through a power pool similar to the California Power Exchange in that a merit order dispatch schedule was created whereby the generation units with the cheapest bid prices were selected first until supply was adequate to meet demand. The pool purchase price for all suppliers became the price bid by the last generation facility needed to accommodate the last unit of demand. The price actually paid to generators also included a financial incentive for maintaining some additional (peak load) generation capacity in the event that demand exceeded forecasts. (Because similar features are still used in other systems and it may be of relevance to California in the future, the mechanism used in England and Wales for capacity payments is described more fully in Appendix A.) Also, as a means of controlling price volatility, a contract-for-differences hedging market was developed. This allowed for bilateral contracts to be negotiated between generators and consumers. According to communication with Richard Green, this accounted for almost 90 percent of all generation since privatization and carried terms of one to fifteen years.

In practice, electricity prices in the England and Wales electricity pool proved to be volatile and subject to possible manipulation. Allegations were made that, due to their dominant position in the pool, National Power and PowerGen were able to manipulate pool prices by strategic bidding. The fact that both companies were once the same company suggests that each possesses an intimate understanding of the other's cost structure. (U.S. Energy Information Administration, 1997, Chapter 2) Thus, without overt collusion, each had information about the other that would be relevant to withholding bids until the most advantageous price could be reached -- without a serious risk of failing to sell power at a lower, but still profitable, price. Moreover, the uniform price structure used in the England and Wales power pool and in California facilitates covert collusion and strategic behavior. (Currie, 2000)

Littlechild (1999) outlined the problem as follows: "The consequence of all this competition is that the share of the two largest companies has halved – a significant and very encouraging change in market structure. However, unfortunately, it is still the case that this has not been enough to create effective competition to bring prices down to where they ought to be." In addition, "I would say that however many companies you have in a market, if that number is fixed, it is always possible for them to agree to keep

prices up. You always need the ability of new companies to come in from outside to compete prices down."

Dissatisfaction with the power pool led to a reconsideration of how electricity markets should be organized, beginning in 1997 (about the time that California was enthusiastically adopting a similar structure). In March 2001, the pool was abandoned in favor of the New Electricity Trading Arrangements (NETA), which are based on bilateral, pay-as-bid trading between generators, suppliers, traders, and customers. That is, each transaction stands on its own rather than having the marginal transaction set the price for the entire market. NETA envisages that private power exchanges will be set up to enable the transactions. (Currie, 2000)

The system includes futures markets, a balancing mechanism to enable the National Grid Company to balance the system, and a settlement process. Long-term contracts provide the foundation for generators and end-users to make long-term plans. Short-term forward trading allows purchasers to make changes in contract coverage one or two days before actual trading begins, providing flexibility to purchase more electricity at less expensive prices or sell contracted power in excess of the purchaser's needs. Spot trading balances supply and demand in real time and sets the price of electricity at that specific time. Thus, the England and Wales electricity market now looks much more like those of Argentina, PJM and Australia than in the past. As observed by one of the architects of NETA, it "moves the electricity market much closer to that of a normal market; and … puts in place a governance structure that allows for relatively easy adjustment and change." (Currie, 2000)

Victoria/Australia

There are three levels of transactions in the wholesale trading market: long-term bilateral contracts; short-term forward trades; and spot trades. Participants in the wholesale market can operate in any combination of these markets. All wholesale electricity trading is accounted for through the pool.

The Code realized that in order to give the correct market signals in the spot market, it is important for the spot price to be allowed to approach realistically high values. The Code also recognizes that in an immature market, such as Australia, allowing the spot price to operate at a level where supply and demand are balanced may result in a very high price that would expose inexperienced participants to unnecessarily high financial risks. Therefore, the Code makes provisions for a temporary Value of Lost Load price cap, set to strike a balance between the highest price that purchasers of power might consider acceptable and a price high enough to ensure that generators would not be discouraged from investing in plants with high operating costs.

4.3. Capacity expansion

California

IPPs are the primary source of privately owned capacity additions that sell into the California market. Unlike the integrated utilities they replace, however, they have no mandate to serve. All decisions about capacity additions are made on strictly commercial grounds. Capacity expansion by publicly owned utilities, such as the Los Angeles Department of Water and Power and the Sacramento Municipal Utility District are undertaken according to their own assessment of their constituents' needs and commercial opportunities to sell power in excess of their own needs.

Environmental permits due to California regulations imply that power plants take about twice as long to site as in the rest of the U.S. (Besant-Jones and Tenenbaum, 2001, p. 22) Local and environmental intervenors have been able to block and delay new capacity through litigation and ballot measures. Moreover, there has been little coordination between power and environmental regulators to accommodate each other's objectives and mandates.

In addition to expansion of generation capacity within California, it is also possible to expand capacity available to California in other states of the Western Systems Coordinating Council (WSCC). By the same token, capacity built in California is available to the rest of the WSCC.

Pennsylvania/PJM

Like California, the de-integration of the electricity sector implies that investment in generation capacity be done strictly on the basis of commercial motives in a competitive market. Moreover, the establishment of PJM Interconnect as the power pool implies that the generation market is the entire PJM region. Thus, capacity built in the rest of the PJM region is available to Pennsylvania, and vice versa. Moreover, transmission interties also connect PJM with other regions.

Argentina

Capacity expansion is undertaken as a commercial activity by IPPs. One constraint on capacity expansion is that no single firm can control more than ten percent of the generation market. This constraint could, in principle, inhibit investment to the point that it is sub-optimal. So far, there are no signs that this might occur.

England and Wales

There is a great deal of freedom for new generators to enter the England and Wales market. (Richard Green guestimates about 10 gW.) Moreover, it is possible to expand capacity through purchases over interties with France and Scotland, although this expansion is limited.

Australia

New generators are free to enter the Australian market. Moreover, it is possible for each state to expand capacity through purchases over interties with other states.

4.4. Lessons Applicable to California

Ownership

There do not appear to be any clear lessons for California from examination of others' policies with respect to ownership of generation. All entities examined have de-integrated ownership of generation from the transmission and distribution functions. The fact that California and PJM have allowed parent companies of distributors to retain ownership does not seem to have itself been a deterrent to competition, given that they must compete on the wholesale market. Market concentration was a problem in early restructuring efforts in Chile and in England and Wales. Argentina, by watching Chile, realized that exercise of market power is possible if there are too few generators and

places a restriction on the percentage of total generation that can be owned by a single entity. In going forward, California might consider this possibility.[6]

Conditions of Supply and Pricing

Some of the most important lessons from others for California come in the realm of how wholesale markets are structured. California's uniform-price auction system has apparently been subject to manipulation for the achievement of something other than the mimic of a "price-equals-marginal-cost" solution envisioned by its architects. This was also found to be the case in England and Wales. (Currie, 2000)[7]

In addition, the attempts to force a "competitive" (price = short run marginal cost) market have come at the expense of a free market. In a free market, say for financial instruments, there is provision for risk mitigation through hedging and for contracts of various durations. California has been unique among the states/countries examined in not permitting *any* meaningful risk mitigation.

Moreover, even England and Wales – the originators of reliance on spot markets, albeit hedged – have replaced the pool with NETA, in which participants can make whatever bilateral transactions they want – at a pay-as-bid price, similar to PJM and Australia. As California moves forward, it will already have an overhang of long-term contracts. Thus, it would seem reasonable to move carefully toward a pay-as-bid market that focuses initially on shorter term transactions, perhaps like the England and Wales' NETA. This structure would allow participants to make their own decisions regarding which terms and conditions would be most appropriate. This would include short-term, intermediate and long-term contracts, as well as extremely short-term balancing transactions.

Capacity Expansion

The principal difference regarding the expansion of generating capacity between California and the other states/countries examined is the impact of environmental considerations on timely development and construction. It would seem reasonable to expect that siting and development processes in California could be streamlined and speeded up somewhat without undue violence to the environment and to community concerns. Also, if environmental advocates fear that faster approval might compromise the process, a mutually acceptable trade-off might be to adopt higher standards to compensate for whatever losses might result from speedier decisions.[8]

In particular, there could be better articulation of goals and needs and better coordination concerns between the responsible state power and environmental agencies. Besant-Jones and Tenenbaum (p. 8) identify what is required: "The economic regulator for the power sector and the environmental regulator need to work together. Each is in a position to undermine the work of the other. The ultimate success of both regulators requires a change in their mindsets."

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[6] However, while restrictions on the market share of generators might foster competition in general, it will not necessarily prevent the exercise of market power altogether. Borenstein (2001, p. 11) observes that in California, "The unregulated generation owners that have been accused of exercising market power own between 6% and 8% of the production capacity in the ISO control area."

[7] Not everyone is sold on pay-as-bid auctions being superior to uniform-price auctions. Wolak (2001a) suspects that they are at least as likely to be manipulated as uniform-price auctions.

[8] I am grateful to Gregory Rosston for this observation.

5. Comparison of Transmission Restructuring

This section examines transmission, the interface between generation and distribution. The transmission system is complex in that it incorporates wholesale market-making and how electricity is dispatched over the network, as well as the physical facilities for moving electricity.

Table 4
Comparisons of Control Parameters for Transmission Ownership and Operation

	Ownership/ control	Access	Operation	Capacity Expansion
California	UDCs own transmission facilities, receive a fee regulated by FERC. Cumbersome stakeholder governing board for CAISO has been replaced.	Open access, to sellers and distributors. Congestion pricing.	CAISO was to operate the transmission system, but not the Power Exchange. Later, CAISO operated the spot market by default	CAISO leads a coordinated planning process.
PJM	Ten IOUs own transmission facilities, receive a fee regulated by FERC. PJM governed by eight-member independent board.	Open access to sellers and distributors, uniform transmission tariffs.	PJM operates as an ISO. It operates the system and manages the exchange market.	PJM administers transmission planning for the region.
Argentina	Private ownership of facilities. Operation of system and market by stakeholder-owned corporation.	All distributors and qualified wholesale end-users have equal access to the grid.	CAMMESA operates the system and the market. Dispatch based on bid prices.	Expansion can take place by private contract or public auction. Conditions are complicated.
England and Wales	Private ownership and operation, under regulation.	All distributors and qualified wholesale end-users have equal access to the grid.	Dispatch and market-making functions are combined in the National Grid Company.	National Grid Company plans and executes expansion.
Victoria/ Australia	State-owned, then privatized in 1997. Regulated	All distributors and qualified wholesale end-users have equal access to the grid.	The Power Exchange is responsible for pool operations and dispatch.	NEMMCO identifies opportunities. Private sector initiative under regulation provides actual expansion.

5.1 Ownership/Control

California

The three major IOUs own the transmission system, although the State of California has offered to buy it. They receive fees for transmission services that are regulated by FERC.

Grid operations are controlled by CAISO, which is a non-profit, public benefit corporation. Although FERC requires governance of CAISO to be independent of the stakeholders in the system, the CAISO and Power Exchange boards were originally built on stakeholder interests. CAISO was governed by a 24 member stakeholder board. It has been said that it "resembled a mini-legislature and was susceptible to roadblocks." (Besant-Jones and Tenenbaum, 2001, p. 14) There was a similar condition in the Power Exchange, where one or another party could veto any changes in market rules, including forward trading on the part of UDCs. (Besant-Jones and Tenenbaum, 2001, p. 34). FERC ordered the CAISO Board to be disbanded and replaced by a smaller, non-stakeholder board.

Pennsylvania/PJM

Ten IOUs own transmission facilities, receiving fees regulated by FERC. PJM Interconnect is governed by an eight-member independent Board of Managers. The PJM Members Committee advises the Board. Owners of transmission facilities have less than 50% of voting control.

Argentina

The transmission network has a national high voltage transmission system (500 kv) and six regional systems (220 kv). Transener, which has been privatized, owns the national high voltage system and one of the regional systems. The majority of the regional transmission companies have been privatized. All of these companies operate under concessions of fixed duration and are closely regulated by ENRE. By law, ownership and operation of transmission systems is separate from ownership and operation of generation.

CAMMESA is responsible for the dispatch of energy. It is a non-profit organization whose owners are the government (represented by the Energy Secretary) and organizations representing generators, transmission companies, distributors, and large end-users. Each has 20 percent of the equity of the company, but the Secretary of Energy appoints its chairman and vice chairman and has some veto powers. However, the government has no more authority to make proposals than the generators, transmission companies, and distributors with whom it shares ownership.

England and Wales

Ownership of the national grid was initially transferred to the regional electricity companies (RECs) upon their privatization. However, in order to preserve its independence, the ownership was through a holding company structure. In December 1995, the RECs divested their shares in the national grid, at which time it became a separate publicly-traded company, the National Grid Company plc (NGC).

NGC is the operator of the grid, responsible for its efficient operation and reliability within the guidelines of the NETA.

Victoria/Australia
PowerNet Victoria owns Victoria's high voltage transmission grid network and is responsible for its maintenance. Until the establishment of NEMMCO in late 1998, the Victorian Power Exchange was responsible for pool operations and system dispatch. NEMMCO now has these responsibilities for the five states/territories that are in the "national" electricity market. NEMMCO is a self-funding company owned by the participant states and the federal government.

5.2. Access

California and PJM
In 1992, Congress passed the Energy Policy Act, which set the stage for all wholesale participants to have access to transmission lines owned by IOUs. Under EPAct and its enabling regulations, all new generating capacity has non-discriminatory access to the transmission network. In 1996, FERC issued Order 888 requiring all vertically integrated IOUs to file an open access transmission tariff that would provide universal access to the transmission grid to all qualified users.

With the implementation of the PJM Open Access Transmission Tariff on April 1, 1997, PJM Interconnection began operating the first regional bid-based energy market in the U.S.

Argentina, England and Wales, and Australia
All of these have open access to the transmission system for all generators and wholesale customers.

5.3. Operation

California
Participants submit output and demand schedules through forty Schedule Coordinators, who submit balanced load schedules to the CAISO on a day-ahead basis. CAISO dispatches are based on the aggregated schedules submitted. To correct imbalances, the CAISO conducts a real-time auction to buy needed energy not covered by commitments. The CAISO is obliged to purchase power regardless of price whenever it is necessary to keep the system from failing. When demand approaches capacity to the extent that reserves are inadequate for reliable service, the CAISO declares three stages of alerts to the public to encourage reduction of consumption. At Stage 3 (1.5 percent reserve margin), the CAISO begins rotating outages by distribution system block. These are typically about 90 minutes per block until adequate reserves are restored.

Congested transmission is allocated via auction by the CAISO to the Schedule Coordinators

Pennsylvania/PJM
PJM is both the market-maker and the operator of the system. It uses merit-order dispatch based on day-ahead offer prices and projected loads. PJM has enforced an offer cap on wholesale prices and accepts no offers that exceed the cap, except under "Emergency Conditions," in which the cap is relaxed.

A generating unit that is dedicated to serving load within PJM is designated a "Capacity Resource," and subject to PJM dispatch. If its energy is not provided when called, its value as a capacity resource is diminished in the future. Also, PJM maintains a market in capacity resources so that those who need capacity to meet obligations can buy from those with capacity in excess of their own needs. Also, distributors can buy and sell capacity resources according to their needs. The price of capacity resources varies according to market conditions.

When capacity utilization is high enough to warrant Emergency Conditions, PJM recalls for its own use any energy produced by Capacity Resources that is being sold via bilateral exports. This recalled energy is paid the market price in PJM. Also, it curtails some service under its Active Load Management program and may engage in load shedding.

Argentina
CAMMESA is responsible for scheduling and dispatch of generating units and conducting the auction for spot market transactions. Also, it coordinates payments for wholesale spot market transactions. It operates according to merit-order dispatch, based on the contractual, seasonal and spot prices, which are largely cost-based. The latter are determined by hourly bids.

England and Wales
Dispatch is governed by the transactions under NETA, as discussed in Section 4.2 above.

Australia
The National Electricity Market Management Company (NEMMCO) is a pool to which all generators above a certain size are obliged to sell their output at prices determined by the highest bid for distribution through regulated transmission networks. However, interstate transactions in NEM currently account for only about 7% of total generation.

5.4. Capacity Expansion

California
CAISO coordinates capacity expansion of the transmission system, with participation from regional transmission planning agencies. CAISO, FERC or other market participants may identify a need for transmission system additions or upgrades. CAISO determines where and when the investment is needed and allocates its costs to the participants according to their benefits. The grid owners are then required to make the required investments and are allowed to recover their costs. (Weiser and Pickle, 2001)

PJM
PJM prepares a Regional Transmission Expansion Plan that coordinates all of the transmission expansion plans throughout the PJM region. It has both five-year and ten-year components to incorporate immediate and intermediate-term horizons. The elements of the Plan originate with the Regional Transmission Owners (RTOs) and are limited to those plans by the RTOs which have a regional impact. The Plan is based on a formal consultation and advisory structure that takes into account the interests and plans of all stakeholders, including those of IPPs planning to build new generating

capacity. The Plan is also integrated into that of the larger MAAC regional reliability council of which PJM is a member. (PJM, 1998)

Argentina

Transmission planning is based largely on petitions by generators and purchasers of electricity. As an alternative to expansion by petition, potential users may band together by private contract and allocate among themselves the costs of the new capacity. However, the expansion can be vetoed by ENRE. (Gomez, 2001)

"Congestion rents" are collected in transmission corridors in which there are capacity constraints. These revenues comprise a fund that is used for transmission capacity expansion when potential users suggest a new line. CAMMESA estimates the cost of the new line and assigns its costs to potential users, and the capacity expansion funds are used to offset part of the cost. The line must be proven to be cost-effective for the entire system. However, potential users who do not wish to pay the assigned costs may band together to oppose the line. If it goes forward, a new transmission company is formed to own and operate the line.

A study by NERA, a consulting firm deeply involved in energy problems, has identified the following flaws in the scheme: (Gomez, 2001)

- Generators may be unwilling to pay for economic lines and, on the other hand, have incentives to invest in lines that are not economic.
- The availability of the fund may encourage uneconomic construction.
- Both of the above may encourage uneconomic location decisions.

England and Wales

NGC is responsible for planning and executing transmission system additions and upgrades under the National Electricity Code.

Victoria/Australia

NEMMCO is required to provide an annual Statement of Opportunities, covering all electricity sector investment, including transmission. This assessment is based on recommendations of the Inter-Regional Planning Committee, which in turn is based on findings by the transmission network service providers. It is up to private sector initiative to act upon the transmission opportunities that are identified.

There are two types of interconnectors to enhance transmission network development. Regulated interconnectors must pass strict tests in terms of contributing to market Development; they receive guaranteed rates of return. Unregulated interconnectors derive their income from the price difference between two sides of the interconnector.

The International Energy Agency (2001, p. 7) believes that interconnection between states of the NEM (which are clustered in the relatively heavily populated eastern part of the country) needs to be reinforced. There are significant price differences between NEM regions, which imply that there is not enough trade. Efficient transmission pricing is needed to encourage investment in transmission and interconnection, as well as efficient plant siting. Transmission pricing should be reviewed to better reflect transmission costs, including grid congestion. One result of such a review might be that

generators as well as end users should pay transmission charges. Such a review of transmission pricing was initiated in 2000. (International Energy Agency, 2001, p7)

5.5 Lessons Applicable to California

Ownership/Control

It seems to make little difference who owns the transmission grid. The important question is who controls its operations and how. All of the systems reviewed here have private ownership. The California and PJM grids are owned by the original private utilities or their successor UDCs. In Argentina, England and Wales, and Australia, the grids are owned by separate private entities. In each case, they earn fees for transmission services under regulation by a national authority. England and Wales is the only state/country examined here in which the owner and the operator are the same entity.

In California, PJM, England and Wales, and Australia, the grid operations are controlled by a board that is independent of stakeholder interests. This has only recently been true in California; and, given that the State of California is represented and the state government is a power purchaser, it may not be true even now. In Argentina, the board is composed of stakeholders, but the Energy Secretary – presumably acting in the public interest – has veto power. All of the boards (California's only recently) are small, making them less cumbersome and more decisive.

Transmission Access

This seems to be a non-issue. All of the systems investigated grant open access to new generators and customers.

Operations

California is the only one of the systems studied that separated market-making from operations. In retrospect, this seems to have been unnecessarily cumbersome. California and the England and Wales pool operated under merit order dispatch, with the lowest-bid units dispatched first, subject to system reliability constraints, under a uniform-price auction. Now, Argentina, PJM, England and Wales under NETA, and Australia operate under a hybrid system that takes account of forward contracts as well as spot markets. Moreover, except for Argentina's spot market, these are pay-as-bid markets rather than uniform-price markets. They also provide financial clearing services for bilateral transactions as well as balancing transactions.

In general, it appears that the systems that work best are the simplest conceptually – bilateral, pay-as-bid markets. In fact, however, when there are many participants, as in California, keeping track of all of the transactions would be complex. Nonetheless, England and Wales – a much bigger system – seems to be functioning well.

Capacity Expansion

Except for National Grid Company of England and Wales, which owns as well as operates the grid, the grid operators of the systems studied take a passive and coordinative role, waiting for others to propose additions to the grid and helping to facilitate agreement. It is not clear that this is the most efficient way of planning and executing transmission system expansion. In Argentina, in particular, the system seems complex and inefficient. Short of unifying the ownership and operation of the grid,

California and PJM may have as efficient a system as could be expected, although it seems that California has taken a long time to construct some needed transmission links under its present system. A question that should be examined is that of incentives for construction of new transmission capacity.

5. Comparison of Distribution/Retail Restructuring

Moving power from the transmission system to the customer's meter may be regarded as two separate functions: the physical "wires" system and the retail supply system, in which retailers use the services of the wires as a regulated common carrier. In the U.S., as of July 1, 2000, 24 States and the District of Columbia had passed laws or regulatory orders to implement retail competition, and more are expected to follow. This section examines how retail competition has been handled in the states/countries of this study.

Table 5
Comparisons of Control Parameters for Distribution and Retail Supply

	Ownership/ control	Oversight, Regulation and Competition	Pricing
California	Open entry into competitive retail market, since collapsed. UDCs are now sole retail providers for market formerly served by IOUs.	CPUC regulation of UDCs, based on performance. . No obligation on the part of UDCs to insure adequate capacity for customers or access to forward markets.	In principle, prices set by retail competition. This principle was diluted by legislated prices for UDCs. Charge to recover costs of stranded assets. Wires services' prices set by incentive regulation.
Pennsylvania	Original IOUs own the system and are retail providers, as are new entrants.	Pennsylvania has full retail competition, regulation of distribution. Obligation to provide reserve capacity. Access to forward markets.	Legislated price caps. Charge to recover costs of stranded assets. Wires services' prices set by regulation.
Argentina	Moving toward full privatization of monopoly concessions.	ENRE regulates retail sales, set rates based on assessment of costs.	Cost-based price cap, adjusted every 5 to 8 years.
England and Wales	Open entry into competitive retail market.	OFFER has regulatory responsibility to see that competition is healthy.	"RPI-X" price regulation.
Victoria	Privatized, but maintaining monopoly rights until 2001. Full competition planned for 2003.	Competition for all customers. Goal is minimum regulation except for wires functions.	"RPI-X" price regulation.

6.1. Ownership/Control

California
AB 1890 provided for "electricity service providers" (ESPs) to enter the retail electricity market in order to create a competitive retail market. Their services were offered over

the UDC's distribution systems, which remain regulated by the CPUC. The UDCs were the default service providers in case retail customers did not choose an alternate ESP.

Pennsylvania
The pre-existing utilities own the distribution system, and their compensation for distribution services is regulated by the Public Utility Commission. Also, however, Pennsylvania has actively encouraged retail competition, with retail service providers using the distribution network as a common carrier. The utilities are default retail service providers.

Argentina
Distribution assets formerly owned by the federal utilities were either privatized or handed over to the provinces. The provinces have since started privatizing these. Monopoly concessions are granted on the basis of competitive bidding under ninety five-year licenses from ENRE. Retail sales are not separated from distribution.

United Kingdom
There is a separation between the wires (distribution) side of the RECs' business (which was to be continually regulated) and the marketing function of the RECs (which was to be gradually deregulated). The RECs were also the first segment sold off to the public by the UK government, as of December, 1990.

In addition to the RECs' marketing functions, "second tier suppliers," unaffiliated with their local REC have entered the market. These include RECs operating outside of their franchised distribution territories and electricity marketing units of National Power and PowerGen. Due to concerns relating to maintaining competition, however, the retail suppliers are required to operate separately from the generating companies and the distribution side of the RECs.

Victoria

Victoria auctioned all of its five electric power distribution companies in 1995. Companies from the United States, and their consortia, led the way in purchasing these plants. This contrasts with England and Wales, where electricity assets were sold at prices set by the national government. Furthermore, all of the companies were sold intact, and to other companies or consortia of companies. No restrictions were placed on foreign investors.

Victoria permitted each of the five distribution companies to retain monopoly rights to supply power to customers in their respective geographic regions. However, in 1996 (in an attempt to introduce competition into what was still a state-owned system), large users (the contestable customers) were freed to purchase electricity from any of the five distribution companies. As of June 30, 2000, Victoria had 22 retailers that sell electricity to contestable customers in a competitive market. By January 2003, all Australian electricity consumers are to be able to choose between electricity retailers.

6.2. Oversight, Pricing, Regulation and Competition

California
AB 1890 created the possibility of retail competition by allowing free entry for new retail sales companies. However, AB 1890 also fixed retail rates for the UDCs at the levels in

effect as of June 10, 1996 and guaranteed a 10-percent rate reduction for residential and small commercial users. This sweetener was financed to some extent by tax-exempt California state bonds. It appeared to be a political *quid pro quo* for imposing a Competition Transition Charge.

Rates were to remain frozen until March 31, 2002. Thus, new entrants in the retail market were faced with competing with entrenched incumbents with artificially depressed prices. (Taylor and Van Doren, 2001) However, at the time AB 1890 was passed, it was widely believed that competition would drive retail rates down, so that retail competition would thrive despite the UDCs' rate reduction. In the event, however, with wholesale prices rising and UDCs' rates fixed by law, new retail suppliers were not able to survive.

The UDCs and other retail suppliers are under no obligation to maintain control of sufficient capacity to serve the loads they sell to. Also, they were forbidden to mitigate risks of inadequate supply by having access to forward markets, either long or short term.

Pennsylvania

The Electricity Generation Customer Choice and Competition Act called for a phase-in of retail choice, with one-third by January 2000. All customers in Pennsylvania can now choose the generator of their electricity, but they are still required to purchase the transmission and distribution components of their electricity services from the traditional utility. Incentives were provided for participation in a pilot retail choice program. This phase-in allowed utilities and the PUC to iron out transition difficulties before full competition was launched.

In terms of numbers of customers that have switched suppliers, Pennsylvania's restructuring program has been called the most successful in the U.S. However, to some degree, retail choice has been forced. For example, as required under PECO's restructuring plan, 300,000 residential customers that had not chosen a competitive supplier were randomly chosen and switched to The New Power Company, which was chosen by PECO to provide "Competitive Discount Service" from March 2001 through January 2004. Customers may opt out of the program or choose another electricity supplier without penalty. (Energy Information Administration, 2001) However, a conversation with a Pennsylvania residential customer indicated that switching back is not easy, in that the telephone number given for that purpose has been constantly busy.

Moreover, like California, Pennsylvania legislation placed a price cap on retail rates for customers served by traditional utilities. Like California, when wholesale prices rose, many customers fled the new retailers back to the traditional utilities whose retail rates were capped. (Erie Times-News, 2001)

PJM requires retail suppliers to have enough capacity to cover all current demand plus a 19 percent reserve.

Argentina

ENRE regulates the retail activities of distribution companies, setting rates and conditions of service. Large users may choose to be supplied either by the distribution companies or directly by generators. If they choose the latter, their rates and terms of service are determined by bilateral negotiation.

England and Wales

OFGEM has responsibility for assuring that competition is healthy and that rates are appropriate. Rate-of-return regulation was rejected in England and Wales for several reasons. First, discovery costs were felt to be expensive, requiring a large bureaucratic structure. Further, it was felt that regulators would always suffer from a disadvantage, given that the utilities could manipulate the information they supplied to their own advantage, leaving the regulator in an inferior negotiating position. Moreover, rate-of-return regulation offered insufficient incentives for the utilities themselves to reduce costs aggressively (although this shortcoming can be mitigated by infrequent rate cases).

Victoria

As in the United States, regulation of distribution and retail sales is the responsibility of the state rather than the federal government. Victoria's Office of the Regulator-General is responsible for promoting competitive markets, free entry and efficiency and for ensuring that end users benefit from competition and efficiency. The overall intent is to act only when the competitive market fails.

6.3. Retail pricing

California

In principle, retail prices were to be determined by competition. However, the circumstances that led to the demise of retail competition, as described in Section 6.2, have led the CPUC to resume its traditional regulatory role.

In addition to fixing the retail cost of electricity, AB 1890 allows for stranded cost recovery in California. Utilities were to apply the difference between their actual operating costs and the legislatively-fixed price toward recovering their stranded costs (under the assumption that the costs of energy would be less than the fixed retail prices). The stranded assets in California consisted primarily of nuclear power plants and generous power purchase agreements with wind, cogeneration and other "qualifying facilities" (QFs) as defined in the U.S. Public Utility Regulatory Policy Act of 1978. The California Public Utility Commission interpreted this act generously for the QFs under Standard Offers 2 and 4, leading to a great deal of power being offered that the utilities were forced to accept at a high price under long-term power purchase agreements. Also, a "Competition Transition Charge" (CTC) on consumption is levied on retail customers to help cover the costs of stranded assets, along with another charge that finances the bonds that provided the rate reduction.

Pennsylvania

Pennsylvania, like California, has price caps for retail customers. In addition, residential and commercial customers received an additional eight percent rate reduction. Thus, like California, retail prices are decoupled from wholesale prices. Also like California, as wholesale prices have risen, retailers are being squeezed.

With regard to stranded costs, the PUC is authorized to determine the level of stranded costs that each utility is permitted to recover. Cost shifting between customers as a result of stranded cost recovery is prohibited. The costs can be recovered through a non-bypassable CTC that will be reviewed and adjusted annually for each customer who

elects to receive service from an alternative generation supplier. The CTC will be collected by utilities over a maximum period of nine years, unless the PUC approves another time frame. California, by contrast, authorized a collection period of only four years.

Argentina

The prices that end-users pay are capped by ENRE. This cap is based on an assessment of costs. Inasmuch as the cap is reset every five to eight years, the cap plus regulatory lag provides an incentive for firms to cut their costs. End-use price caps set by ENRE consist of an energy charge, a loss charge, connection and transmission costs, cost of capacity in the wholesale market, and a fixed distribution charge.

However, distributors may request adjustments to the initial structure. Such requests must be approved by ENRE. Rate-change requests are subject to challenge on several fronts. ENRE may call hearings on rate adjustments, for example, if it believes that a company's rates are "unjust, unreasonable, unjustifiably discriminatory, or preferential". If ENRE inaction does not act on a request within 120 days, the licensee may institute its requested changes as if they had been approved. Thus, the distribution companies control the agenda, an attractive feature for investors. (Heller and McCubbins, 1999?)

The distribution companies' control over the initiation of policy changes indicates that the government designed the regulatory structure to ensure that private investors would continue to earn a satisfactory rate of return beyond the tenure of the government that put the reforms into place. However, it also ensures that – in principle, at least – retail prices will be closely linked to costs and that retail customers will capture some part of distributors' productivity gains. So far, the system seems to be working, as retail prices have declined.

England and Wales

Regulatory control over retail prices is the responsibility of the Director General OFGEM

For two years (1998 and 1999), constraints were placed on retail prices to households, leading to real price reductions of six percent and three percent per year. However, price controls were not binding inasmuch as distributors were able to reduce their costs by even more. Also, companies were able to buy distribution assets at less than their replacement costs. "Price reductions *in toto*, since privatization, have been between 23% and 32% in real terms; the smallest reductions have actually been for the extra large and domestic customers," who had more political clout than the other retail classes before privatization. (Littlechild, 1999)

England and Wales use an "RPI-X" approach to ratemaking for the "wires" sectors (transmission and distribution), in which base-year prices are escalated by the retail price index (RPI) minus an adjustment factor (X) that is generally held to represent expected productivity change. Other adjustments could be incorporated to allow for exogenous influences on price. RPI-X has also been applied to electricity retailing for residential users (although this market is scheduled for deregulation).

RPI-X regulation employs a multi-year review cycle, typically of 3 to 5 years. This provides companies with an incentive to increase efficiency faster than "X" in order to realize the benefits of their cost reduction efforts over the review cycle. Upon completion of the regulatory cycle, the regulator conducts a new review and sets new benchmarks

both for the initial set of prices and for "X". The regulator is then able to pass on some of the benefits of the realized efficiency gains to consumers.

In practice, RPI-X might not be very different from pre-1970s rate-of-return regulation. The incentive aspect of improvement over time is a well-known feature of rate-of-return regulation with long intervals between general rate cases – so-called "regulatory lag." Also, it appears that resetting the benchmarks under RPI-X has difficulties of discovery similar to those of general rate cases under rate-of-return regulation.

In addition, industrial customers in England and Wales have had the option of real-time rates since 1991, and they have been adopted fairly widely. (Communication with Richard Green)

Victoria
Price cap regulation for distribution services is similar to that of England and Wales. Beyond that, prices are set by competition between retailers.

6.4. Lessons Applicable to California

Ownership, Control, Competition and Regulation
The jury is still out with respect to whether retail supply is amenable to effective competition. California and Pennsylvania have contaminated the experiment with legislated retail prices for incumbent utilities that, in times of rising wholesale prices, make competition from new entrants unviable and threaten the financial integrity of the incumbent utilities – a competitive Pyrrhic victory for the incumbents.

One question is whether there is enough price and product differentiation to make it worthwhile for customers to shift from incumbent to alternative suppliers. Even before escalating wholesale prices, the response to alternative suppliers in California and Pennsylvania was lukewarm. The response seems somewhat better in England and Wales and in Australia, but it is not clear that there have been major benefits in either price or quality of service compared to a regulated distribution/retail supply monopoly.

Argentina eschewed retail competition, and its retail sector seems to be working well. A question that should be asked by California in the future with respect to retail competition is, "Is it worth the trouble?"

Argentina has stuck with cost-based retail regulation, with long periods between reviews. The five to eight years between reviews provides incentives to cut costs. The lower costs are then captured for customers, and the cycle is begun again, with continued incentives to cut costs, and continued (but lagged) capture of the cost cuts by customers. It is a system reminiscent of conventional regulation in the United States before the 1970s -- inelegant but perhaps as efficient as more sophisticated schemes.

England and Wales and Australia have adopted RPI-X regulation for distribution services. On its face, this type of regulation seems less intrusive and less subject to manipulation by distributors than Argentina's cost-based regulation – if one knows what "X" is.

Pricing

It is clear that one of the most important mistakes in California was to decouple retail prices from wholesale prices, a mistake that is being repeated in Pennsylvania. None of the other states/countries have engaged in this particular folly. However, only England and Wales have initiated real-time rates for large industrial users and none have done so for small users, an innovation that is past-due in matching pricing to costs. Allowing retail prices to follow wholesale prices, preferably by real-time pricing, seems to be the way for California to go, but it is not necessary to look to the experience of other countries to determine that.

7. Implications for California

Other states and countries have had successful experiences in restructuring their electricity sectors. They have done so by greater reliance on free markets, whereas California, in seeking its *optimum optimorum* of price equals short-run marginal cost, built rigidities into its system that kept it from adjusting when conditions in electricity markets took an unexpected turn. All of the other states/countries except Pennsylvania/PJM started restructuring before California, and the structure of Argentina's electricity sector has been stable for several years. Thus, there is a track record of what works. Although unscrambling California's current electric omelet will not be easy, there are clear lessons that can be learned.

Many of these lessons have already been learned by simply observing what does not work in California. However, it is useful to know that alternatives do work, so that there is guidance for the future rather than simply bemoaning the past. First, restructuring for any given stage of electricity production and delivery – generation, transmission or distribution/retailing – is like jumping across a chasm. You either jump all the way across, or you do not jump at all.

California jumped half-way in wholesale markets by not allowing the UDCs to participate in any transactions other than the spot markets. The failure to permit the risk-mitigation of forward markets contributed significantly to the volatility of California's electricity markets and may well have contributed to raising average prices higher than they would have been otherwise.

California also jumped half-way across in its attempt to create competition in retail markets while legislating fixed retail prices for the UDCs. The result was that new entrants could not compete – and UDCs could (were forced to) compete all too well and face bankruptcy as a result. It is highly likely that if California had not restructured at all – that is, maintained its vertically integrated, regulated utilities – it would have been better off. In fact, most states in the U.S. have continued to maintain this structure, except for allowing generators to compete for wholesale markets. However, it is likely that California would have been even better off than under traditional regulation if participants had been free to choose the terms of how they would compete and let the market tell them whether or not they were right.

Thus, it seems obvious that one lesson is that it is folly to decouple retail prices from wholesale prices, although Pennsylvania is only now learning this, and some still do not

believe it.[9] Retail prices reflective of wholesale prices would have reduced California's demand, thereby helping to relieve capacity shortages and upward pressure on wholesale prices. Real-time pricing -- at least for large customers – would tie retail and wholesale prices even more tightly. It seems to have been successful in England and Wales for large industrial users; and it seems to be within reach for small end-users except on an experimental basis.

A second lesson is that despite the theoretical attractiveness of uniform-price auctions for spot markets, pay-as-bid price-setting is less likely to be vulnerable to generators gaming the market by withholding capacity. England and Wales had the longest history of uniform-price auctions and finally discarded them in favor of pay-as-bid bilateral agreements. Australia and PJM have maintained uniform-price bidding on their spot markets, but their spot markets are complemented by long-term and intermediate-term markets, so that even if there is gaming it affects only a relatively small part of the power supply.

A third lesson is that despite the attractiveness of price equaling marginal cost in static equilibrium, real-world markets like electricity are dynamic; and participants need to be able to mitigate risk by arranging to buy and sell power under long-term and intermediate time structures, as in financial and commodity markets. PJM, Argentina and Australia recognized this from the outset, as did England and Wales in the widespread use of contracts for differences.

A fourth consideration – not really a lesson because the results are not clear – is whether retail competition is desirable. So far, it seems like a party that few are interested in attending. The theoretical, and even ethical, advantages of consumer sovereignty are clear; but there appear to be transaction costs in switching from the devil one knows. Before whole-heartedly adopting retail competition, a careful review of what end users/voters really want would seem to be in order.

Finally, the biggest lesson of all should be that "not invented here" is not an acceptable principle for developing public policy, particularly for electricity. Whenever California begins to unscramble its electric omelet, it should take the time necessary to do the job right; and this includes deliberate scrutiny of what has and has not worked elsewhere. The end result may be unique to California, but it should not embody repeating history's mistakes.

[9] "Despite the recent drop (in those choosing non-utility retail services), state consumer advocate Sonny Popowsky said the Electric Choice program offers end users with an ideal scenario. When wholesale prices are high, consumers are protected by rate caps. When they drop, end users can shop for the lowest rate. 'The goal is for customers to get the maximum benefit,' Popowsky said. 'If you have the protection of the rate caps, at least consumers are protected.'" (Erie Times-News, 2001)

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Appendix A
Description of Capacity Payments in the England and Wales Power Pool

Under the power pool, the price actually paid to generators also included -- in addition to the energy prices that were determined under the bidding system -- a financial incentive for maintaining some additional (peak load) generation capacity in the event that demand exceeded consumption forecasts. This capacity payment equaled the value of lost load (VOLL) times the loss of load probability (LOLP). The VOLL attempts to

measure the system cost of not producing enough electricity to meet peak load. Another way of looking at VOLL is that it attempts to measure the "extent to which generators are prepared to invest in additional capacity in excess of the actual maximum on the system." The LOLP measures the probability that supply will be insufficient to meet demand at a particular point in time.

The LOLP changes by season and day. The closer demand is to scheduled supply, the higher the LOLP and therefore the higher the capacity payment. Thus, the price paid to electricity suppliers under the pool was the system marginal price (as determined by bidding) plus (VOLL * LOLP). (U.S. Energy Information Administration, 1997, Ch. 2)

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