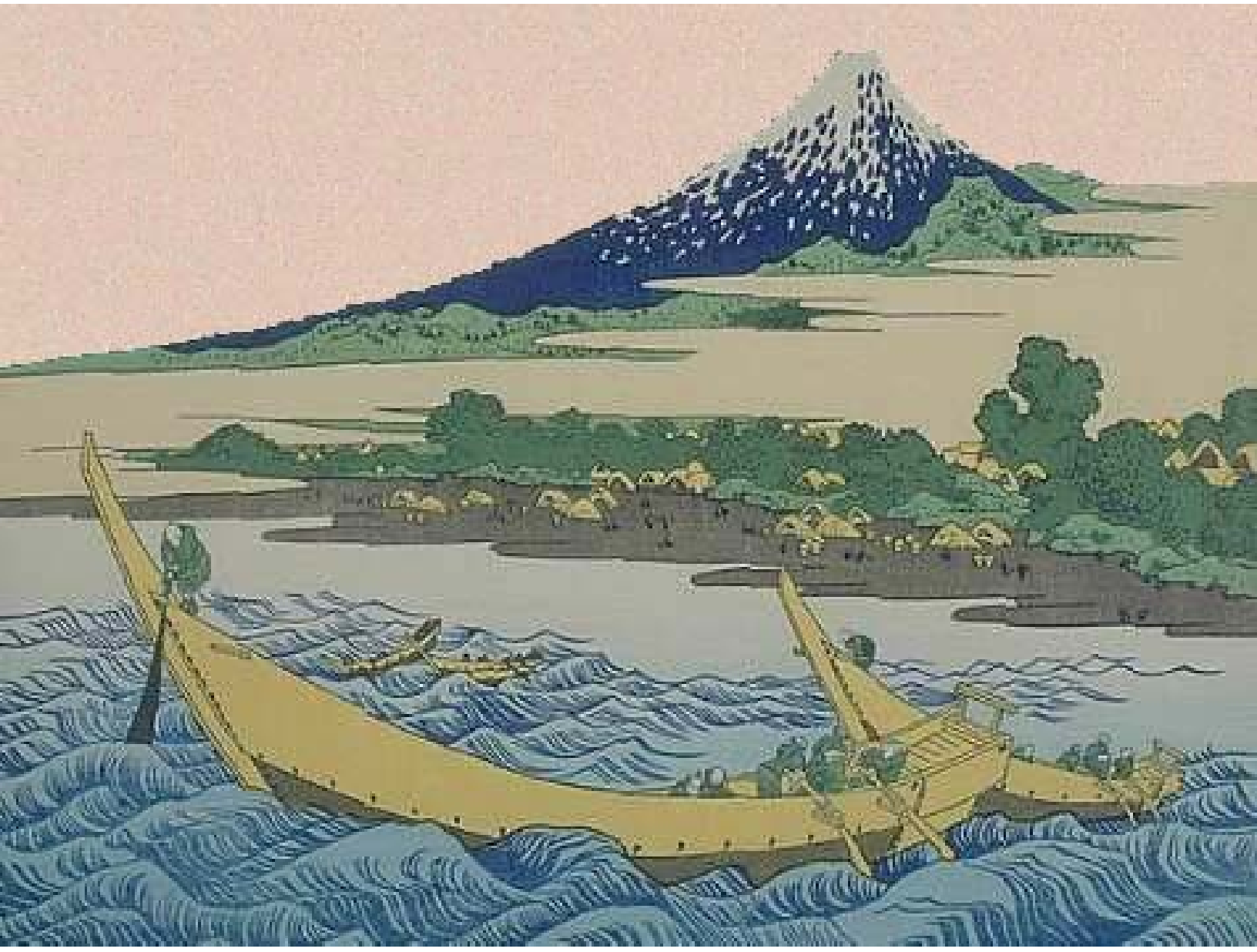
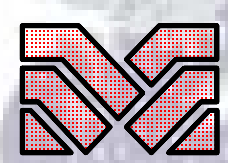


Tsunami:
Western Power Market Prices Since May 22, 2000

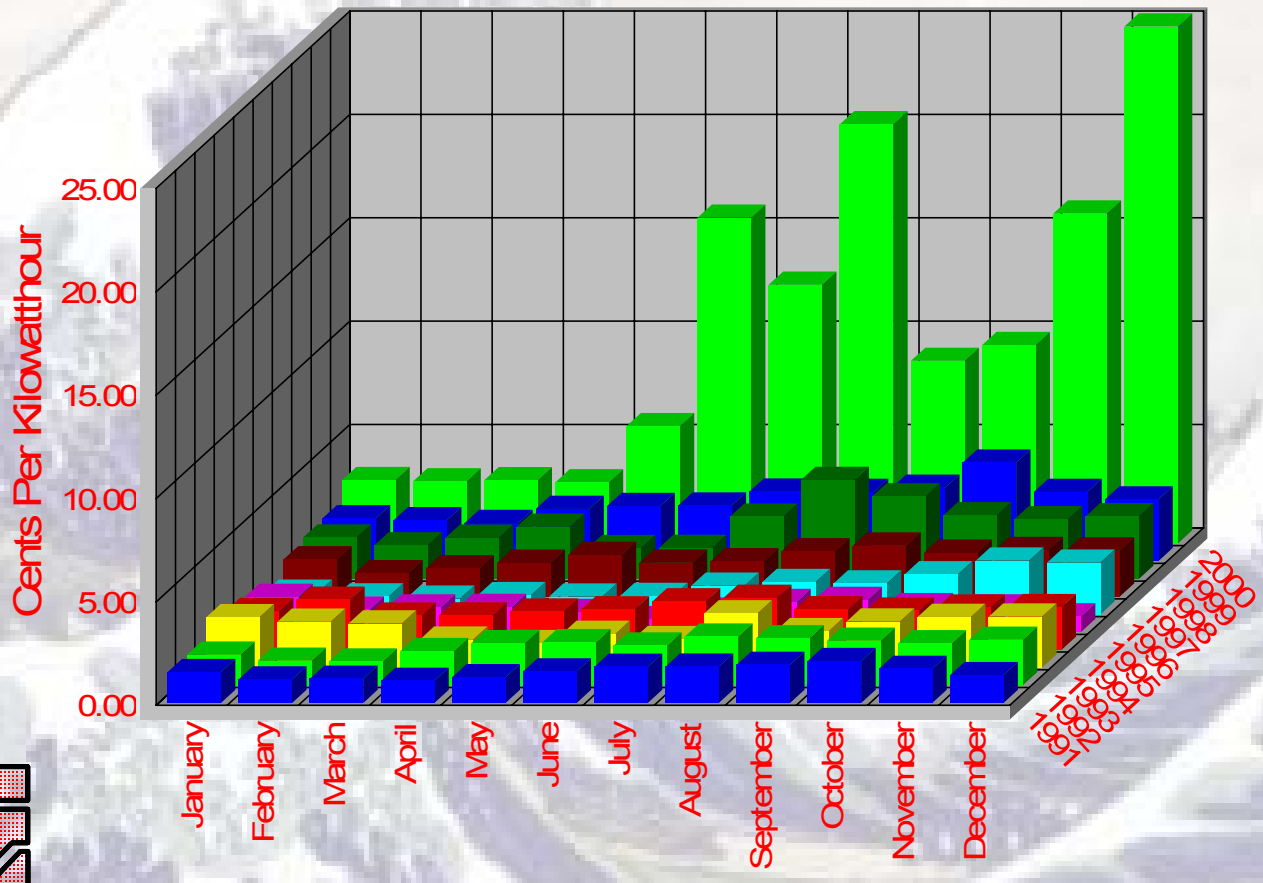
Robert McCullough
Managing Partner
McCullough Research

Tsunami

- Power Markets 2000
- The Three Spikes
  - California On-Peak
  - California Off-Peak
  - Regional Off-Peak
- Current Events
- Resource Mix Changes



Twenty Years

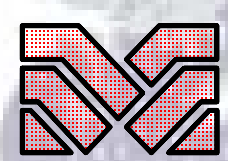


A Short Lesson In History and Geography

- How did we get here?
- What happened before AB 1980?
  - The start of the competitive bulk market in electricity
  - PURPA
- AB 1890
- Where are we?
- How does all this fit together?

Fifty years when nothing happened

- 1934 through 1979
- Customers arrived
- Rates generally fell
- No major institutional changes



What happened before AB 1980?

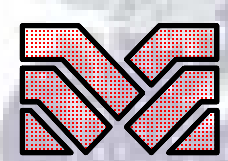
- The competitive bulk power market
- PURPA

The competitive bulk power market

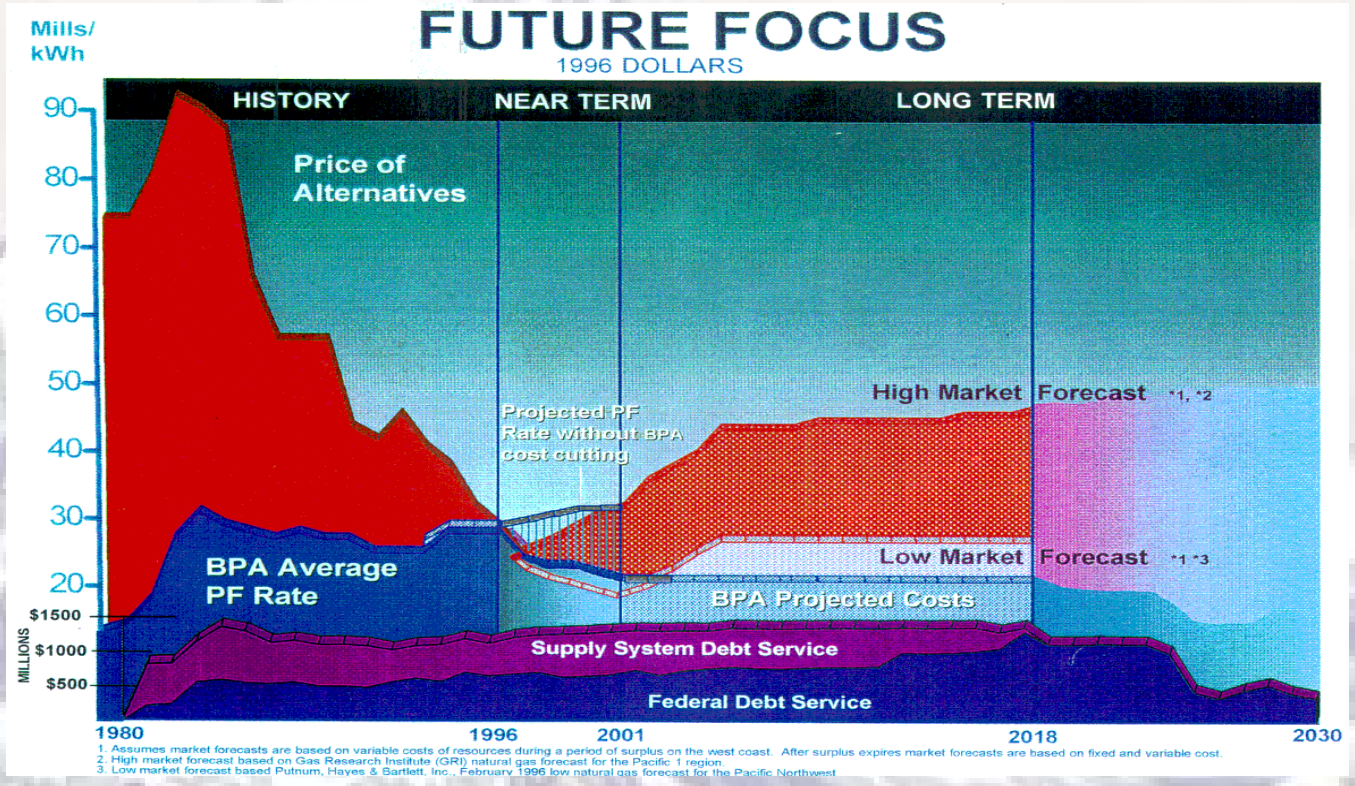
- Started in 1980 with the Regional Power Act
- Smoothly represented the operating cost of the most expensive thermal plant operating until May 22, 2000
- Continues to operate without governmental supervision (with the exception of California and Alberta)

PURPA

- Jimmy Carter's most brilliant legacy
- Opened the generation market to free enterprise
- Lowered base load generation costs from $1,000 to $2,000 per kilowatt to $500 today

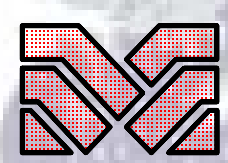


BPA's Past and Future



AB 1890

- Senator Peace's brilliant compromise
- May a hundred provisions bloom, may a hundred agencies contend
- Purportedly the creation of competition, the law brought into place one of the most comprehensive interventions of government into business in U.S. history

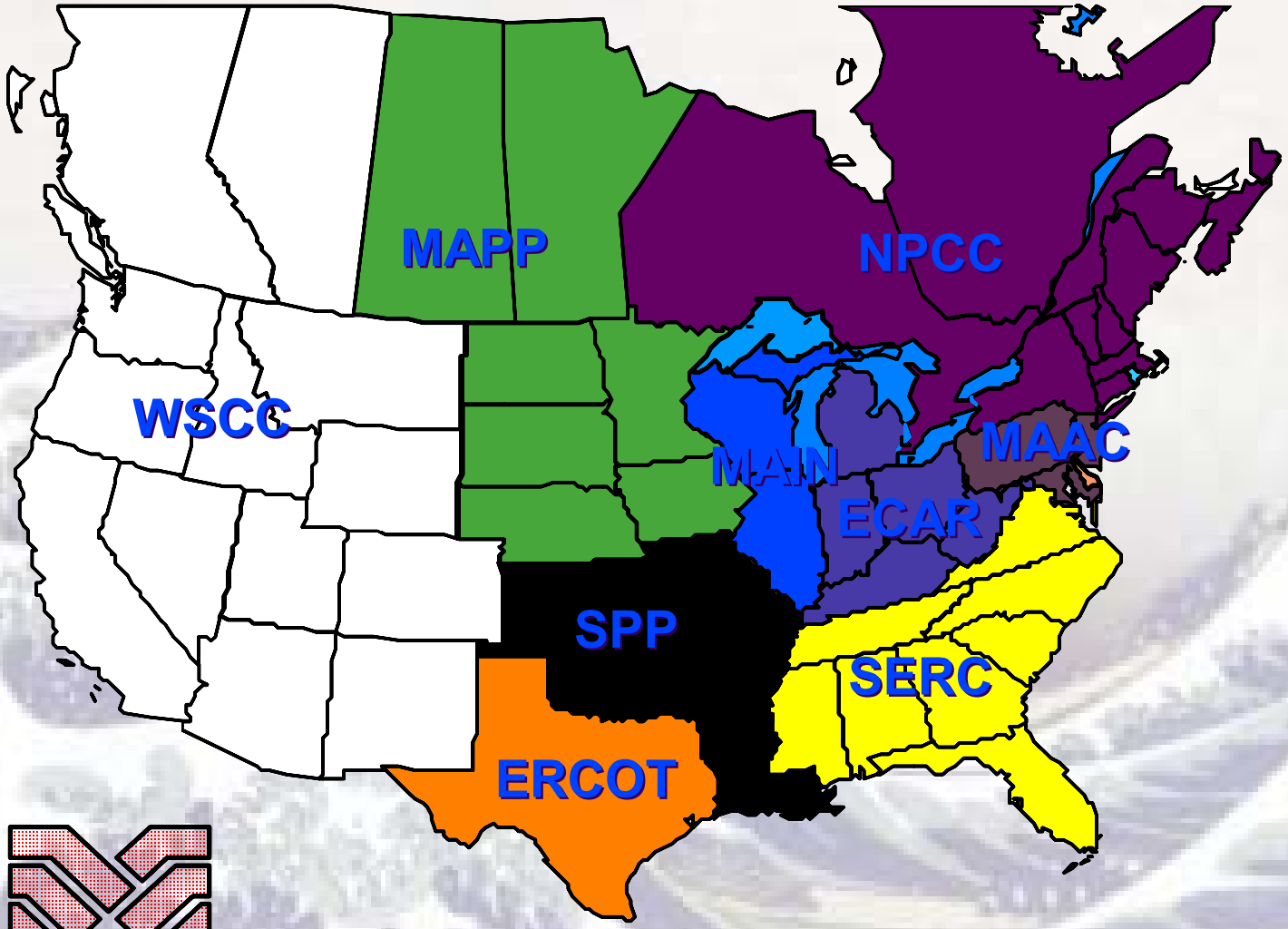


California's System

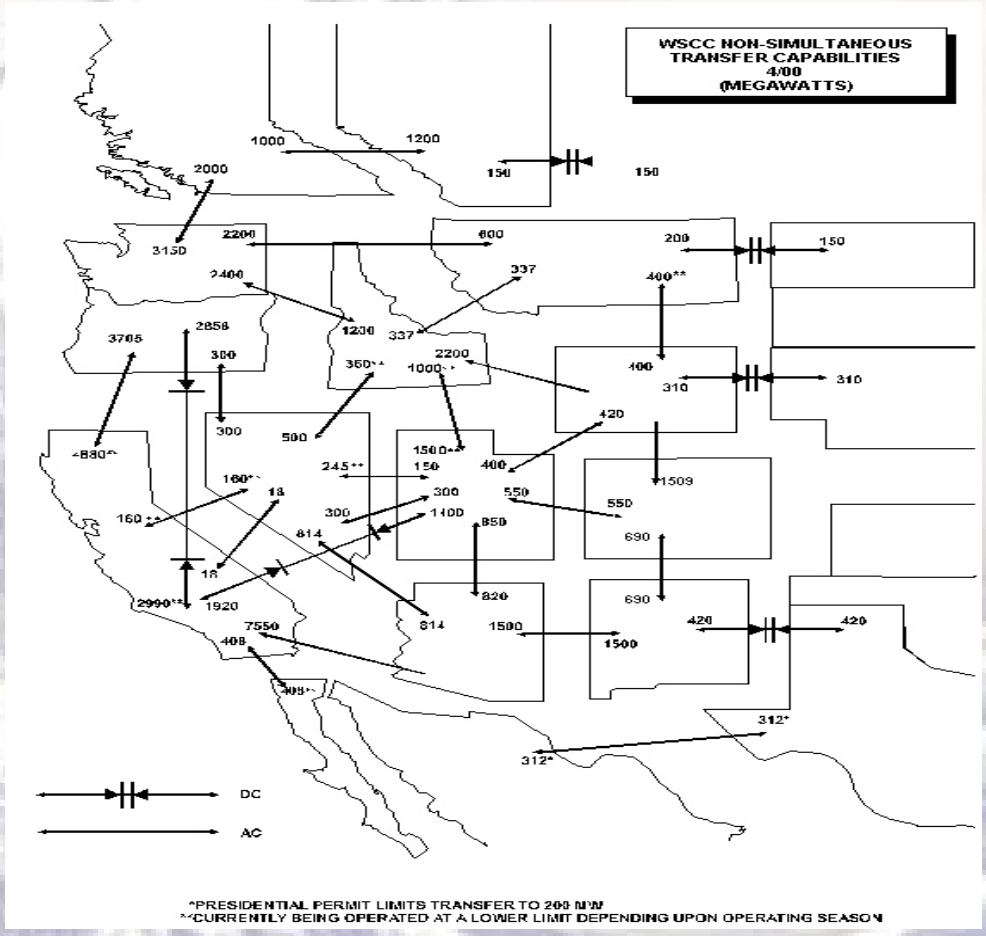
Prices

Where are we?

- The west coast of the U.S. and Canada is a single integrated electric market
- Prices in California this summer have driven prices from Edmonton to Tijuana
- California driven price increases have made transmission costs insignificant by comparison


MAPP
NPCC
WSCC
MAIN
MAAC
ECAR
SPP
SERC
ERCOT

West Coast



*PRESIDENTIAL PERMIT LIMITS TRANSFER TO 200 MW
**CURRENTLY BEING OPERATED AT A LOWER LIMIT DEPENDING UPON OPERATING SEASON

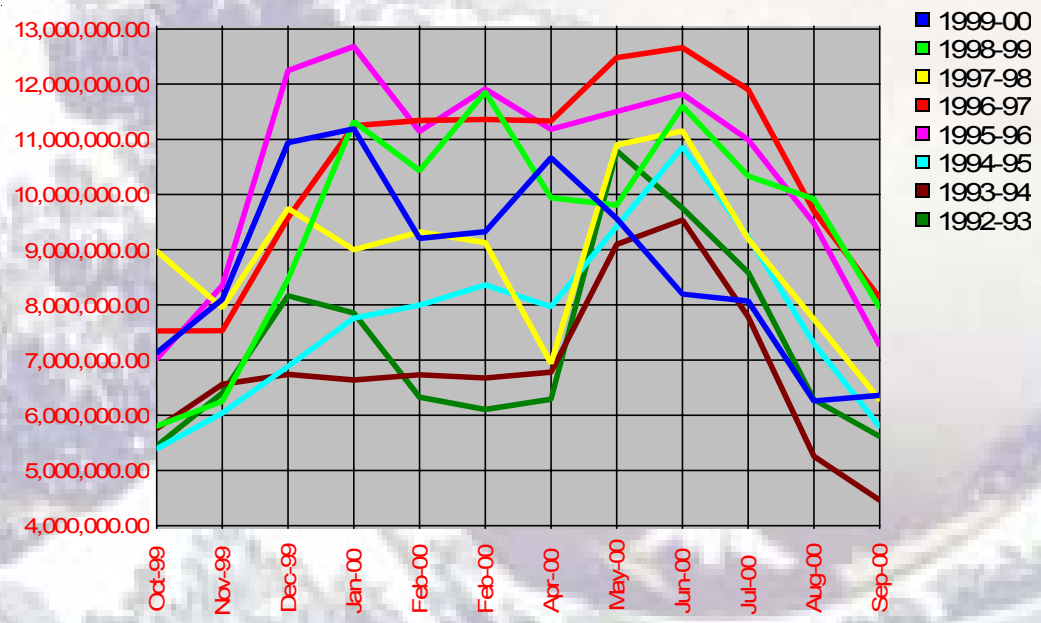
How does all this fit together?

- California imports power in the summer
- The Pacific Northwest imports power in the summer
- Overall, the capacity surplus is large
- Energy surplus floats with regional hydro

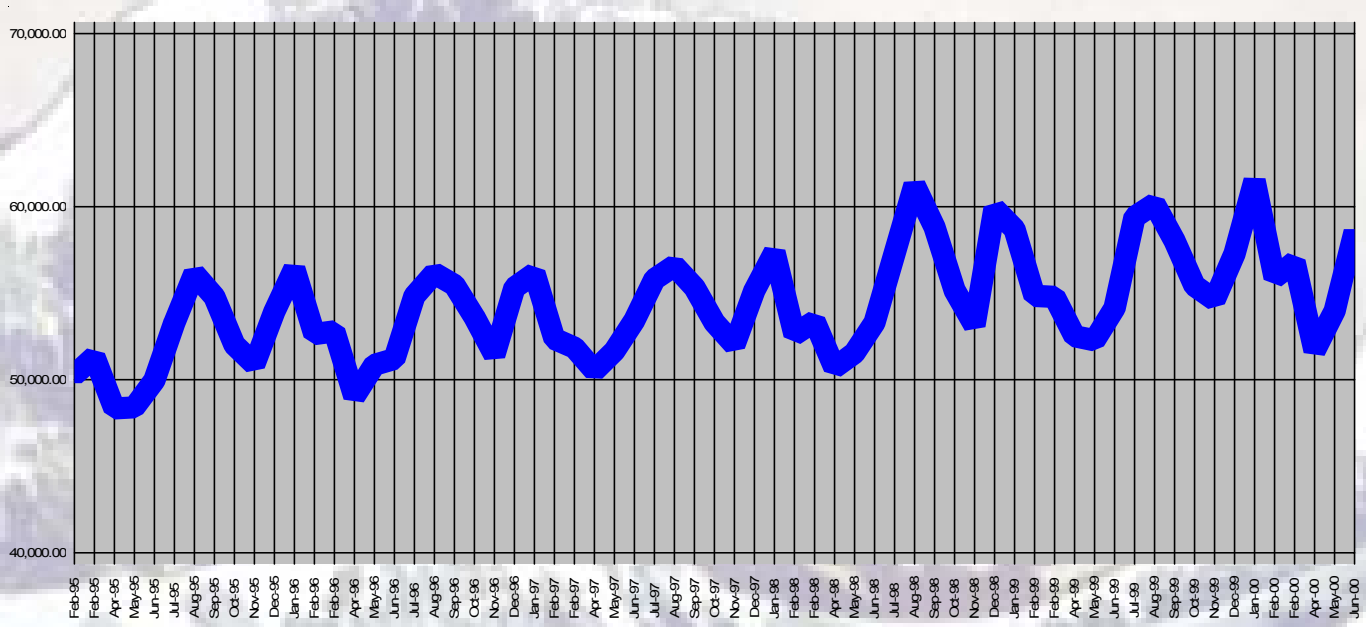
Basic System Ops 101

- Prices -- both on-peak and off-peak have wildly diverged from fundamentals
- We have no evidence of shortage other than price
- Prices are inefficient -- they do not reflect the cost of new generation or the availability of substitutes
- We cannot be both surplus and deficit -- either we face interruption or an exercise of market power

Regional Hydro



WSCC Loads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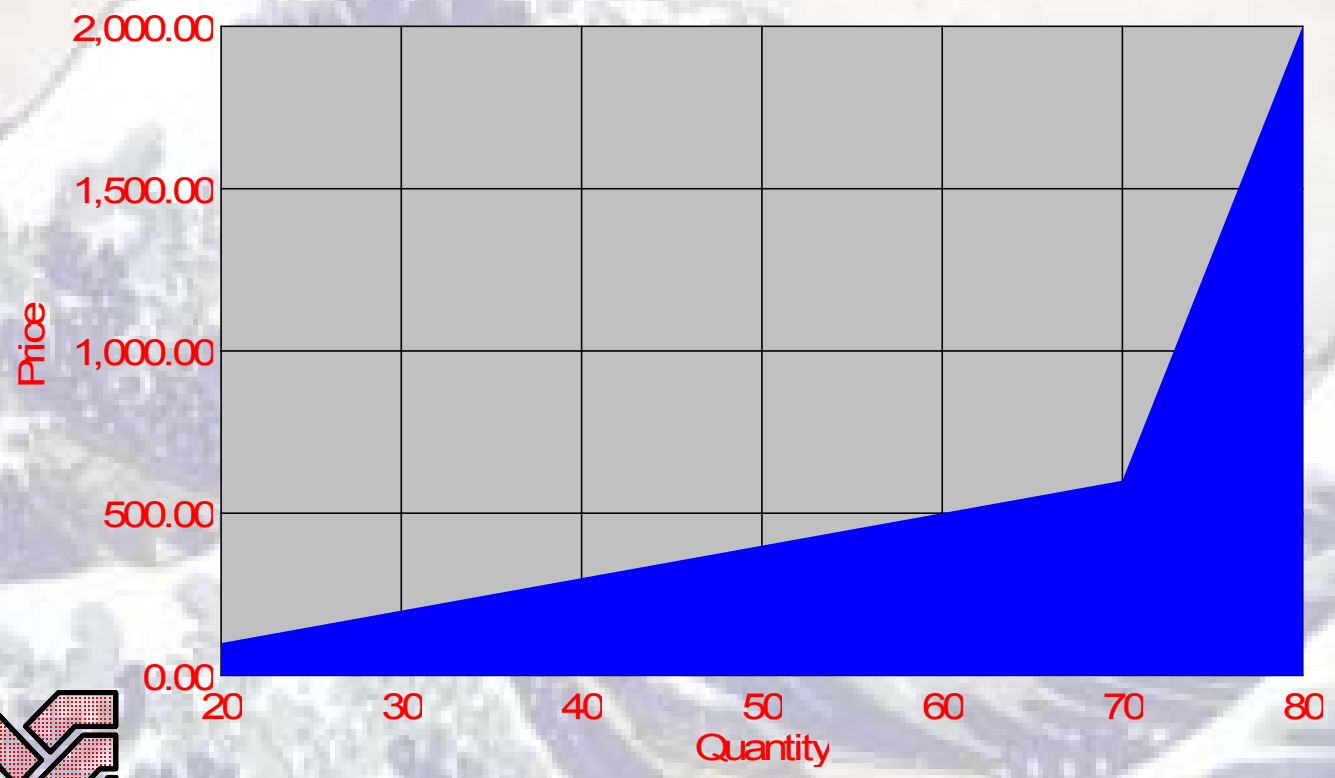
May-00
Jun-00

Basic Economics

- With the exception of California and Alberta, the WSCC resembles a traditional commodity market
- Commodity markets reflect short term marginal cost (in our case fuel cost) until capacity limits are reached
- When a capacity limit is reached, prices increase until alternatives become preferable

Commodity Supply Curves



Data Availability

- In spite of efforts by the California ISO and other parties to make data availability difficult most data is available
- Almost all large plants are available on a three month lag from the EPA
- The WSCC's EHV database is available with great difficulty and seems to have limited utility
- FERC and EIA database provide monthly generation and cost data for the great majority of utility and non-utility plants
- Utility loads -- especially Canadian utilities -- are a problem

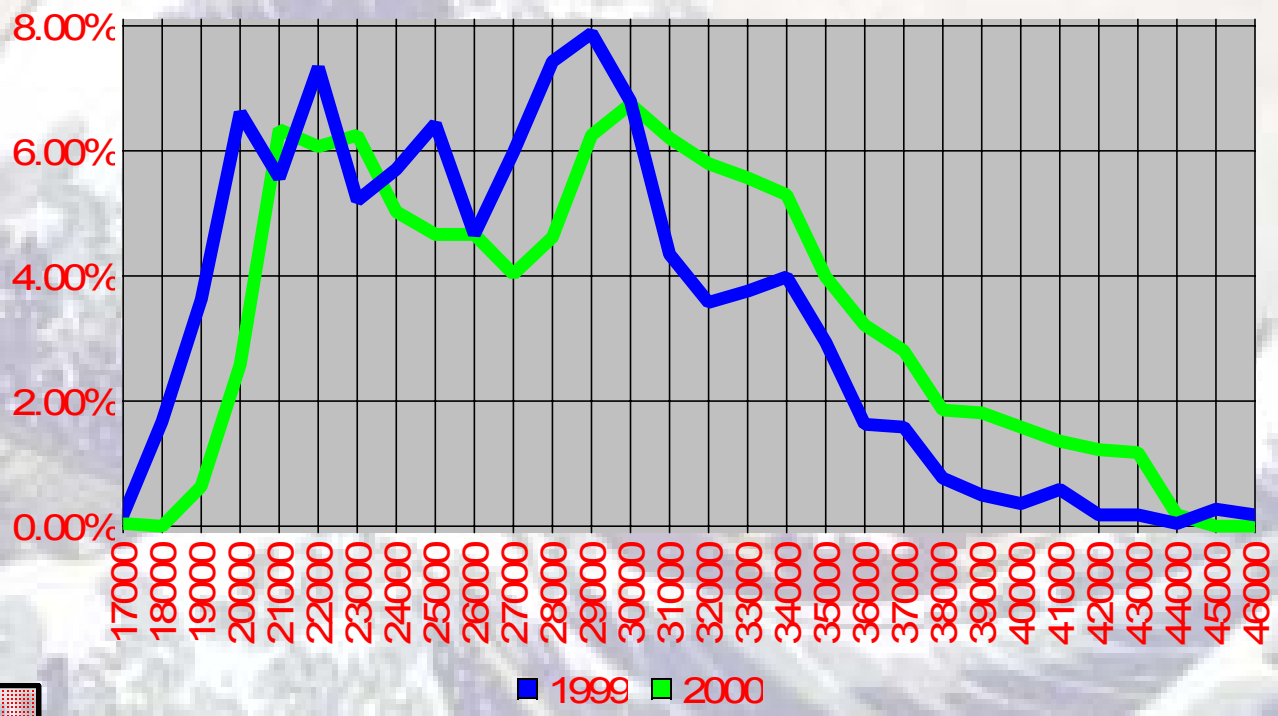
The Three Spikes

- California On-Peak
- California Off-Peak
- Regional Off-Peak

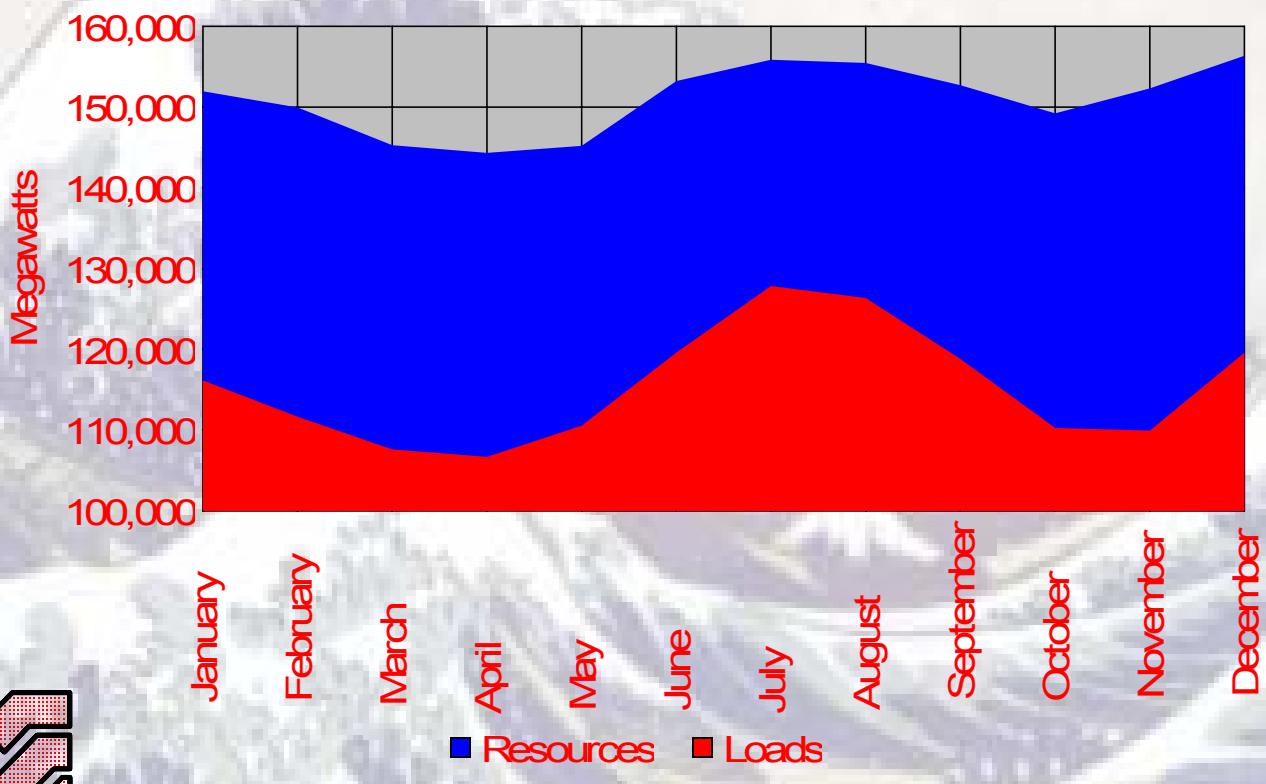
California On-Peak

- ISO perceptions of shortage are proving very subjective
- Inadequate ISO methods are securing scarcity in the midst of abundance
- Overall, in the contest between the ISO and the WSCC, the ISO is failing to prove their case

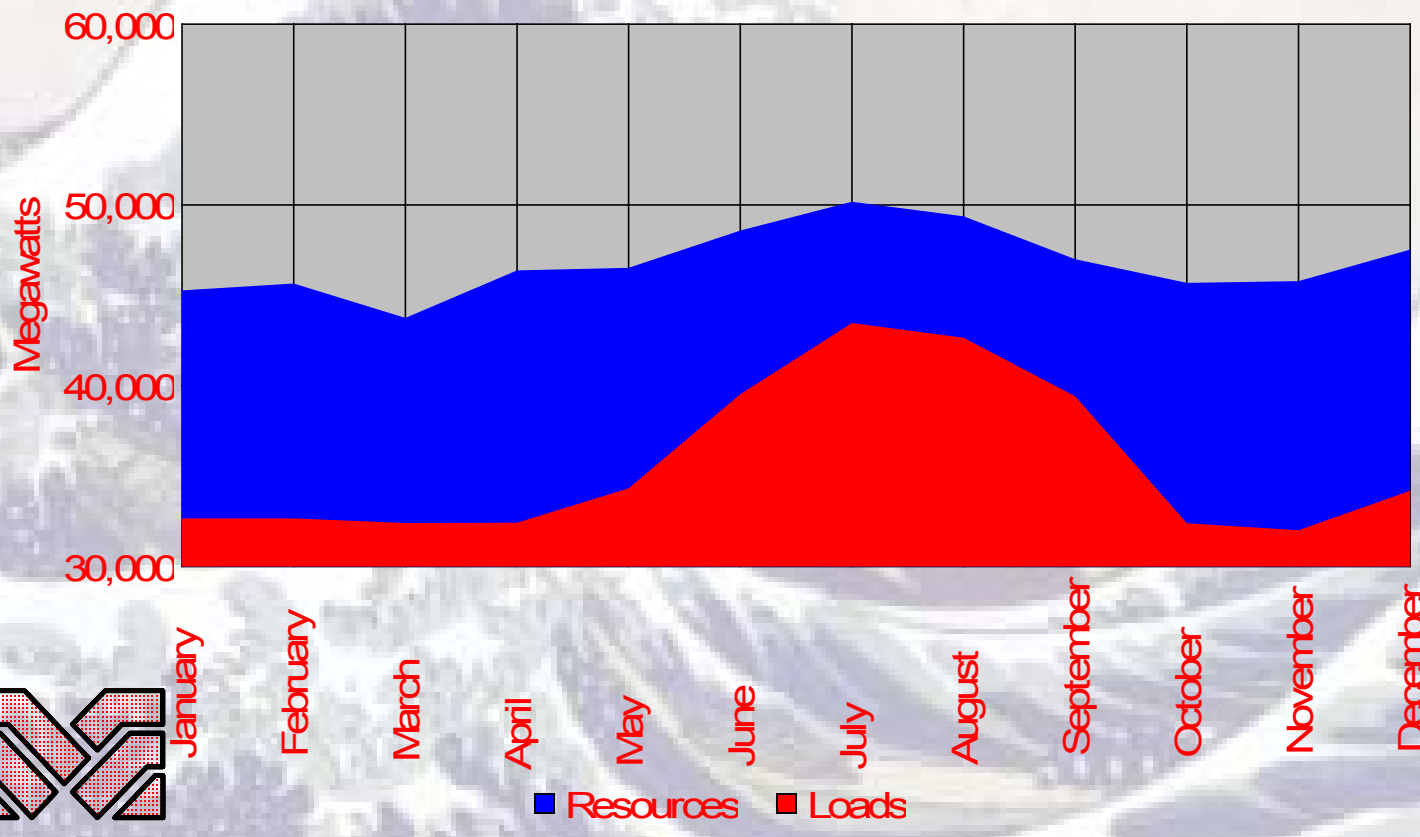
ISO Loads:
May Through July



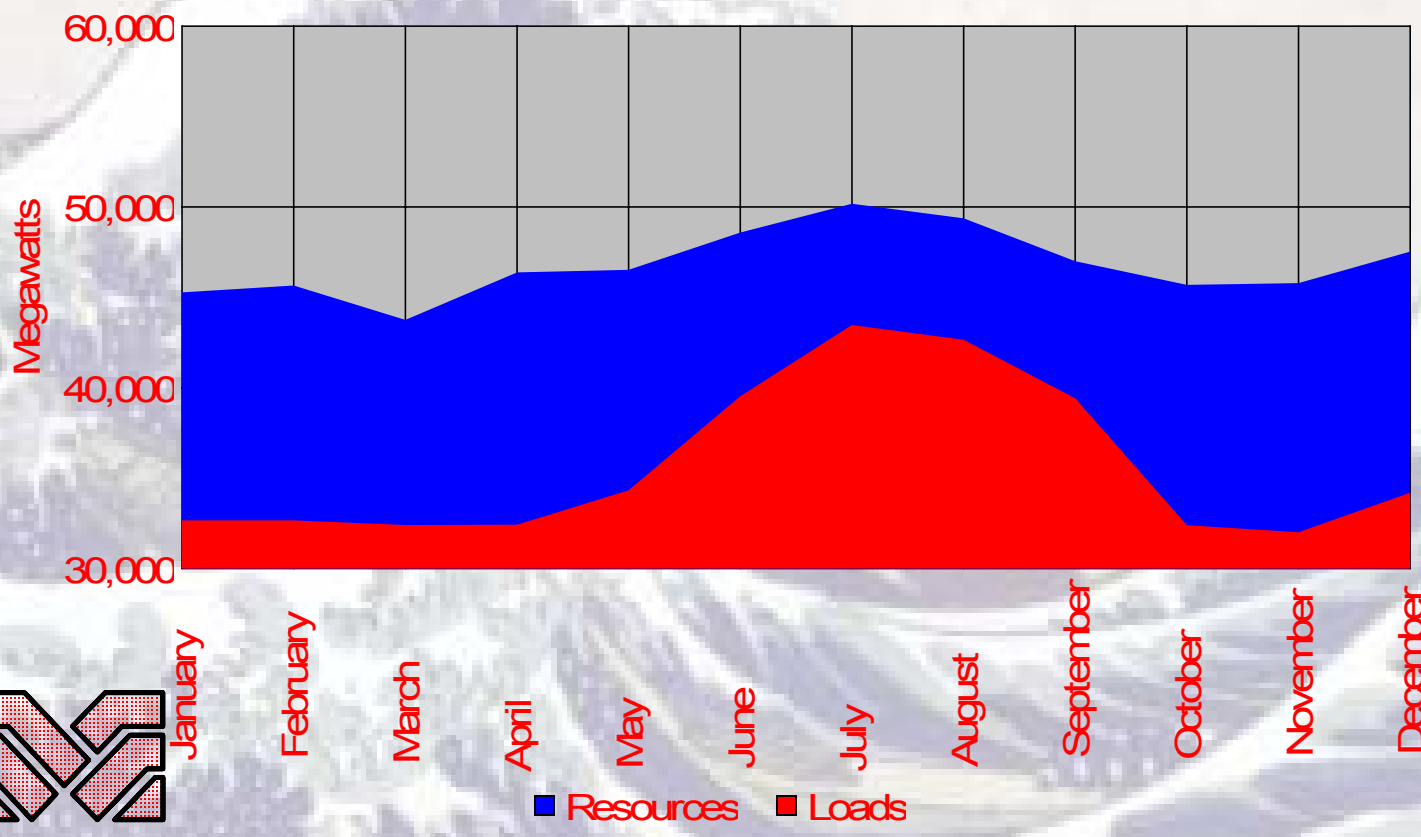
WSCC Capacity Balance



California Capacity Balance

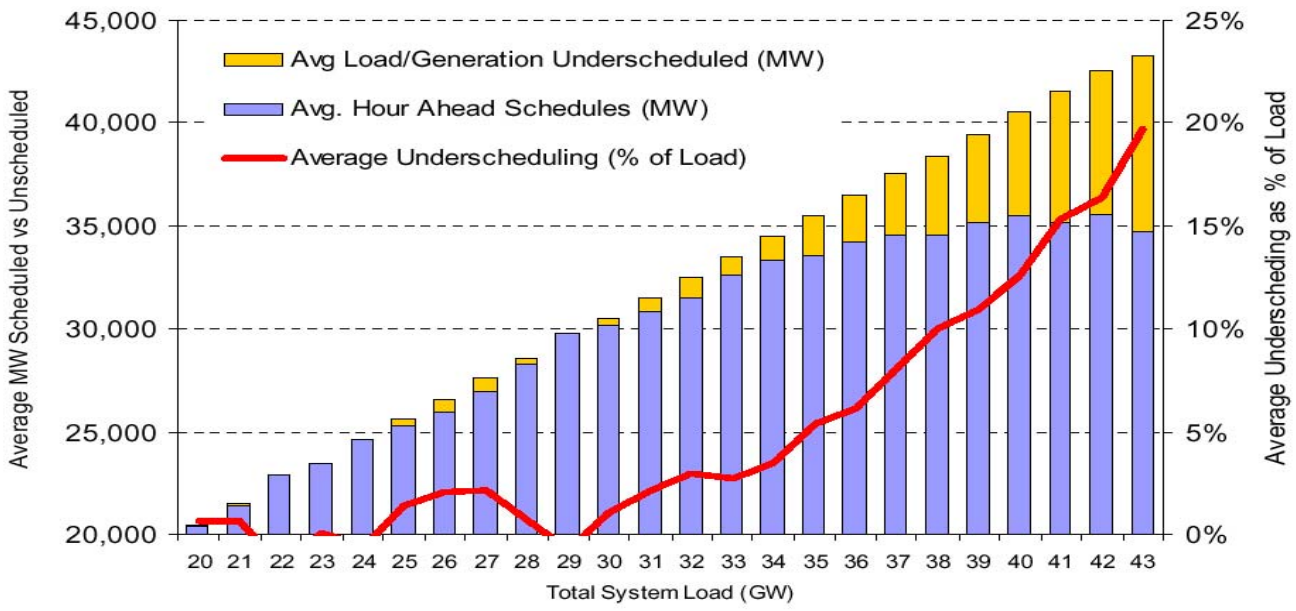


ISO Capacity Balance

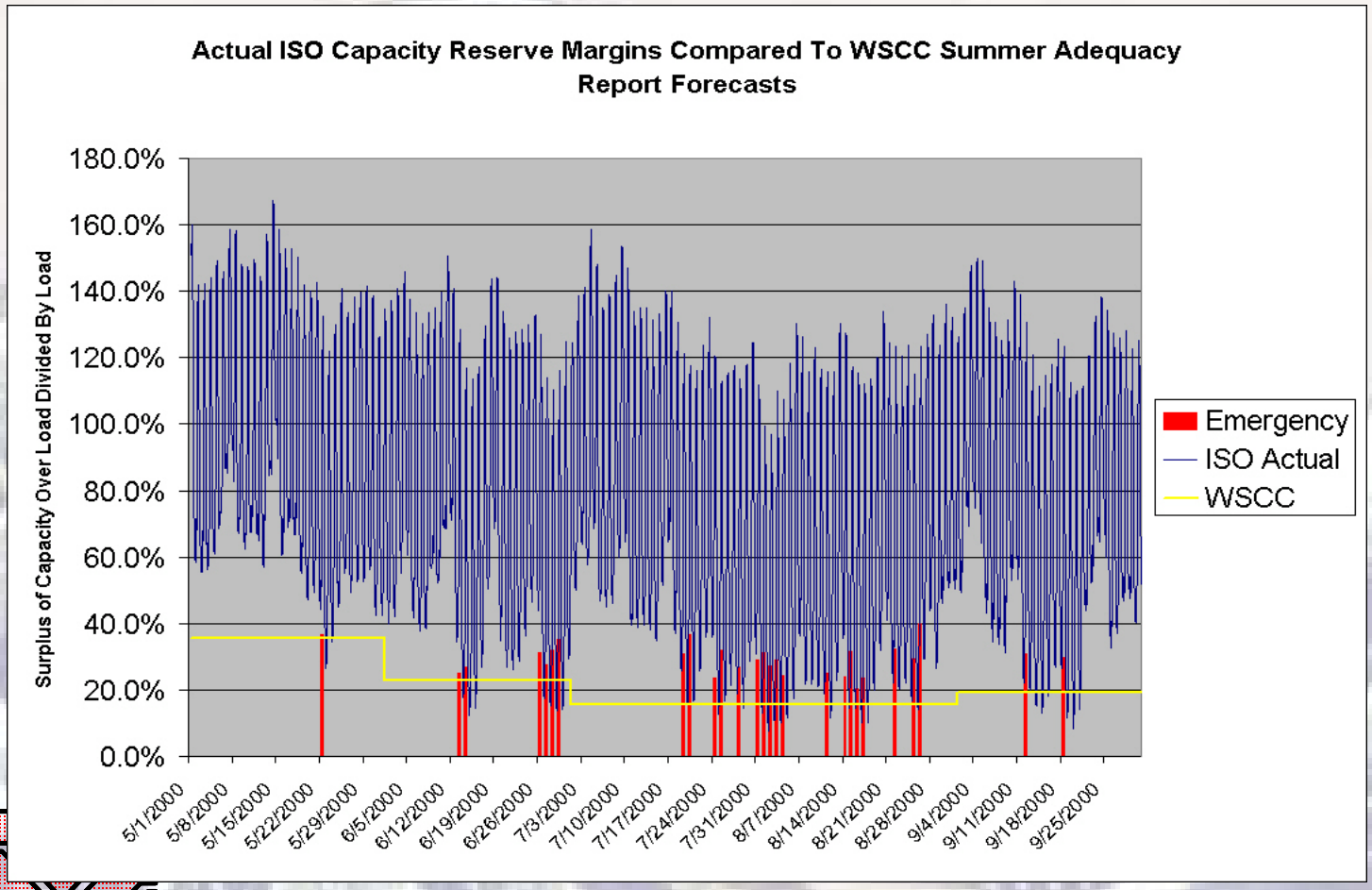


Undergeneration

Figure 13. Average Underscheduling of Loads and Generation by System Load Level (June, 2000)



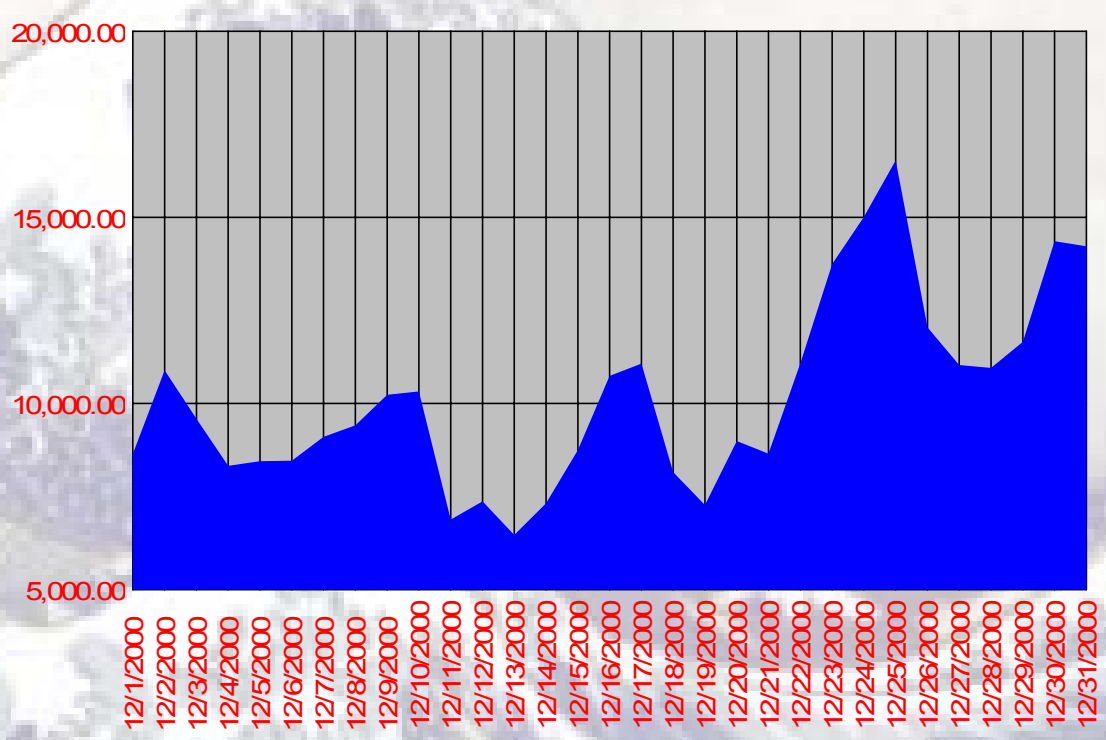
Actual ISO Capacity



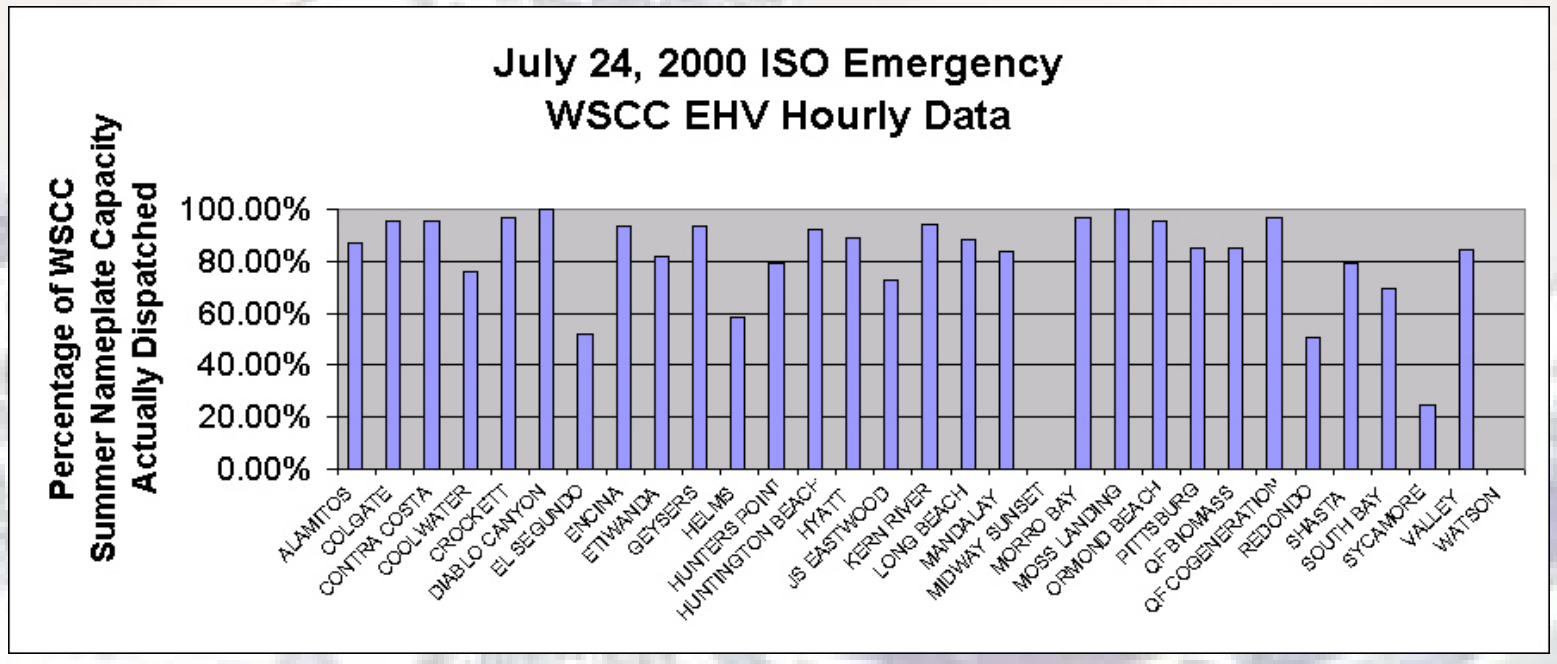
ISO Margins

- Capacity margin across the ISO's May and June emergencies averaged 32.1%
- Capacity margin across the ISO's emergencies from May through September averaged 20.1%
- Capacity margin after outages in December were 21.6%

ISO December Surplus



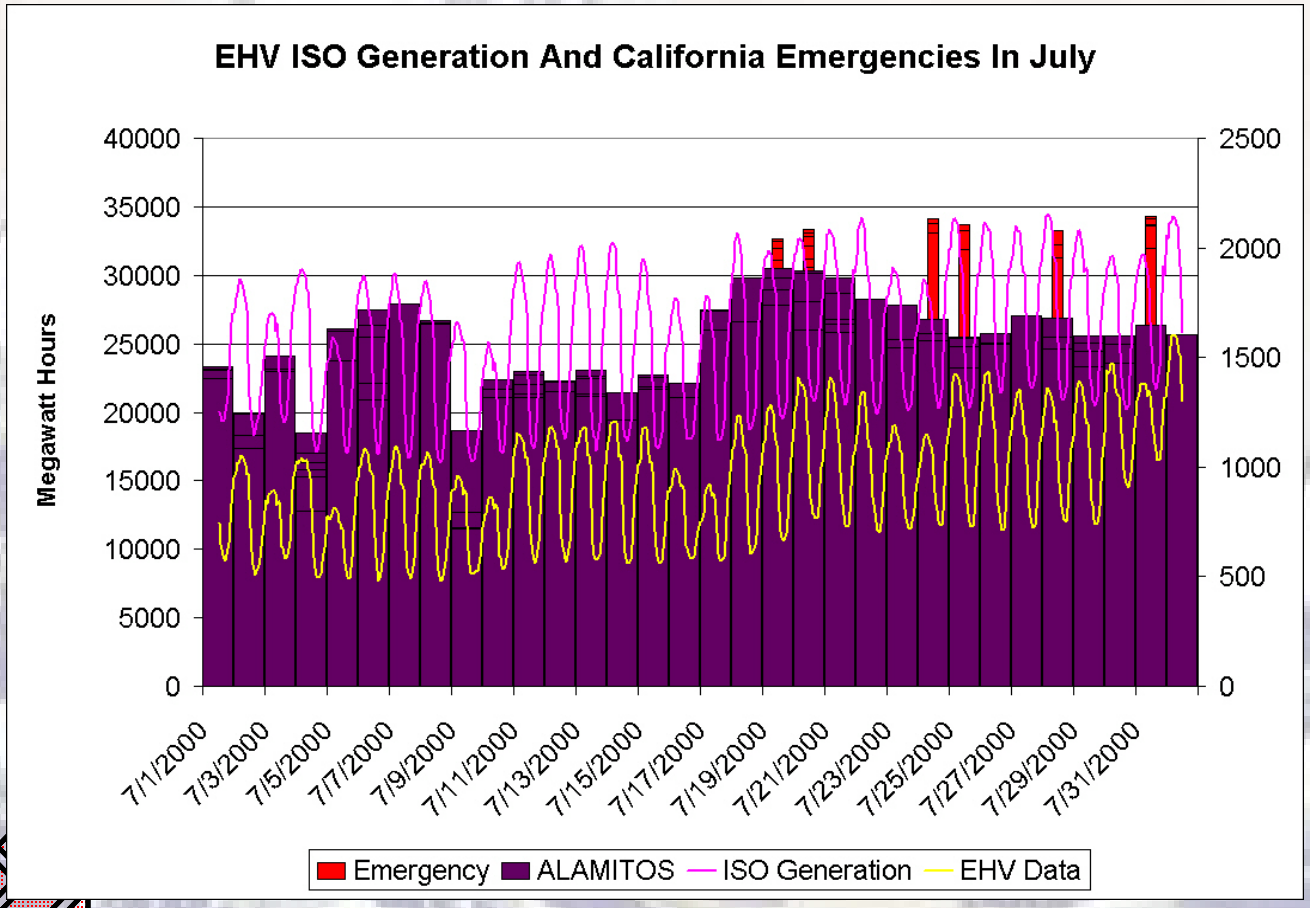
An ISO Emergency



The Missing Peak

- Alamitos dispatch isn't close to maximum during system emergencies
- Overall, system dispatch matches emergencies poorly -- raising questions of how seriously the emergencies are taken by generators

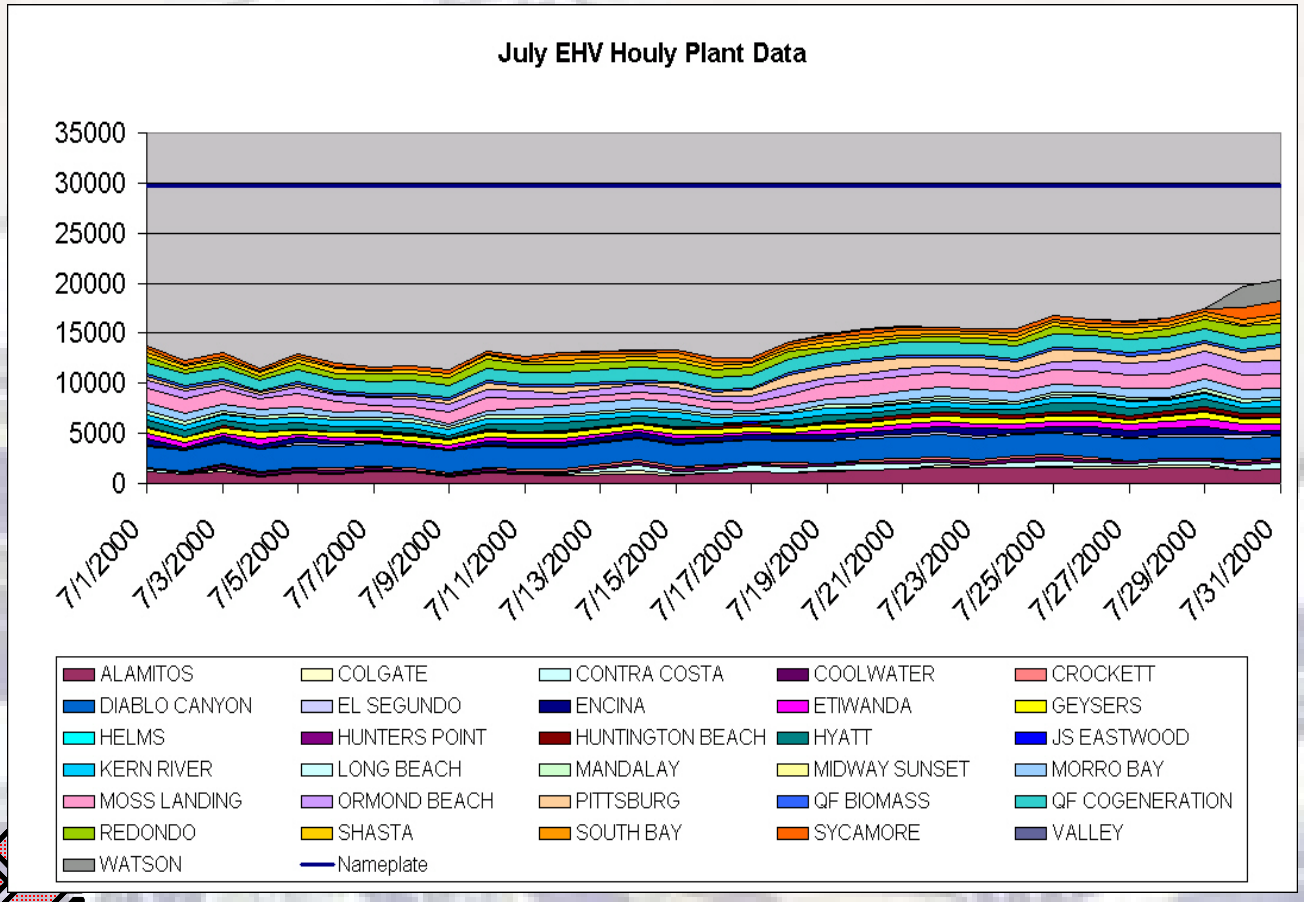
The Missing Peak



Inefficient Peak Dispatch

- ISO plants dispatch erratically
- Although total capacity equals nameplate, actual dispatch averages only 50% of nameplate
- ISO dispatch doesn't even approach nameplate during system peaks

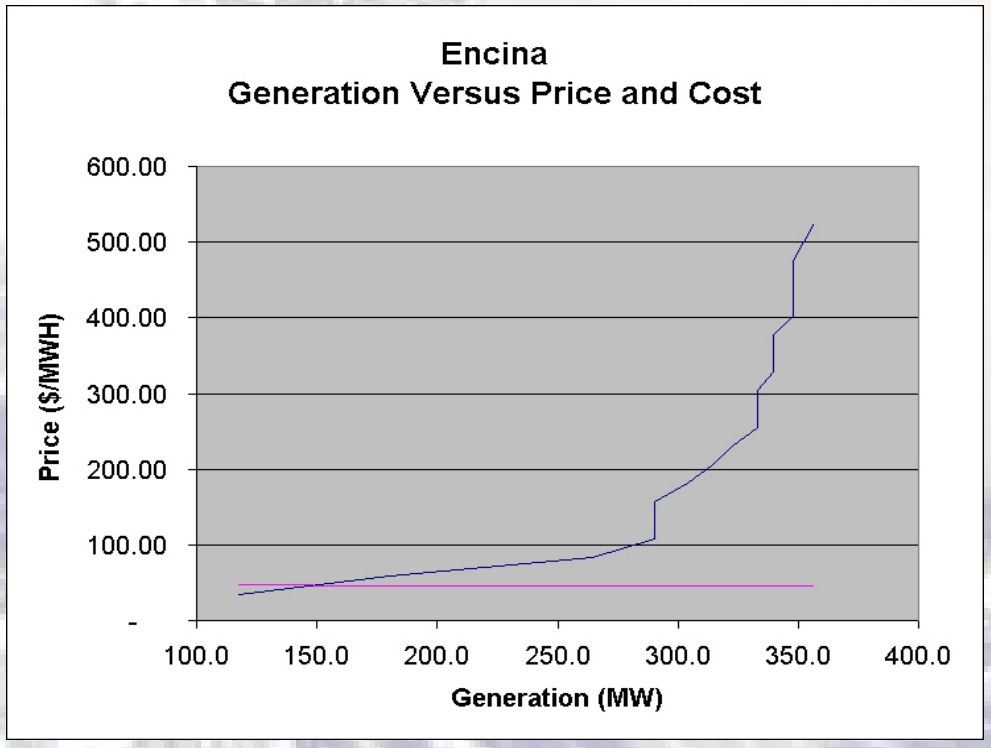
Inefficient Dispatch



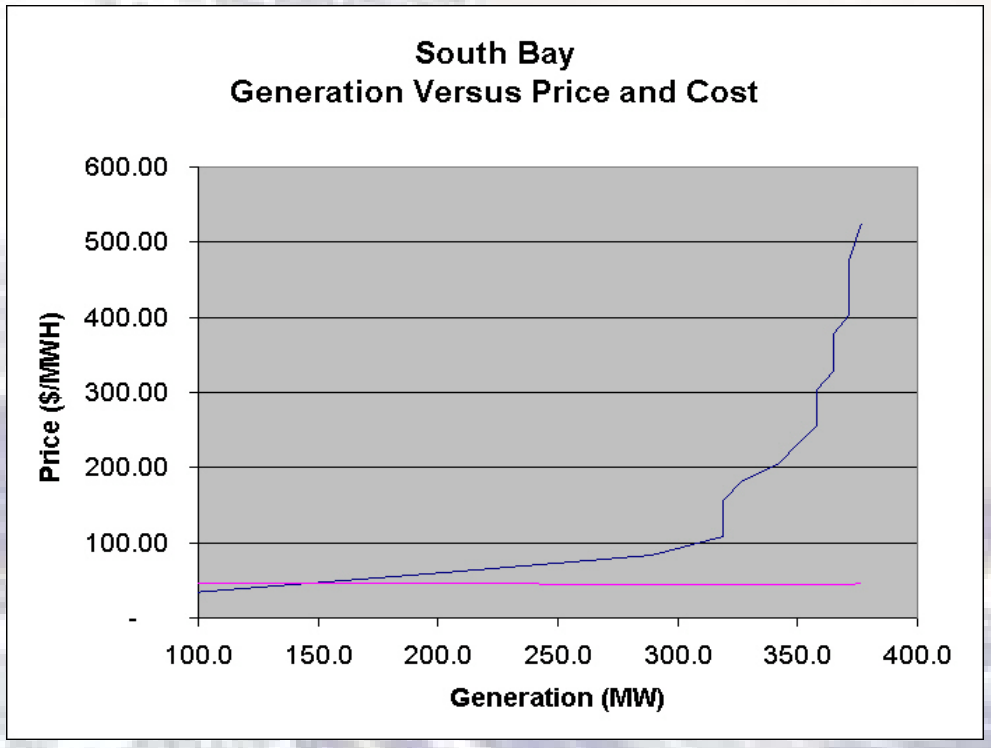
California Off-Peak

- Hourly investigation of economic dispatch at California "marginal" plants indicate large changes in behavior -- both on-peak and off-peak
- Price responsiveness of dispatch has seemingly diminished dramatically

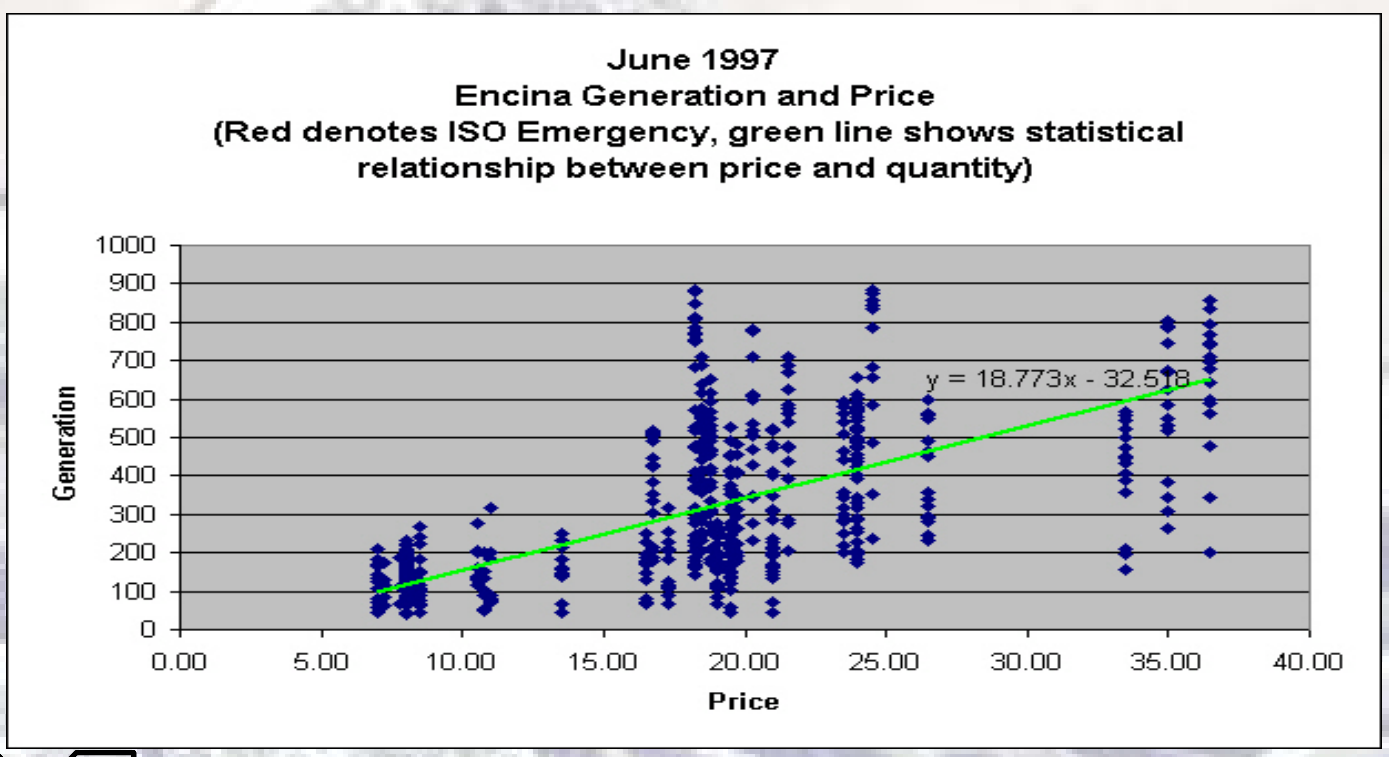
Encina: June 2000



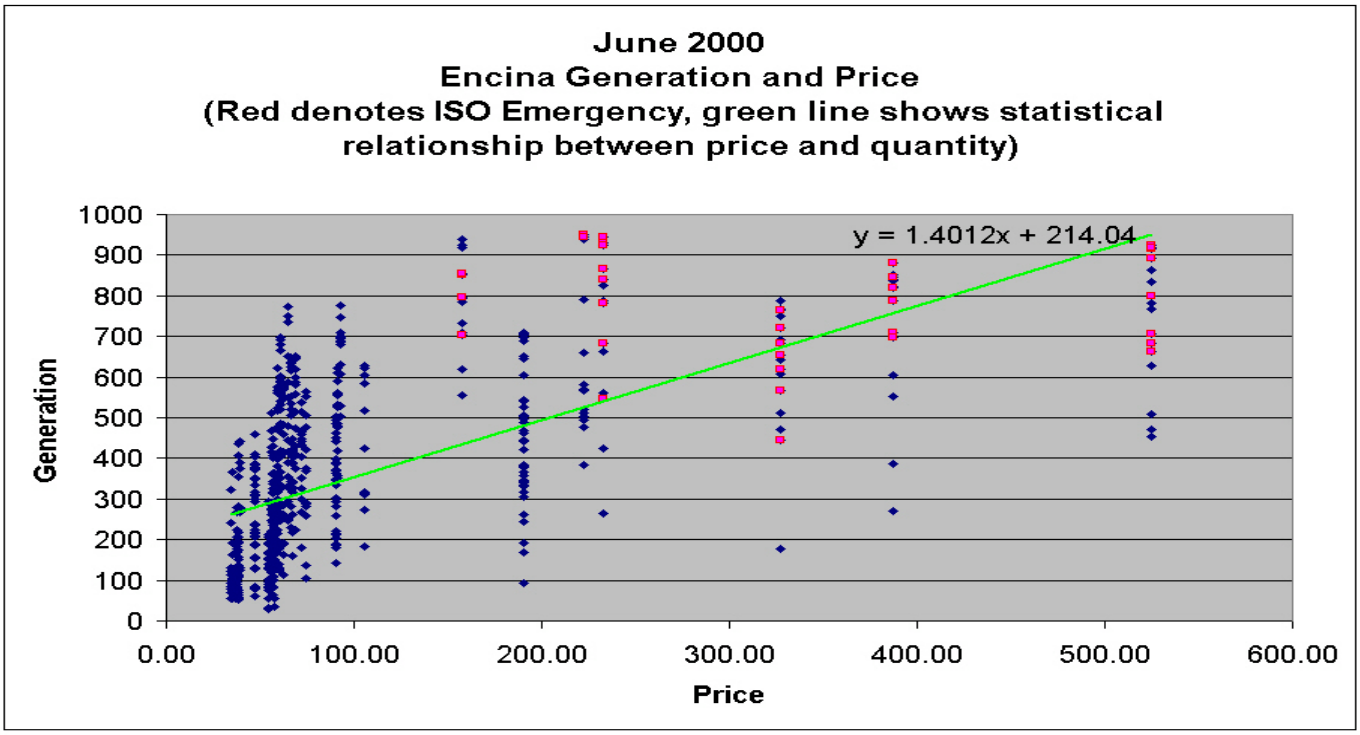
South Bay: June 2000



June 1999: Encina Generation and Price



June 2000: Encina Generation and Price



Off-Peak Conclusions

- It now costs the market 13 times as much to raise generation levels as it did in 1997
- Substantial evidence exists for signaling -- change production levels to check the responses of other generators
- Replacing the internet with major generating units as "tom-toms"

Regional Off-Peak

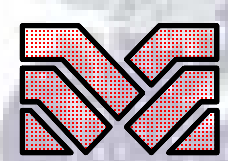
- Northern off-peak generation appears far more logical
- Marginal generating units in Oregon, and Washington do reflect traditional marginal dispatch rules
- Moving California plants to Oregon would increase generation from 30% to 50%

Optimal Dispatch: June 2000

- Encina 180%
- South Bay 164%
- Hermiston 100%
- Gadsby 120%
- Naughton 101%

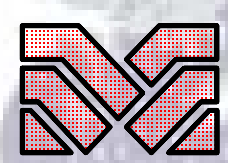
Bottom Line

- California thermal dispatch is clearly distorted -- plants are not dispatching at levels remotely near cost
- California perceptions of shortage are erratic and unverifiable -- also not shared even within the state
- Sufficient data is now available to estimate the cost of market power to consumers



Estimating Impact

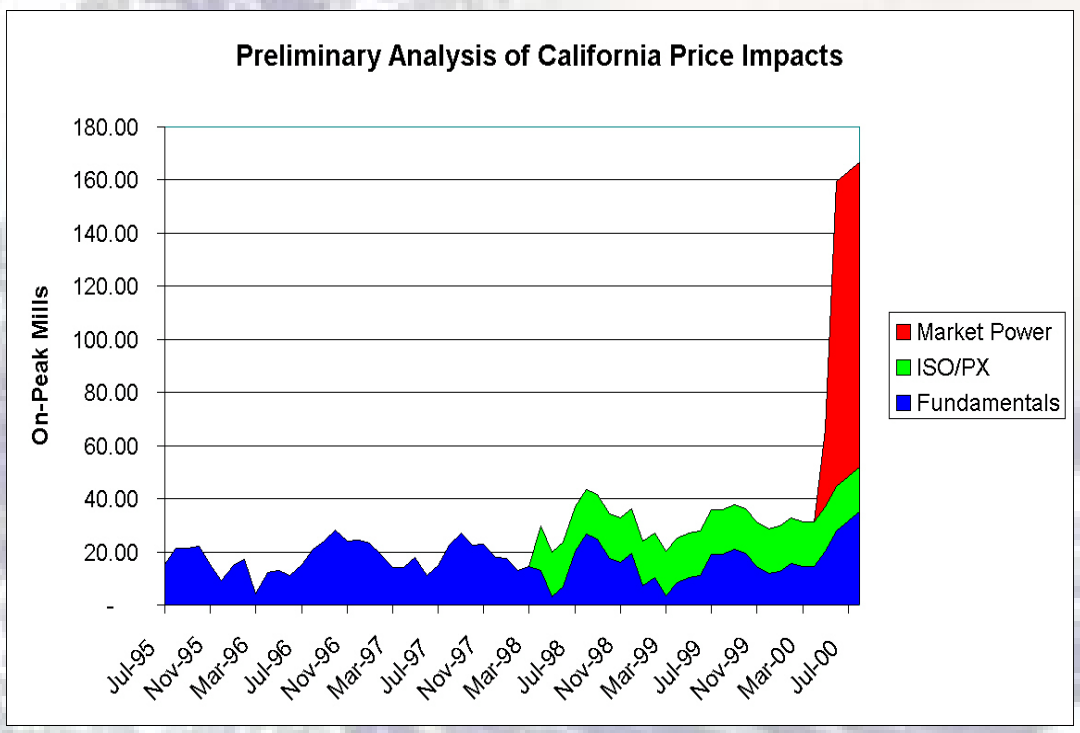
- Sufficient data is now available to estimate the level of prices
- A statistical approach allows estimating of the impacts of capacity availability, hydro generation, natural gas prices, and ISO/PX impacts from July 1995 to August 2000
- The analysis can be updated as additional data becomes available from FERC, the EIA, and NR Canada



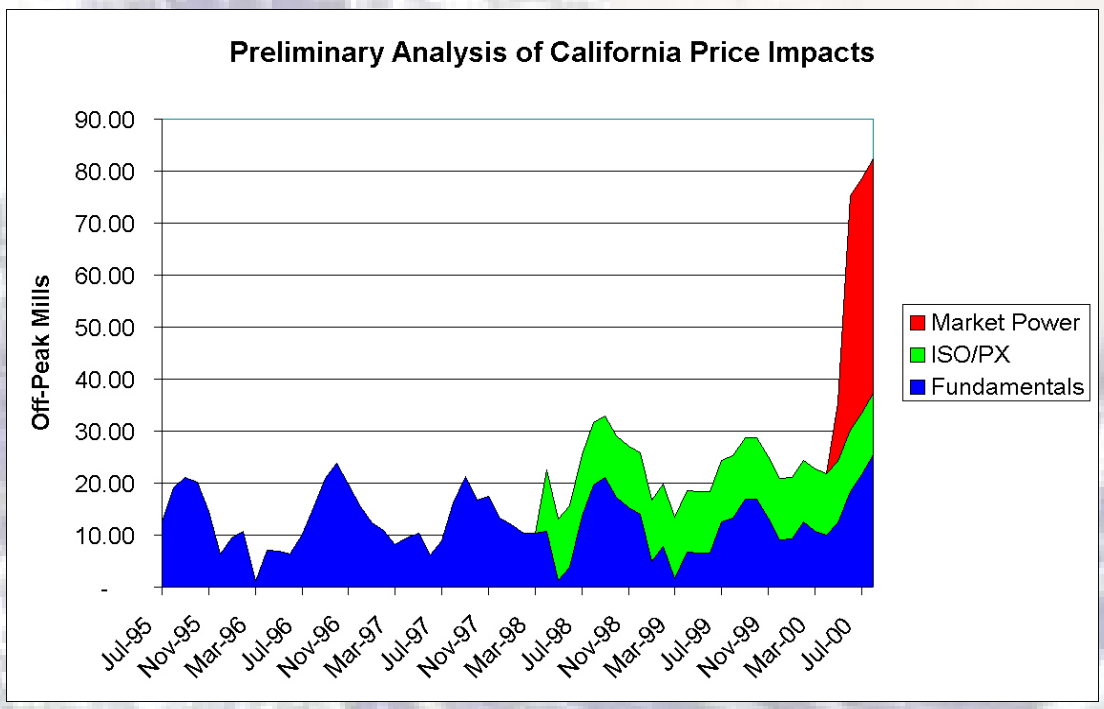
Calculated Refunds

- On-Peak: 99.4 mills +/- 13.4 Mills
- Off-Peak: 32.6 mills +/- 8.4 Mills
- Refunds appropriate from May 22nd throughAugust 31st
- Additional data will continue to refine estimates on a month by month basis

On-Peak Price Impacts

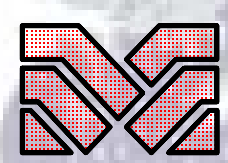


Off-Peak Price Impacts

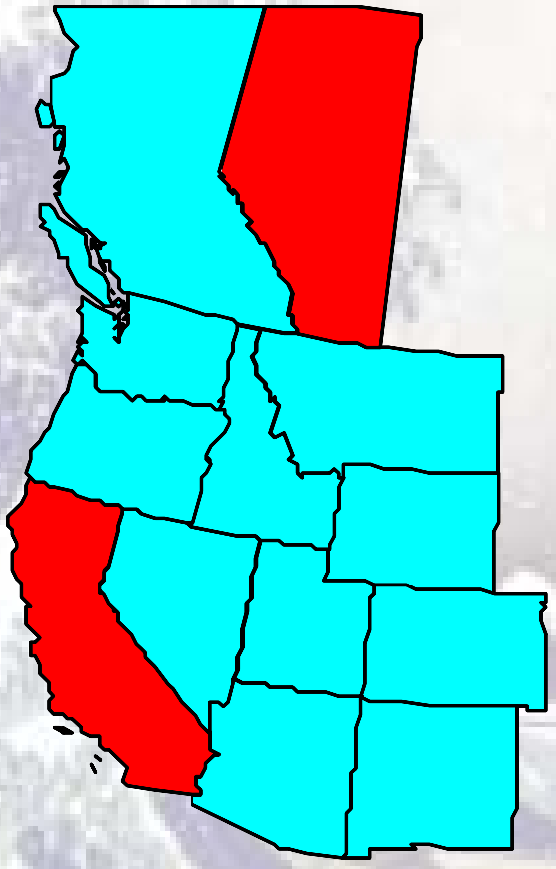


Governmental Intervention

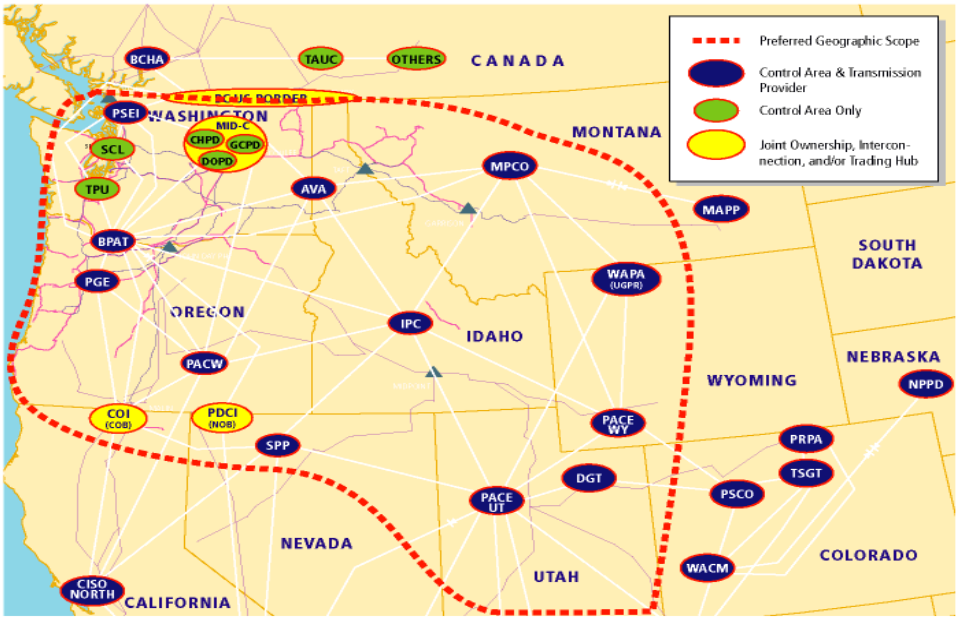
- The history since 1998 is that governmental control of bulk power markets has proved very expensive
- Alberta's experiment has been as bad in its way as California's
- Proposed RTO solutions for the Pacific Northwest may well extend these deadweight costs throughout the region



Current Intervention

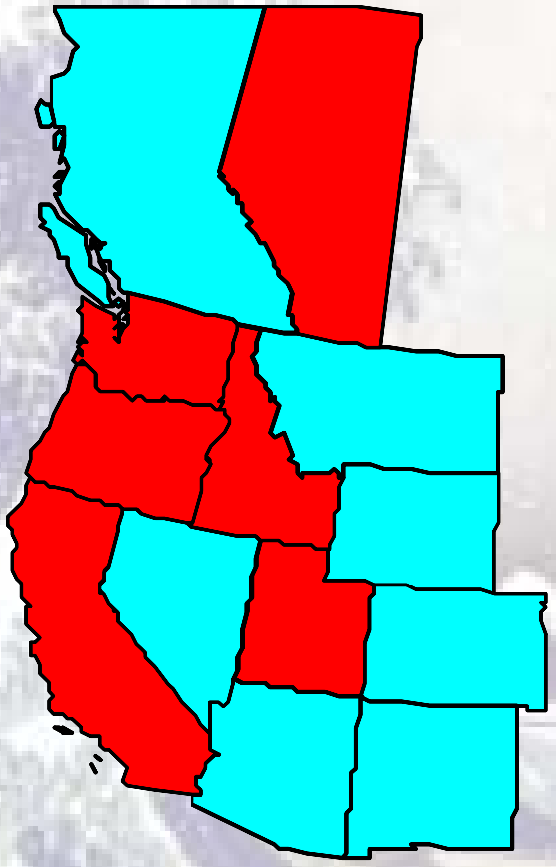


Northwest RTO



BCHA- British Columbia Hydro & Power Authority
TAUC- TransAlta Utilities Corporation
PSEI- Puget Sound Energy
Mid-C- Mid-Columbia Utilities
CHPD - Chelan County PUD
GCPD - Grant County PUD
DOPD - Douglas County PUD
SCL- Seattle City Light
TPU- Tacoma Power
BPAT- Bonneville Power Administration, Transmission Business Line
PGE- Portland General Electric
PACW- PacifiCorp West
COI- California-Oregon Intertie (or, Alternating-Current Intertie)
COB- California-Oregon Border
NOB- Nevada-Oregon Border
PDCI- Pacific Direct
PGE- Portland General Electric
PACW- PacifiCorp West
COI- California-Oregon Intertie (or, Alternating-Current Intertie)
COB- California-Oregon Border
NOB- Nevada-Oregon Border
PDCI- Pacific Direct-Current Intertie
AVA- Avista Corp.
MPCO- Montana Power Company
WAPA- Western Area Power Administration
IPC- Idaho Power Company
PACE/WY- PacifiCorp East in Wyoming
PACE/UT- PacifiCorp East in Utah
DGT- Deseret Generating & Transmission Cooperative
MAPP- Mid-Continent Area Power Pool
PSCO- Public Service Colorado
PRPA- Platte River Power Authority
TSGT- Tri-State Generation & Transmission Association, Inc.
WACM- West Plains Energy

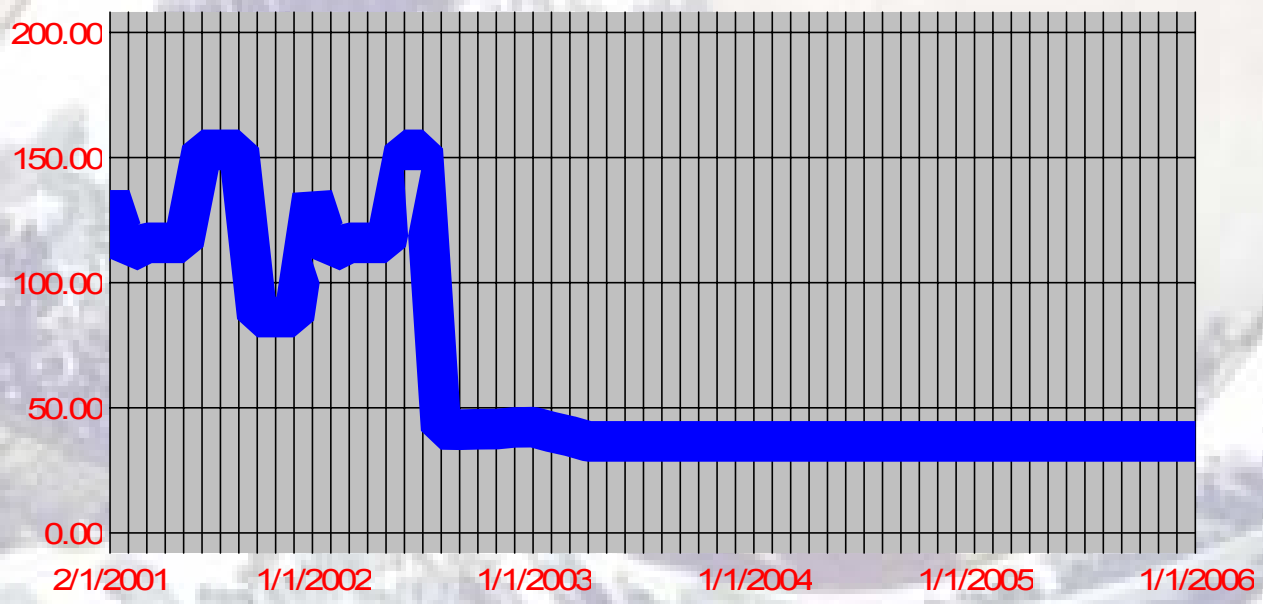
Proposed Intervention



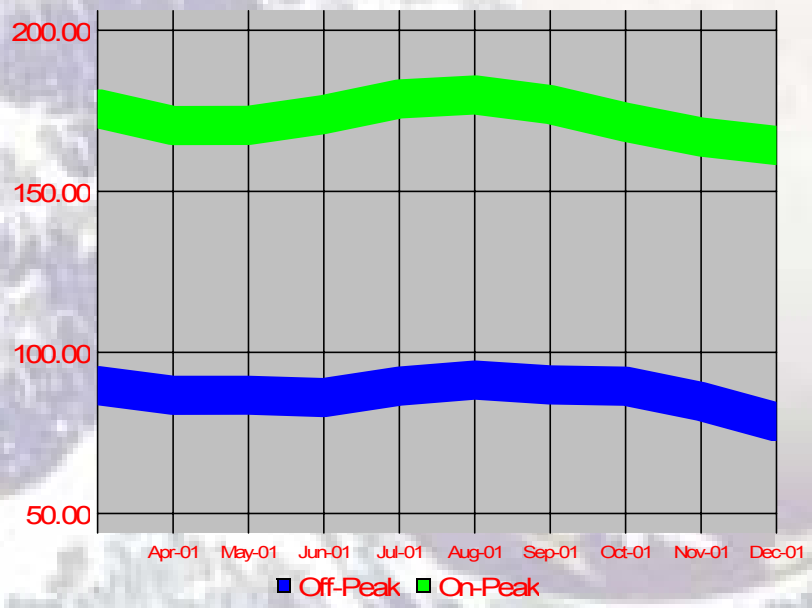
Market Expectations

- "Future curves" are confused at best
- Most market participants predict prices reflecting short term distortions and long term natural gas prices
- While simple, these forecasts are hardly

Future Curves



Forecast For 2001



Resource Choices

- When you have a hammer, all problems look like nails
- At natural gas prices in the $2.00/mmbtu range natural gas dominated regional resource choice

Resource Screening

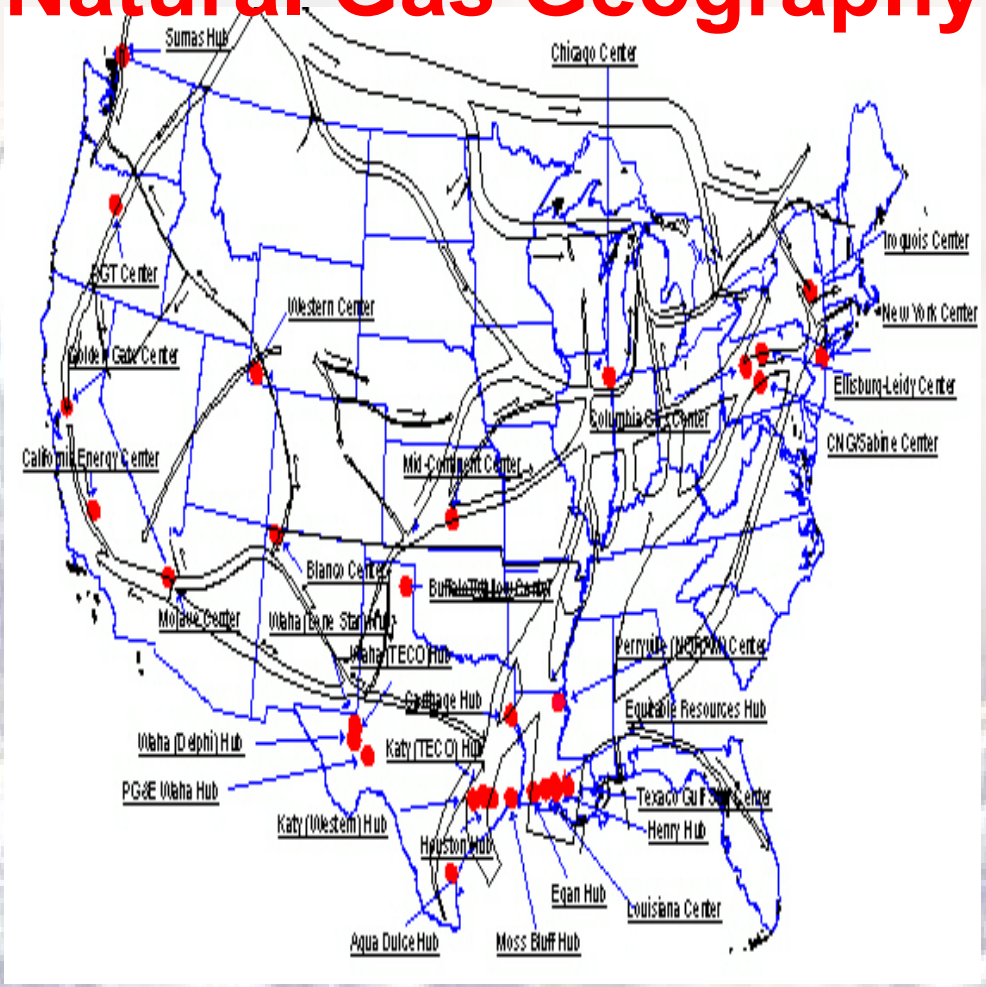
Coal Technologies

	Pulverized Coal Steam-Electric	Atmospheric Fluid-Bed Steam-electric Power Plant	Coal Gasifier Combined-cycle Power Plant	Pressurized Fluid-Bed Combined-cycle Power Plant
Configuration	1x300	1x200, circulating bed	1x540, Destec process	1x340, bubbling bed, supercritical
Status	Mature commercial	Mature commercial	Early commercial	Demonstration
Typical Application	Bulk power supply	Bulk power supply	Bulk power supply	Bulk power supply
Unit Capacity (MW)	300	200	540	340
Availability (%)	85%	90%	86%	81%
Heat Rate (Btu/kWh)	10,070	10,290	8,490	8,510
Overnight Cost ($/kW)	$1,650	$1,930	$1,480	$1,340
Fixed Operating Cost ($/kW/yr)	$48	$39	$15	$39
Variable Operating Cost (mills/kWh)[3]	1.1	1.3	5.4	1.0
Development & Construction Lead Time (Months)	48/36	48/36	36/38	36/36
Cash Flow (%/yr)	1/1/1/2/25/45/25	1/1/1/2/25/44/25	1/1/2/25/45/25	1/1/2/25/45/25
Service Life (Years)	40	40	30	30
Comparative Levelized Energy Cost (cents/kWh)[4]	4.4	4.7	3.9	3.5

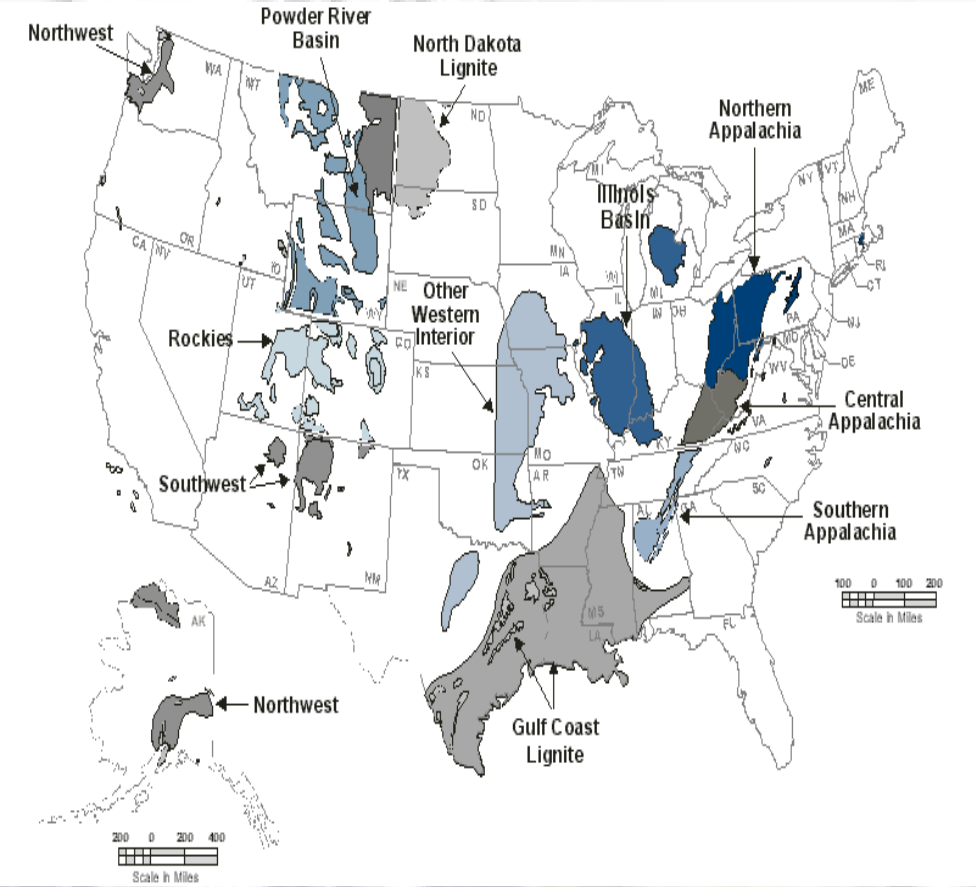
Pacific Northwest

- Natural gas plant locations tend to follow pipelines
- Coal unit locations tend to follow rail
- Given the path of current natural gas prices developers will begin to study maps of

Natural Gas Geography



Coal Geography



Recommendations

- With the pressure on to replace markets with centralized solutions, we can expect increased volatility and inefficiency
- Plant selection should favor baseload
- At current prices coal is less expensive than gas