

## Commoditization in North American Power Markets

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### Who Are the Players?

- Load Bearing Entities (Utilities) – Duquesne Light
- Independent Power Producers – Calpine
- Marketers – Enron
- Brokers – TFS
- System Operators – CAISO
- Market Coordinators – PJM

## And What Exactly Do They Trade?

- All Contracting is Effectively Financial
1. Bulk Power Market
    - Spot Market/Real-Time Market : Contracting generally one-hour ahead for one-hour blocks of energy
    - Day-Ahead/"Prescheduled" Market : Contracting generally one-day ahead for peak/off-peak blocks of energy; Firm and Non-firm contracting
    - Forward Markets : Contracting for month/quarter/year-long (or longer) blocks of energy
  2. Transmission Rights
  3. "Ancillary Services"
    - Spinning Reserves, RMR, etc.

## Where Exactly Do They Trade?

- North American Grid Divided into 3 ½ Pieces
- "Interconnects"
1. Eastern Interconnect: NEPP, MAAC, SERC, ECAR, SPP, MAPP, MAIN, FRCC (sort of)
  2. Texas Interconnect: ERCOT
  3. Western Interconnect: WSCC
- Hubs Within Each Interconnect



## Brief History of the North American Power Market

- 1940s, 1950s: Pacific Interties Constructed
  - Seasonal Exchanges of "Economy Energy" Between Northwestern and Californian/Southwestern Utilities
- PURPA (1978), EPA (1992), FERC Order 888
  - PURPA Allows Nonutility Generation, EPA Opens Wholesale Markets to Nonutility Traders (e.g., Enron), FERC Order Guarantees Nondiscriminatory Access
- 1991: WSPP Recognized by FERC
  - Market-based Ratemaking "experiment"
- 1996: Futures Market Opens
  - NYMEX Offerings at COB and Palo Verde in WSCC in Anticipation of Western Market Restructuring

## Why Have Markets At All?

- Successes in Oil and Gas Markets
- Three Objectives
  1. Keep Grid in Balance Through Real-Time Purchases and Sales
  2. Manage Congestion Throughout the Grid
  3. Provide Accurate Price Signals for System Planners
- Formerly the Job of Engineers

## Prices As Signals

- Aid in System Planning

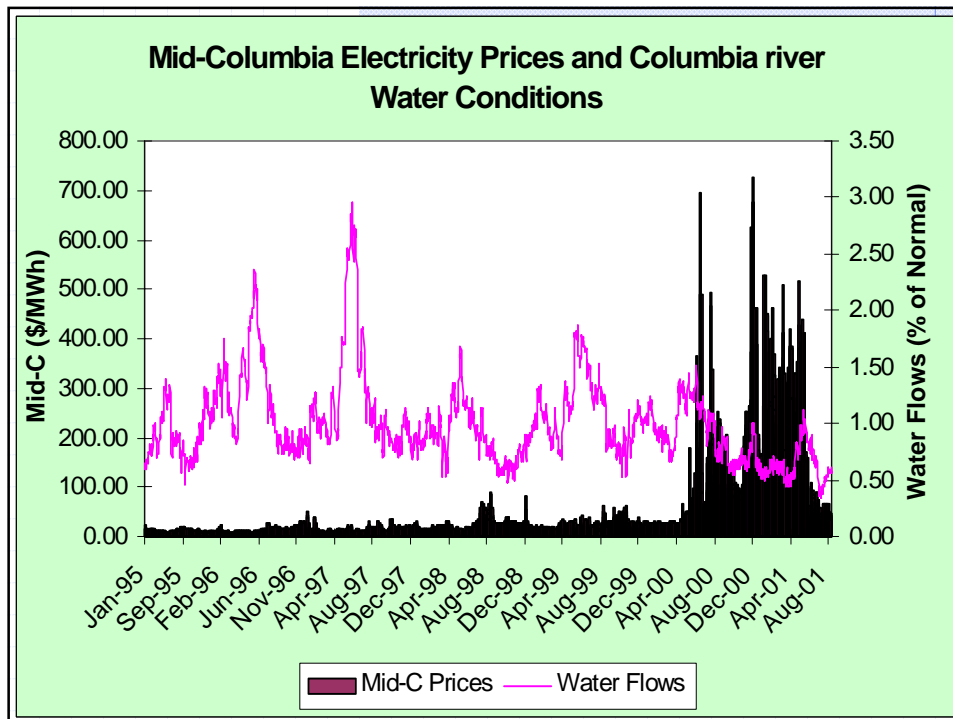
e.g., Give advance warning to generators as to whether operation or shut-down is most cost-effective

- So, What Should These Signals Look Like?

1. Hydro-Based Systems (Pacific Northwest)
2. Thermal-Based Systems (PJM)

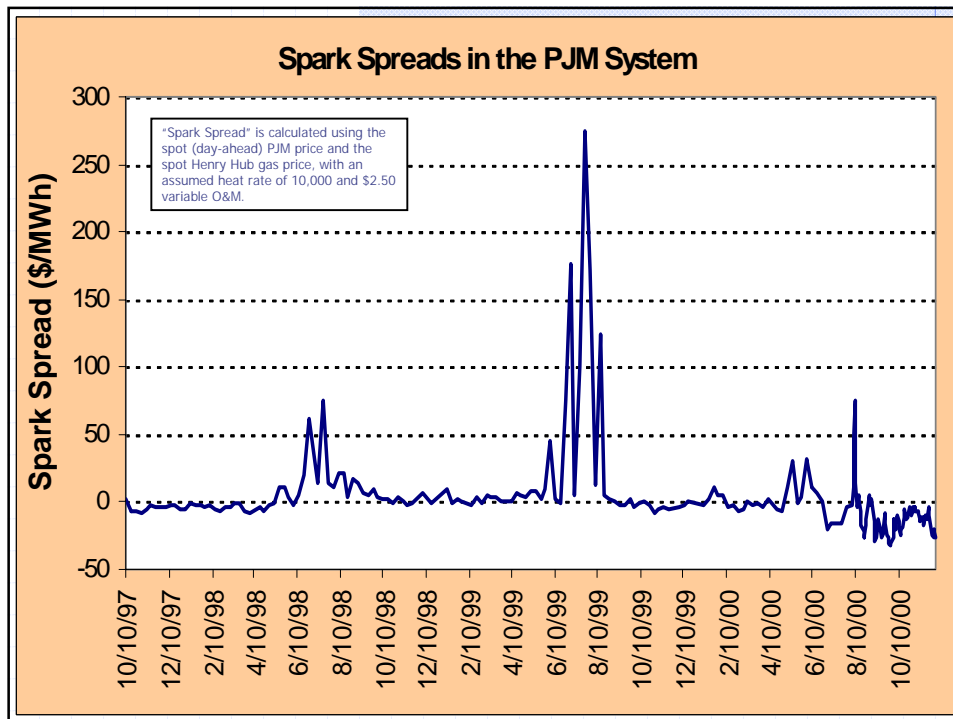
## Hydro-Based Systems

- Hydro or Pumped Storage Generators can “Store” Electricity Through Reservoir Management
- Prices Reflect Expected Future Hydro Supply
- Price Structure Generally Stable and Reflective of Low Marginal Cost
- Price “Spikes” Normally Associated with Poor Water Supply
- Spikes Generally not Severe, but Sustained Over Long Periods



#### Thermal-Based Systems

- Storage Options Virtually Nonexistent
- Prices Reflect Cost and Availability of Fuel
- Price Structure More Volatile
- Price "Spikes" Normally Associated with Generation Outages or Fuel Supply Disruptions
- Spikes Generally Severe, but not Sustained

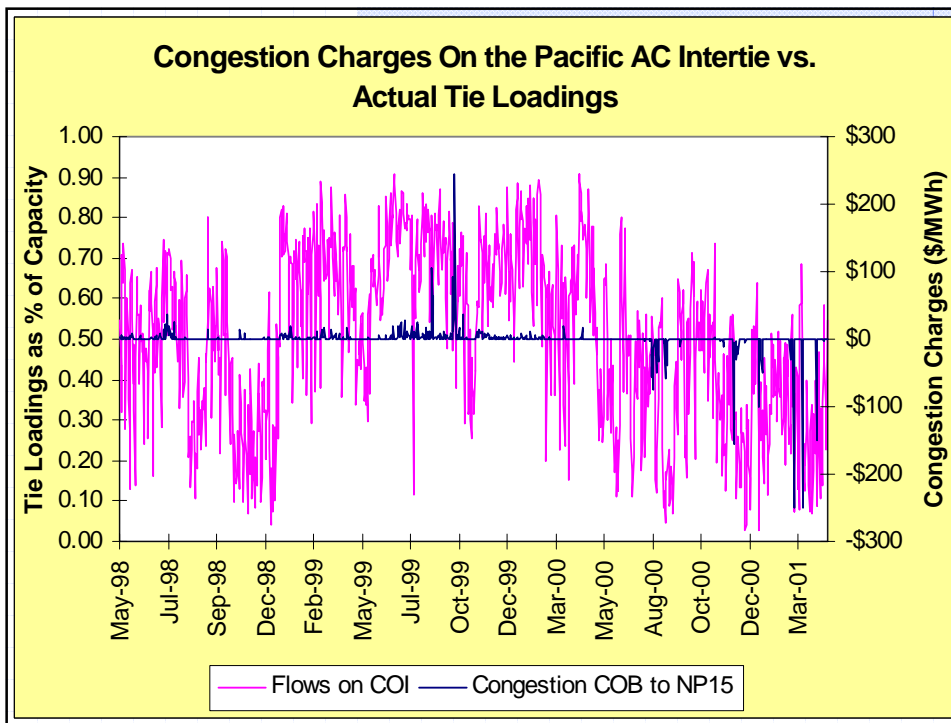


### Prices as a Congestion Mangement Tool

- Generally Used in Restructured Systems
  - Command-and-Control Mechanisms such as TLRs
  - Common in Non-Restructured Settings
- In California, Mixed System of "Incremental" and "Decremental" Market Bids, Combined with Centralized Decision-Making
- In PJM, Non-economic Dispatch
- Information Problem

## The Information Problem in Congestion Management

- Unlike in Most Commodity Markets, Transportation Costs in Electricity are not Fixed in the Short-Term
- Principal Causes of Congestion (Weather, Generation/Transmission Outages) are Unpredictable
- Also Unlike Most Commodity Markets, Transmission Charges for One Market Participant Depend on the Behavior of All Other Market Participants
- Variable Congestion Fees Imply High Transactions Costs for Bilateral Negotiations (Or an Infeasible Solution)





## Prices as Balancing Mechanisms (Real-Time Energy)

- Ancillary Services

- Spinning Reserves, RMR, Must-Take, Must-Run, etc.

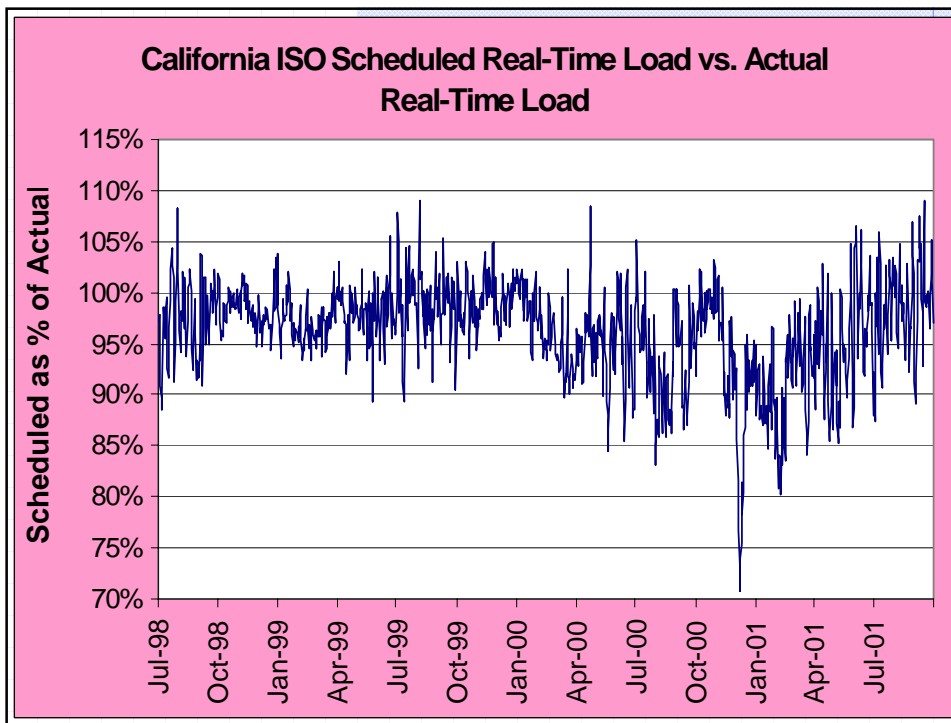
- Real-Time Bidding

- Meant to be Small Fraction of Overall Market (5 or 10% of Load)

- High Costs of Gathering Information, High Transactions Costs

- High Running Costs (Seem to Increase More Than Proportionally With Number of Participants)

- Less Flexibility in Load than Generation



## Remaining Issues

- FERC Order 2000 Mandating Development of RTOs
  - Intended to Ensure Open Access to Transmission Lines
- Development of Forward Markets
  - Nonstorability has Inhibited Growth
  - NYMEX Futures Contracts a Failure
  - All Restructured Markets To Date Centered Around Spot Markets
  - System Planning in a Market Environment Impossible Without Clear Price Signals
  - Tradeoffs Between Speed and Accuracy of Pricing Signals in Electricity Markets, Necessitates Separate Markets/Institutions for Forward and Balancing Energy

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