



The  
Cambridge-MIT  
Institute  
Electricity Project

# 14.23 Government Regulation of Industry

Class 16: Problems of De-regulation - The Case of  
Californian Electricity

MIT & University of Cambridge

# *Outline*

- Markets: by accident or design?
- What is the nature of the electricity market?
- General principles of market design
- The design of the Californian electricity market
- The Californian Power Crisis of 2000
- Lessons for market design

# *A Competitive Electricity Market*

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# *Elements of an Electricity Market*

- Generators
- Transmission Owners
- Independent System Operator (ISO)
- Power Exchange (energy market)
- Balancing Market
- Ancillary Services
- Distribution Companies
- Power Retailers
- Regulators e.g. CPUC and FERC

# *Economics of a Competitive Electricity Market (Hogan, 1998)*

- Short-Run market
- Transmission congestion
- Long-run market contracts
- Scheduling and balancing
- Long term investment
- Access fees to recover embedded costs
- Security concerns and capacity reserves

# *Supply and Demand for Electricity*

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# *Transmission Constraint Costs*

Table: Graphic Removed

Blue and Red are bilaterally  
contracted generation at A

# *Issues in the design of markets*

## *(Chao and Huntington, 1998)*

- Markets are not an accident!
- Primary motivation is to promote long-run efficiency gains through competition that stimulates technical innovation and efficient investment.
- Requires unbundling and new institutions, this will add transaction costs.
- Efficient short run price signals are essential for long run efficiency.
- Market design should exhibit compatibility across regions and consistency across market segments.

# *Issues in the design of markets*

- Policy makers tend to undervalue the importance of customer choice and product diversity in achieving long run welfare maximisation.
- Some long-run decisions will require public intervention because they involve important externalities.
- Informed public policy requires impartial evaluation and frequent monitoring of market performance under different rules and institutions.

# *Key things to be decided*

- Which elements of the industry will be vertically unbundled?
- How much horizontal unbundling will be undertaken? (in generation?)
- Where will competition be introduced? (in retailing?)
- What trades will be banned or regulated? (e.g. voluntary or compulsory trading in pool)
- What protection will consumers (especially domestic) receive? (e.g. price cap tariff with local distributor)
- By what mechanism will market be cleared? (day ahead, real time?)
- Who will oversee the operation of the market and who be responsible for revisions? (governance of ISO or Power Exchange)

# *The Californian Electricity Market*

- California - world's 5th largest economy
- Californian electricity industry \$23bn p.a., 45MW peak demand, 44MW available capacity in CA.
- US political trend setter.
- Leading state for environmental development.
- Overly democratic: frequent public ballot initiatives.
- Three large utilities: PG&E, SCE, SDG&E; (R=9.6,7.9,2bn)
- No new base load capacity between 1987-00.
- Capacity additions came from expensive IPPs.

# *The Background to the Reform*

- Early 1990s recession in California, GSP declined for three years.
- Power prices 50% higher than neighbours and twice the average for the US.
- In 1993 California Public Utilities Commission (CPUC) proposes reform.
- April 1994 CPUC after hearings and forums with the industry, environmentalists and consumers formally opts to pursue full-scale reform.

# *The new institutions of the market*

- The Californian Power Exchange (PX)
  - Conduct day ahead and day of markets wholesale auction for generation and sale of electricity. Prices set hourly, PX price was to be paid to all generators in a given auction.
- Independent System Operator (ISO)
  - Manage the transmission facilities, co-ordinate the flow of PX power as purchased in the day ahead market and the bilateral contract market, charged with maintaining reserves, but PX not allowed to provide it with information for economic dispatch<sup>13</sup>.

# *The Legislation*

- Assembly Bill (AB) 1890
  - 10% rate reduction and 5 year rate freeze to 2002 (PG+E suggestion).
  - Subsidies to renewable energy
  - Stranded costs to be recovered via a competitive transition charge (CTC) if wholesale price below retail price. This implied that there would be no retail competition in the interim.
- Bill passed both houses without a single dissenting voice on Sept 23, 1996. Governor Pete Wilson said ‘we have pulled the plug on another outdated monopoly and replaced it with a new era of competition’.

# *The CPUC's final adjustments*

- Utilities encouraged to divest generation assets in return for higher allowed return on wires businesses.
- Incumbent utilities barred from signing bilateral contracts or hedging contracts to prevent foreclosure.
- Retail rate freeze would end in March 2002 or after the utilities had paid off their stranded assets.
- ISO empowered to run a real-time spot market to secure generation for reliability with no limit on the prices it would pay. This was an additional market which the generators could sell into in competition with the PX.

# *Comparing Pre- and Post-restructuring*

	Pre AB 1890	Post AB 1890
Generation	Utility owned plant Utility purchases	PG&E, SCE and SDG&E retain nuclear plant and renewable contracts. Duke, AES/Williams, Dynergy, Reliant, Southern buy divested plant. Prices set in PX Large users buy power from generators
Transmission	Utility operated system Prices set by FERC	ISO controlled system Prices set by FERC
Distribution	Utility operated system Prices set by CPUC	Utility operated system Prices set by CPUC

New market becomes effective on 1 April 1998.

# *The Anatomy of a Crisis*

- The new market initially functions well: April 98 - April 00.
  - Prices in PX low and PG&E and SCE collect \$10bn towards stranded costs. However redesign was contemplated.
- In the summer of 2000 a number of shocks occurred accompanied by unusually hot weather and transmission lines overheating:
  - Hydro-power shortages (8% of statewide demand)
  - Natural gas shortages (prices rise up to 1600%)
  - Emission controls (electricity demand drove price of NO<sub>x</sub> permits)
  - Demand growth (5%+)
  - Plant outages (up to 10MW)
  - Grid problems (old and unreliable)

**CALIFORNIA PX DAY-AHEAD PRICES**  
 (\$/Mwh: Weighted Averages 7 x 24)

	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>
January	-	21.6	31.8	260.2
February	-	19.6	18.8	363.0 (ISO RT)
March	-	24.0	29.3	313.5 (ISO RT)
April	23.3	24.7	27.4	370.0 (ISO RT)
May	12.5	24.7	50.4	274.7 (ISO RT)
June	13.3	25.8	132.4	103.8 (ISO RT)
July	35.6	31.5	115.3	62.6 (ISO RT)
August	43.4	34.7	175.2	45.2 (ISO RT)
September	37.0	35.2	119.6	35.0 (EST)
October	27.3	49.0	103.2	
November	26.5	38.3	179.4	
December	30.0	30.2	385.6	
<b>AVERAGE</b>	<b>30.0</b>	<b>30.0</b>	<b>115.0</b>	

Table courtesy of Paul Joskow. Used with permission.

Source: Joskow (2001), <http://econ-www.mit.edu/faculty/pjoskow/files/CALELE901.pdf>

## FIGURE 4.11: Energy Emergencies and Blackouts in California

Graphic Removed

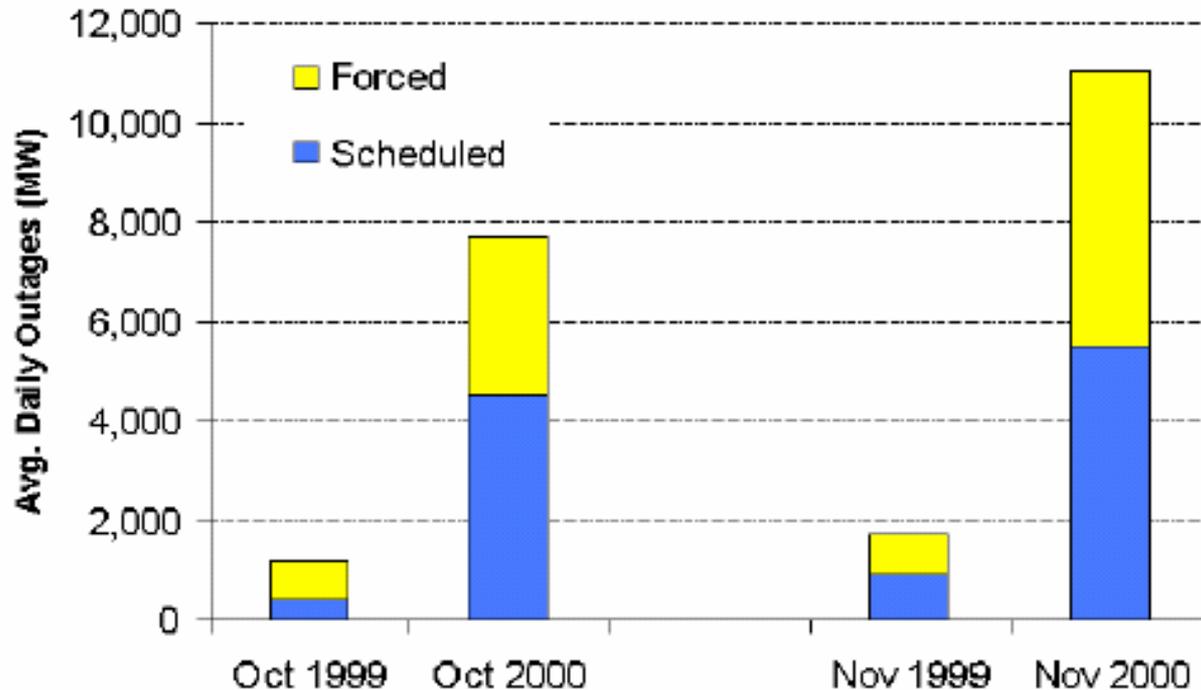
Stage 1: Operating reserves forecast to be below 7%.  
Stage 2: Operating reserves forecast to be below 5%.  
Stage 3: Operating reserves actually below 1.5%.

Source: Sweeney (2002), <http://www.hoover.org/publications/books/fulltext/electricity/145.pdf>

Chart courtesy of Paul Joskow. Used with permission.

# *35% of total capacity unavailable*

Reported Capacity Outages (1999 vs. 2000)



# *The Anatomy of a Crisis*

- Retail rates were frozen, SDG+E rates did rise but large rises in July 2000 caused re-imposition of rate freeze by Sept 2000.
- There was arbitrage between the PX and ISO markets as generators preferred to go into the ISO emergency market and leave the PX.
- In December 2000 FERC declared that IOUs did not have to buy all their power in the PX, the market declined. FERC imposed soft price caps of \$150/MWh.

# *Some ongoing problems*

- Rolling blackouts in January 2001 affecting 380,000 customers and costing \$2.3bn as storm reduces capacity at a nuclear PG+E plant.
- Paying for new supplies (\$12.5bn 2001) - prices raised 1 June 2001, state has been buying power via CDWR.
- Deferred costs - PG+E bankrupt March 2001.
- Overcharging by generators and MW laundering.
- Decreasing consumption - minus 11% May 2001 compared with May 2000 due to weather/suasion.
- New Supplies - 10MW applied for between 1997 and 2000. 32MW expected between 2001-05.

# *Lessons*

- When markets are complex ‘design by committee’ allowed interest group politics, rhetoric to supercede common sense, technical realities and international experience.
- Spot markets work badly when supplies are tight.
- Consumers should be allowed to face wholesale prices and/or their suppliers should be able to sign long term contracts or financially hedge.
- Spare capacity is a public good in an interconnected system and it should be adequately remunerated.
- Where markets overlap, rules should be standardised as much as possible across them (e.g. ‘MW laundering’).
- Allowing efficient investment is critical as this is likely to be one of the biggest benefits of reform.
- Mid-course corrections to market design need to be built into the market re-design process to take account of learning.

# *Next*

- *Introduction to Social Regulation: Externalities.*
- *Read VVH Chap 19.*