

Arbitrage, Risk Management, and Market Manipulation: What Do Energy Traders Do and When it is Illegal?

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Motivation for Talk

- Over past two years, energy traders from a number of companies have pleaded guilty to various charges and/or paid substantial penalties
 - Enron, El Paso Natural Gas, Reliant Energy, Dynegy, Williams
- What do energy traders do and why did they get in trouble with the law?
 - Would they have gotten in trouble if Enron bankruptcy had not occurred?
- What can be done to prevent these actions in the future?
 - Have these steps been taken?

Outline of Talk

- What do energy traders do?
 - Explain several concepts in energy trading
 - Arbitrage
 - Risk management
 - Market manipulation
- Enron's "asset-light" corporate strategy
 - Profiting from "spark spread"
 - Arbitraging transmission congestion
- Enron's Trading strategies
 - Market manipulation versus unilateral market power
- Natural gas market price reporting
- What did energy traders do that was illegal?
- Public policies to make energy traders work for consumers

What does a trader do?

- Buy something he has no intention of consuming
- Sell something he has does not and cannot produce
- A trader profits from buying low and selling high
 - Over time (day-ahead versus real-time market)
 - Across geographic locations (Southern versus Northern CA)
- Can also sell first and buy back later
 - Short selling
- For these reasons, traders often called arbitragers

What does a trader do?

- What is arbitrage?
 - Exploiting price differences over time and across locations
 - Price at location A is \$20/MWh
 - Price at location B is \$30/MWh
 - Arbitrage implies buying at A and selling at B
 - If cost of transporting from A to B is less than \$10/MWh this is profitable
 - In electricity markets, if transmission network is not congested transportation cost is extremely low
 - Electrons flow according to laws physics not laws of economics (path of least resistance)
- Arbitrage can benefit market efficiency
 - Act of buying at A and selling at B will cause prices to rise at A and fall at B until price difference is equals transportation cost
- Arbitrage causes “law of one price” to hold

What does a trader do?

- Different arbitrage strategies imply different magnitudes of risk
 - Buy power for delivery one year from now to sell in spot market one year from now implies significant risk
 - Buy power for delivery tomorrow to sell in spot market tomorrow implies significantly less risk
- A commitment to sell power at a fixed price for 4-year period while buying power from spot market implies enormous risk
 - This is what three investor-owned utilities in California did beginning in April 1998
- Buying power to deliver into a potentially congested portion of the transmission network implies significantly more risk than delivery to a point in the network than is not expect to be congested
- Traders typically to take on more risk if they expect to earn a higher return

What does a trader do?

- Traders can also supply “liquidity” to market
- Liquidity is not a well-defined economic concept
 - Best definition is ability to transact large volumes without incurring significant price movements
- For buyer of a large volume of energy, a trader can arrange transaction with minimal price increase
- For seller of a large volume of energy, a trader can arrange transaction with minimal price reduction
- Trader still profits from difference between price it buys at and price it sells at
- Traders jointly have an incentive to provide liquidity so that market participants will use their services

What does a trader do?

- Traders can also provide risk management services
- Energy buyer would like lowest average energy price and for given variance in energy purchase prices
- Trader can construct a portfolio of financial instruments to achieve this goal for energy buyer
 - Find entities best able bear each type of price risk
 - Nuclear energy unit owner would like to provide flat load shape
 - Sell 24 hours x 7 day per week a fixed quantity of energy at fixed price
 - Combustion turbine owner can provide price spike insurance during peak hours
 - Payout maximum of 0 and $[P(\text{spot}) - P(\text{exercise})]$ per MWh of insurance

What does a trader do?

- Trader constructs a portfolio of forward contracts that achieves buyer's goals
- In this sense trader serves a similar role to a travel agent
 - Arranges complicated portfolio of travel (energy) services that achieves buyers goals at least cost
 - By performing these services for a number of clients, travel agent (trader) may be able to give each client a better deal than they could obtain for themselves

Enron's "Asset Light" Strategy

- Jeff Skilling, former Enron CEO claimed that Enron did not need to produce any energy or own any generation units to be profitable in the energy industry
 - Enron owned no fossil-fuel generation capacity in California
 - Enron primarily owned natural gas pipelines
- Enron simply needed to know what the market participants that did own generation or natural gas producing facilities would do before they did it
 - Take a financial position to exploit this superior information
- Enron devoted significant resources to political influence and information gathering
 - Substantial research on forecasting and optimal bidding
- Market participant with superior information faces the least amount of risk in executing arbitrage strategies

Enron's "Asset Light" Strategy

- Benefits of asset light strategy
 - During early stages of market development there are significant arbitrage opportunities that are not very risky
 - This is particularly true for most experienced and more well-informed traders
 - Enron had significant international electricity and natural gas trading experience before California market started
 - No need to incur significant expense of owning and operating a generation facility to earn substantial profits
 - Can earn substantial profits in glut or tight market, just need to have anticipated these market conditions before others

Enron's "Asset Light" Strategy

- Costs of asset light strategy
 - As market develops other market participants learn about arbitrage opportunities and they become significantly less profitable
 - Competitors can hire away Enron's human capital
 - Greater risks must be taken to have any expectation of maintaining initial profit levels
 - Must find new markets to exploit informational advantage
 - Enron's broadband futures market was a failed attempt at this

Profiting from the Spark-Spread

- All merchant generation owners in California have energy trading affiliates
 - AES/Williams, Mirant, Duke, Dynegy and Reliant
- A gas-fired generation unit provides the owner with the *option* to sell natural gas as electricity
 - To exploit the spark-spread
- Assume the following parameters
 - Firm has a long-term take or pay contract for natural gas
 - The spot price of natural gas is \$2/MMBTU
 - The spot price of electricity is \$30/MWh
 - Heat rate of generation unit = 10 MMBTU to produce 1 MWh of electricity
 - Typical value for generation units in California

Profiting from the Spark-Spread

- Firm can sell natural gas delivered under contract
 - As natural gas in spot market at \$2/MMBTU
 - As electricity at \$3/MMBTU = ($\$30/\text{MWh} / 10 \text{ MMBTU/MWh}$)
- Firm derives \$1/MMBTU more from its natural gas by owning generation unit—Profit from owning facility
 - Sell gas as electricity to earn highest profits
- If spot price of natural gas rises to \$3.50/MMBTU firm should sell gas in spot market instead of producing electricity—Examples from CA
- Note that long-term contract price of natural gas is irrelevant to these decisions
 - Cost of natural gas is sunk, because contract is take or pay

Enron Memos

- On May 6, 2002, the Federal Energy Regulatory Commission (FERC) released a set of three memos provided by Enron:
 - Memo of December 6, 2000, from Enron counsel Christian Yoder and outside counsel Stephen Hall to an Enron senior counsel Richard Sanders describing various Enron trading practices in California. (The Yoder/Hall memo)
 - Memo of December 8, 2000, between the same parties; except for the date, this memo is identical to the December 6 memo
 - A draft memo, never finalized, from other counsel to Enron senior counsel Richard Sanders prepared at various times during 2001, providing further explanations of the Enron trading practices and sometimes correcting the descriptions in the Yoder/Hall memos.
- Enron recently waived any attorney/client privilege. FERC then immediately posted the memos on its web site.
 - They are still there under “Market Oversight and Investigations”

Impact of Enron Memos and Strategies

Enron memos provide undeniable evidence of intent to

Maximize profits = exercise all available unilateral market power

Energy traders are not benevolent providers of energy

No surprise to California, but big surprise to FERC

Biggest problem was names of strategies—Death Star, Get Shorty, Fat Boy, etc.

Politicians and press had a field day with name

By then Enron had declared bankruptcy

Andrew Fastow’s accounting fraud had been revealed

Energy traders were now a disfavored group

Most “Enron strategies” were used all from start of market

No guarantee strategies would earn profit--Gamble on prices across locations, time and products

Some did involve fraud, but this is virtually impossible to detect

Selling Non-Firm Energy as Firm Energy

Impact of Enron Memos and Strategies

Major source of price increases during period June 2000 to June 2001 in California was not due "Enron Strategies"

Not even a significant fraction of these price increases can be attributed to Enron strategies

Strategies were used during period 1998 to 1999 when market in California was perhaps best performing wholesale electricity market in US

Massive price increases during period June 2000 to June 2001 occurred because of withholding of energy from California market by major suppliers

Unilateral exercise of market power

No shortage of energy or generation capacity to serve California

Shortage of regulatory oversight from Federal Energy Regulatory Commission (FERC)--Failure enforce Federal Power Act

See "Diagnosing the California Electricity Crisis" on web-site

After bankruptcy and disclosure of accounting frauds, Enron became a convenient scapegoat for FERC to blame for California crisis (to shift blame from FERC)

Exercising Market Power

- Traders can also exercise market power
 - Line between legal and illegal activities may be crossed
 - Distinction between unilateral coordinated actions
- A market participant or trader exercises market power by taking actions that raise the market price and profiting from this price increase
- Coordinated behavior among firms to raise prices is distinct from exercising unilateral market power
 - Coordinated actions in restraint of trade (price-fixing) are illegal under Section 1 of the Sherman Act
- All firms in all markets attempt to exercise unilateral market power all hours of the day
 - Exercising unilateral market = maximizing profits = serving management's fiduciary responsibility to its shareholders
 - These actions are not illegal under US antitrust law

Market Manipulation

- Market manipulation is not defined under US anti-trust law
- Unclear what market manipulation exactly is
 - Depends on your perspective
 - “Your market manipulation is my exercising unilateral market power”
 - Good political theater to accuse firms of market manipulation
 - Analogy to buying a car, negotiating a raise
- May be able to get some traction on this distinction if firm’s actions significantly degrade system reliability or market efficiency
 - Possible definition is Market manipulation = Actions to raise market prices that harm ability of other firms to deliver energy through transmission network
 - US anti-trust law does not provide much support for this view
 - Financial markets do have prohibitions on this type of market manipulation

Market Manipulation

- Problem for traders--To engage in financial arbitrage under current California design must potentially “falsify information” provided to ISO
 - Example--Trader believes $P(\text{real-time}) > P(\text{day-ahead})$
 - Schedule 100 MWh load and generation on day-ahead basis even though only have 75 MWh of actual load to serve
 - This implies that trader is buying 25 MWh at $P(\text{day-ahead})$ and selling at $P(\text{real-time})$ for a profit of $(P(\text{real-time}) - P(\text{day-ahead})) * 25$
 - This how some traders have been accused of wire fraud and fraud
 - Requires information on actual load served and when this was known to trader
 - Trader transcripts allowed Department of Justice to obtain guilty pleas

Market Manipulation

- Enron trader told Enron plant worker to take plant in Las Vegas (LV Cogen) off line on January 17, 2001, first day of rolling blackouts in California
 - Trader can take financial position that exploits this action by plant worker
- General example of “sick day” problem among generation unit owners
 - Impossible to tell if real reason plant is “forced out” is that it can’t run or because it is profitable for firm for unit not to run
- Futile for regulator to attempt verify if unit can really operate as CPUC attempted to do
 - This is a waste of time and money for same reason that employer does not spend time or money to verify if employee is sick when he or she takes a sick day
 - Human body and generation units are extremely complex machines and it is very difficult for an outside party to tell if they are really able do their job

Reported Capacity Outages (1999 to 2001)

Average Megawatts of Capacity Off-line (Planned or Unplanned)			
Month	1999	2000	2001
January	3068	2423	9940
February	5096	3243	10895
March	5740	3389	13737
April	5739	3329	14911
May	3032	4012	13431
June	1216	2683	6758
July	963	2233	5004
August	878	2434	4229
September	1195	3621	5287
October	1761	7633	8805
November	2988	10343	12199
December	2569	8988	11112

Current Average MWs of Capacity Off-line Significantly
Less than Comparable 2000 and 2001 Levels

Profiting from Congestion

- Silverpeak incident resulted in Tim Beldon (Enron trader) pleading guilty to conspiracy to commit wire fraud in late 2002
 - Neither FERC nor Department of Justice did anything about this at the time it occurred in early 1999
- Congestion management in California market
 - If more suppliers wanted to schedule more energy into California than could be carried over the transmission line then
 - The day-ahead price outside of California would be reduced
move down willingness-to-supply curve of those firms
 - The day-ahead price inside California would be increased to
move up the willingness-to-supply curve of instate firms

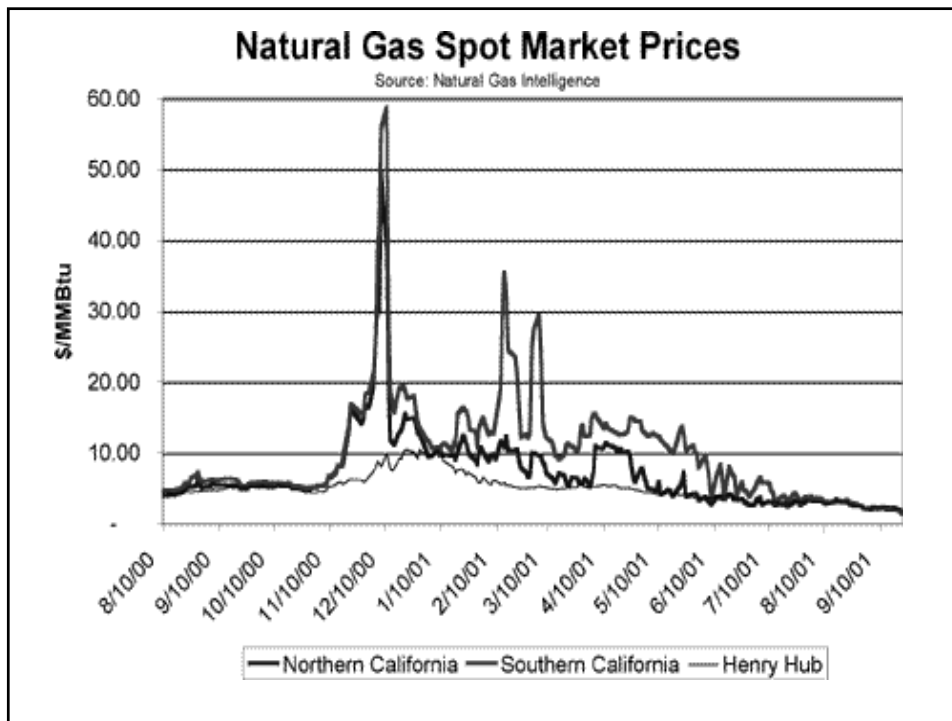
Profiting from Congestion

Beldon scheduled 2,900 MW over a line that could only transfer ~20 MW

- This caused a massive increase (approximately 70%) in the day-ahead price in California (total wholesale energy payments rose by ~\$6 million)
- A supplier can schedule more than capacity of line because net flows are what matter to system operation (this is true in all US markets)
 - 2,900 MW into CA and 2,890 out of CA implies a net flow into the state of 10 MW
 - However, it is highly unlikely someone would schedule a counter-flow of this magnitude
- Major reason price rose so much in California is that insufficient bids to manage congestion were submitted in day-ahead market
 - Following this incident, CA load-serving entities submitted a significantly larger quantity of bids to manage congestion into state across all interfaces
 - Was this market manipulation?

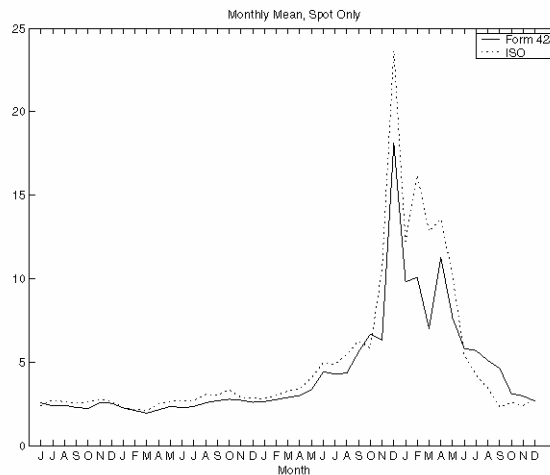
Natural Gas Problems

- There are no anonymous centralized markets for natural gas in Western US
- Transactions are primarily bilaterally negotiated
- Information on transactions prices primarily collected by industry press from self-reports by traders
- During crisis period (December 2000 to June 2001) FERC allowed price of natural gas to be used as justification for higher bids into electricity market
 - Over objections of many independent observers, FERC implemented a soft price cap
 - If supplier could cost-justify a bid higher than \$150/MWh and was needed to serve demand, it could be paid as-bid for power
- Traders recognized that one way to enable themselves to bid higher in electricity market is to make gas price index higher



Natural Gas Problems

- Simple solution—Report higher transactions prices to industry publications to raise index
 - During period of soft cap average price difference between California and Henry Hub (in Louisiana) was \$8/MMBTU
 - Before soft cap period average price difference was roughly \$0.50/MMBTU, which is FERC-regulated cost of transportation from Henry Hub to California
 - Average price of natural gas from April 1998 to June 2000 was approximately \$2.75/MMBTU
- A comparison of these price indexes to prices paid by non-merchant gas-fired units in California over soft-cap period shows significantly higher prices for the industry indexes relative to average prices paid by non-merchant plants
 - No significant difference in prices before and after crisis period



Natural Gas Problems

- When FERC asked companies if their employees ever reported fake trades
 - Some companies reported that they were “shocked” to learn that some of their employees reported fake trades
- Commodity Futures Trading Commission (CFTC) subsequently found practice of reporting fake trades to be epidemic and systematic
 - 18 energy companies agreed to pay \$250 million in fines
- FERC has little, if anything, to make traders and their employers responsible for reports to industry publications
 - Many fixed-price forward contracts for gas delivery clear against these prices
 - Many forward contracts for gas delivery are based on spot prices computed based on these indexes

Natural Gas Problems

- It is only a matter of time before market conditions once again make it too tempting for traders and their employers to inflate or deflate their reports
- Enron’s Legacy—Energy trading not subject to CFTC oversight as a result of Enron’s lobbying efforts
 - Argument was that energy trading was primarily for physical delivery
 - All trades are over the counter, not through formal market such as New York Mercantile Exchange (NYMEX) or Chicago Board of Trade (CBOT)

Remaining Anti-trust Issues

- What constitutes “coordinated actions in restraint of trade” by power marketers
- How much information exchange is necessary to complete trades?
- How much information exchange allows “coordinated actions” among firms to raise prices?
- Hard to see how firms could have been as successful as they were at raising prices during crisis without some mechanism for exchanging information
- Explicit collusion among traders seems unlikely and unnecessary to explain June 2000 to June 2001
 - See “Measuring Unilateral Market Power in Wholesale Electricity Markets: The California Market 1998 to 2000” from web-site

Remaining Anti-trust Issues

- Enormous volume of trading, many times of amount energy consumed, suggests that marketers and generators derive some “intrinsic value” from trading
- Sample conversations between traders
 - “Cut that ... output! Get them prices up!”
 - “Let’s see how much we can move the price by reducing our output this hour.”
- How to deal with firms that consciously take actions to harm system reliability or market efficiency
- US or State anti-trust law may be too blunt and slow-moving of an instrument to deal with these problems

Public Policies to Control Problem

- Every hour of every day suppliers and traders attempt to exercise all available unilateral market power
 - This is a fact of life in all markets
- FERC and Commodity Futures Trading Commission must establish standards for communication between traders to prevent exchange of information that can allow suppliers to raise prices
 - Similar standards exist in securities markets
- FERC must impose reserve right to validate all forward electricity transactions
 - Price reports to industry publications can be randomly verified by FERC with penalties for fraud
 - Without these safeguards traders are likely to inflate prices when it becomes profitable to do so

Public Policies to Control Problem

- Disclose all information used by grid operator to run market in real-time
 - All bids, schedules and output levels in wholesale electricity markets
 - All flows on pipeline in the case of natural gas
- Keeping information on operation of grid confidential only benefits those able to pay the cost to collect it and therefore exploit it
 - FERC's data release policy allowed market power problems in California to persist and develop into full-fledged crisis
 - FERC required all market data to be kept confidential
 - Made "sunshine regulation" of market participant behavior impossible

Public Policies to Control Problem

- Establish process for determining market manipulation similar to what exists in financial markets
- Require load-serving entities to purchase a substantial fraction, greater than 90% of expected energy demand, in fixed-price forward contracts far in advance of delivery
 - Fixes revenue stream of supplier so that it shares desire of consumers to have lowest possible spot prices
 - Until it covers it forward position with energy production from its generation units
 - Eliminates incentive for suppliers to declare sick days
 - Eliminates incentive for suppliers to cause congestion
 - Spot electricity markets are almost by definition very thin, so a prudent strategy is to limit participation in these markets
 - Lessons learned by all other international markets, but not US
- Foster active demand-side participation in market
 - Make final consumers more sophisticated players

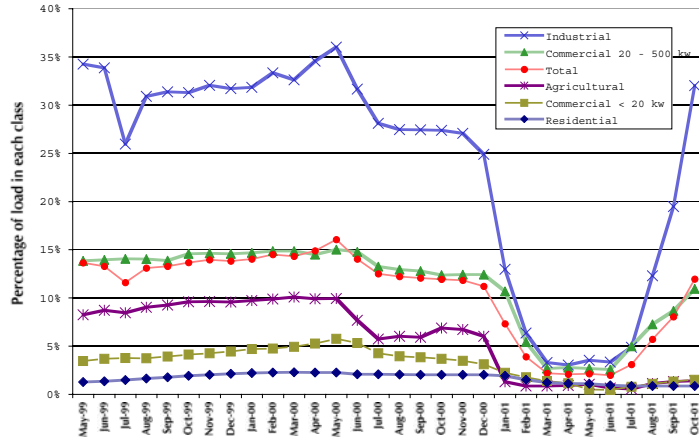
Can Consumers Play in the Market?

- To the extent that regulatory process allows them, they are already do
 - Reduction in demand in response to increase in fixed retail rates in early 2001
 - California's 20-20 program--Roughly 1/3 of California consumers qualified for rebates
- Extremely dull price incentives were surprisingly successful at making wholesale market performance improve

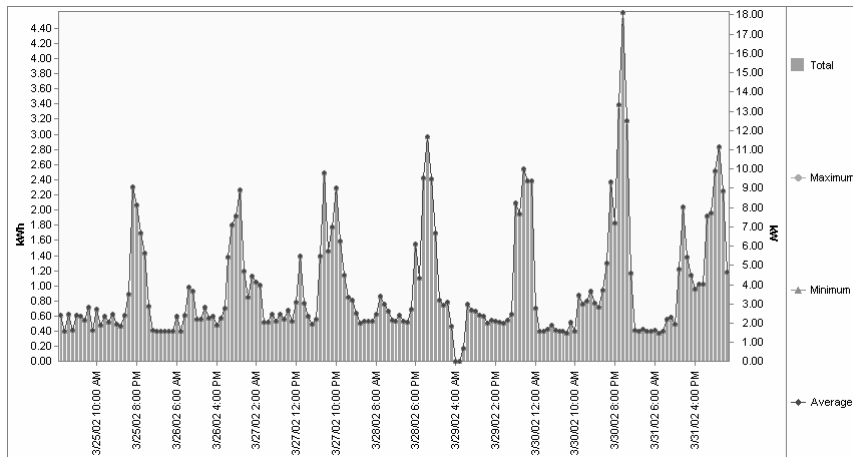
Consumers very sophisticated to the extent they are allowed



Customers Choosing Non-Utility Service by percentage of class load

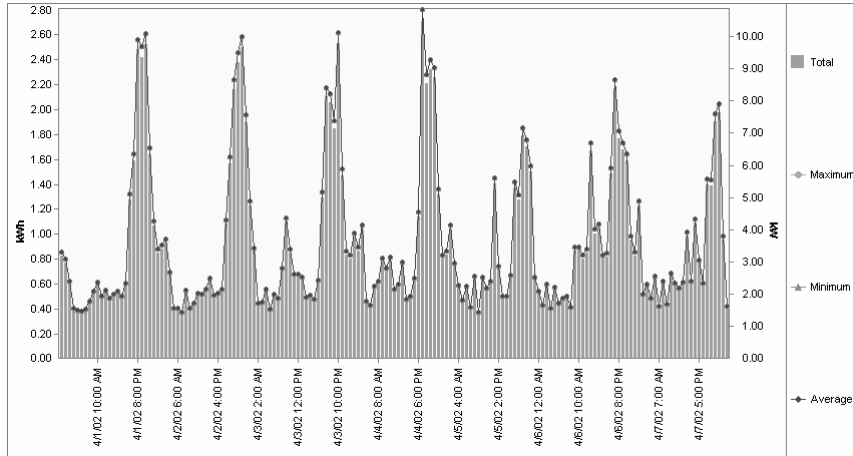


Even Residential Consumers Can Respond



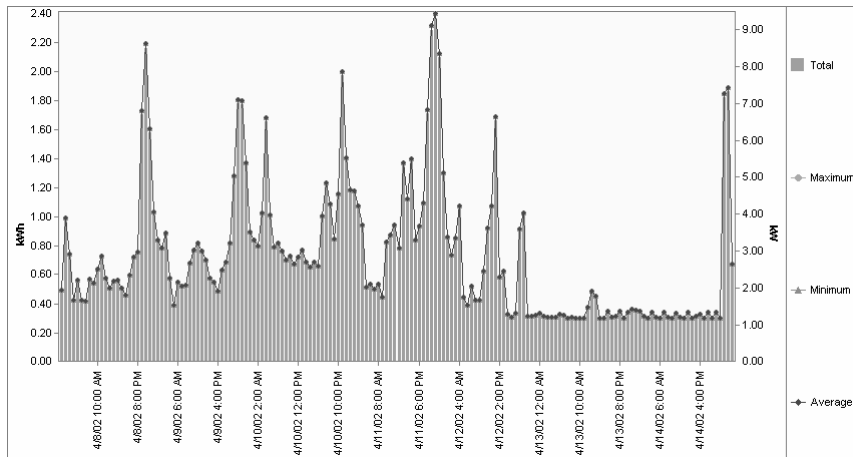
Weekly Consumption Monday to Sunday

Even Residential Consumers Can Respond



Weekly Consumption Monday to Sunday

Even Residential Consumers Can Respond



Weekly Consumption Monday to Sunday

History May Be Repeated

- Despite all of problems in California market during June 2000 to June 2001, few lessons have been learned
 - California Public Utilities Commission (CPUC) is backing off requirement that load-serving entities engage in adequate forward contracting
 - Excess focus of building generation units, not on preventing them from being withheld from market to raise spot prices
 - Generation units are costly to build and must be pay for if build and produce harmful emissions if they are operated
 - In hydro-based and import dependent market capacity problem are not major risk, withholding of energy is
 - Energy problems are solved by adequate forward contracting

History May Be Repeated

- Despite obvious benefits of active demand-side participation in wholesale market
 - During period in summer and autumn of 2001 California installed real-time meters on all customers with peak demands above 200 kW at California taxpayers' expense
 - Large industrial customers
 - CPUC has not implemented a single tariff that allows customers to benefit from active participation in wholesale market
 - Fixed-price customer still pays volatile wholesale price, but has no ability to benefit altering consumption in response to it
 - With active demand-side participation in wholesale market and adequate forward contracting, California can get by with less capacity and serve the same number customers at a lower average cost

Example--US Airline Industry

- Load Factors = (Seats Filled)/(Seats Total),
 - In regulated regime highest load factors approximately 55% in 1976
 - Pre-9/11/02, load factors were close to 75%
- This increased capacity utilization rate allows real average fare per passenger-mile to be significantly less than under regulated regime
- Regime works because of large number of sophisticated price-responsive consumers.

Competition Can Benefit Consumers

- Benefits from re-structuring must come from a change in behavior of market participants
 - Firm operate more efficiently
 - Short-term operation at least cost
 - Investment decisions based on market signals
 - Consumers must actively manage electricity spot price risk or pay retailer to do it for them
 - Market makes use of existing generating capacity more efficiently--serve more customers with less capacity
- Energy traders can increase benefits from wholesale competition that consumers receive if safeguards recommended above are place

Questions and Comments?
For more information see
<http://www.stanford.edu/~wolak>