Risk Analysis for Mergers, Acquisitions, and Asset Valuation

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Using Market Data in Risk Analysis

- Agenda
  - Data Availability
  - The Value of Data-Informed Risk Analysis
  - Capital Expenditure and Regulatory Risk Analysis Applications Using Market Data

Using Market Data in Risk Analysis

- Data Availability
  - Why Market Data?
  - The Rise of Data
  - Market Centers
  - Important Characteristics and Limitations
- The Value of Data-Informed Risk Analysis
- Capital Expenditure and Regulatory Risk Analysis Applications Using Market Data

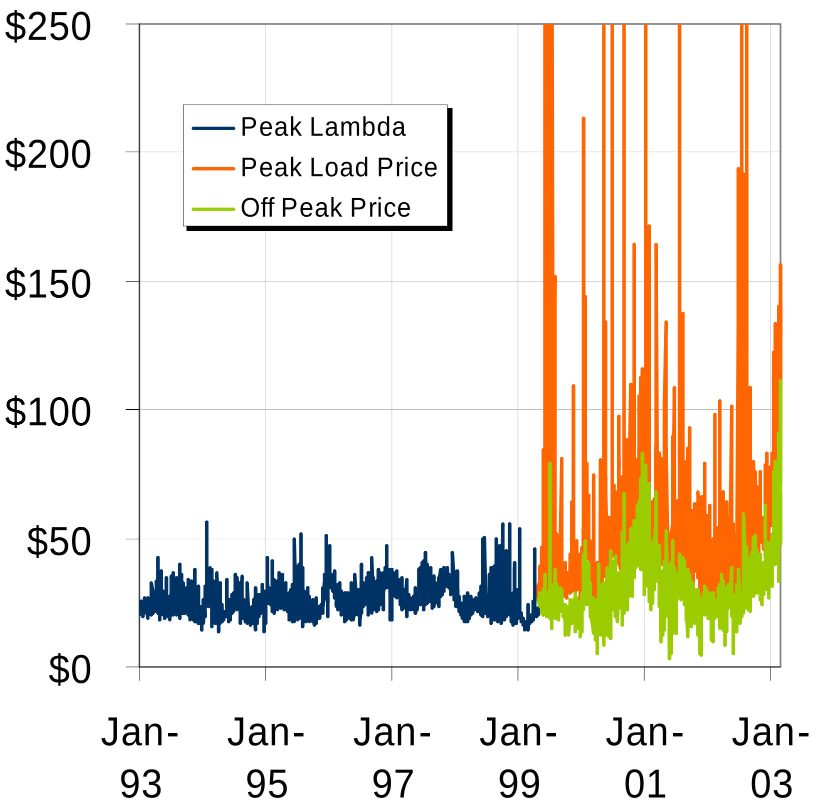
Why Market Data?

- Practical Reasons
  - Market data provide the clearest picture of what **actual** firms are paying for **actual** commodities
    - No subjectivity
  - We can shift from **what *should* this asset be worth?** to **what *is* this asset worth?**
    - Equilibrium in electricity markets can be fragile and elusive
- Strategic Reasons
  - Prices as information (volume and liquidity)
  - Market data tell us how markets evolve
- Bottom Line
  - Using actual market data produces more accurate values and improves management and investor decision making

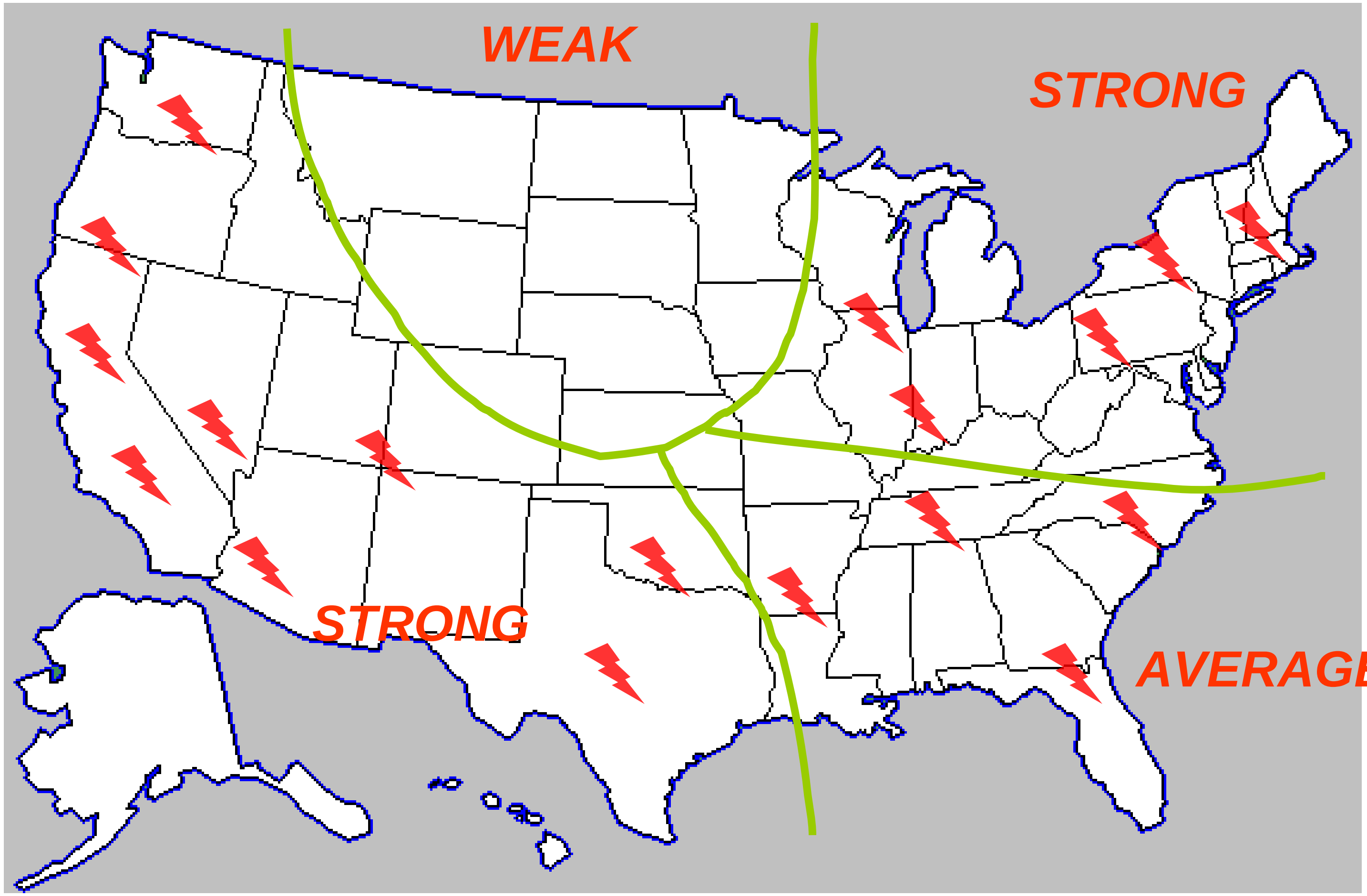
The Rise of Data

- From System λ to Energy Clearing Prices (ECP)
  - Volatility is a consequence of healthy, competitive markets
- Most Important Data for Risk Analysis
  - Primary Markets
    - Energy
    - Capacity
    - Ancillary Services
  - Secondary Markets
    - Emissions Credits
    - Fuel Prices

NEPOOL Data: Introduction of ECP



Data Availability

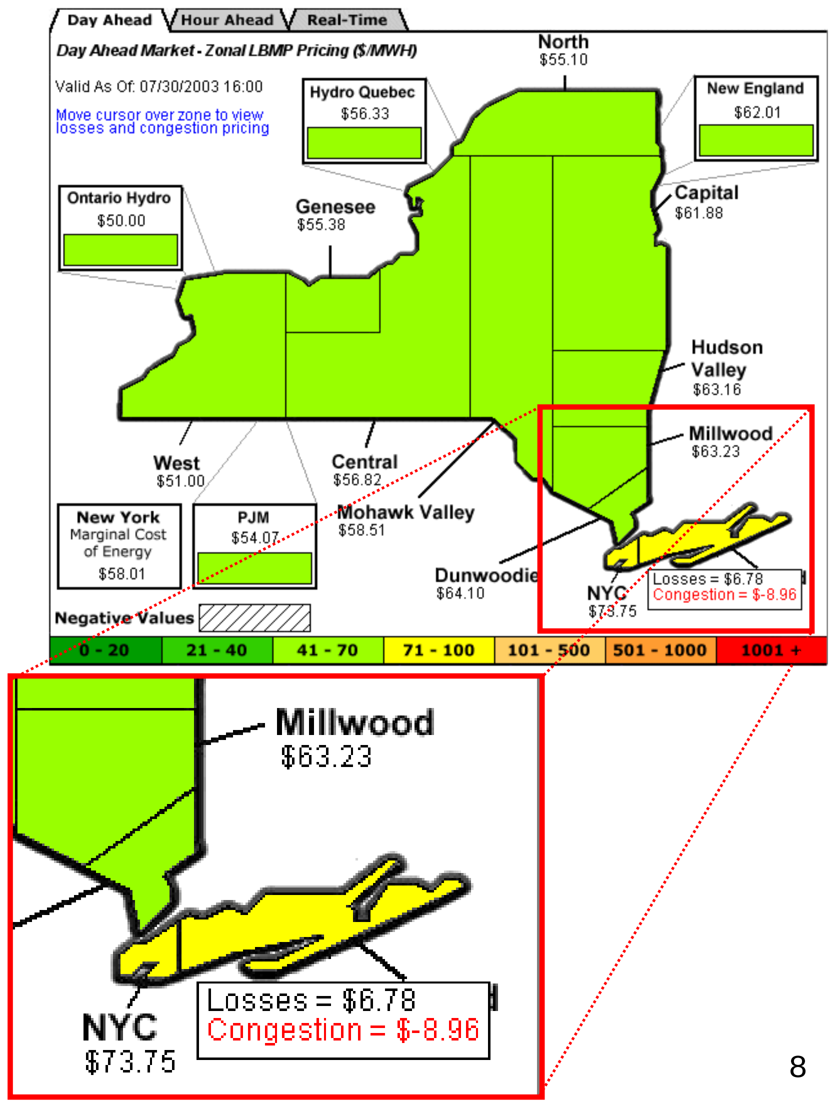


Energy Products

- Four Key Features Distinguishing Types of Prices
  - Zonal vs Nodal
    - Zonal reduces market power potential; nodal is theoretically more efficient
  - Spot vs Long-Term Bilateral
    - Spot markets promote competition, but bilateral contracting moderates volatility
  - Portfolio vs Unit-Specific Scheduling and Bidding
    - Portfolio scheduling allows more flexibility, but makes it harder to manage congestion
  - FTR (Financial Transmission Rights) vs TCR (Transmission Congestion Rights)
    - Both rights are financial, not physical

Energy Products

www.nyiso.com



- Because of the physical characteristics of electricity, the price to *generate* electricity must be considered together with the price to *transport* it
- Locational Marginal Prices
  - LMP = Energy + Congestion + Losses

- Energy: *marginal costs of generation*
- Congestion: *compensation for out-of-merit-order dispatch due to transmission constraints*
- Losses: *cost of line losses*

- The congestion premiums may be substantial during peak load periods for some regions (compared to equilibrium forecasts of marginal fuel-based energy prices)

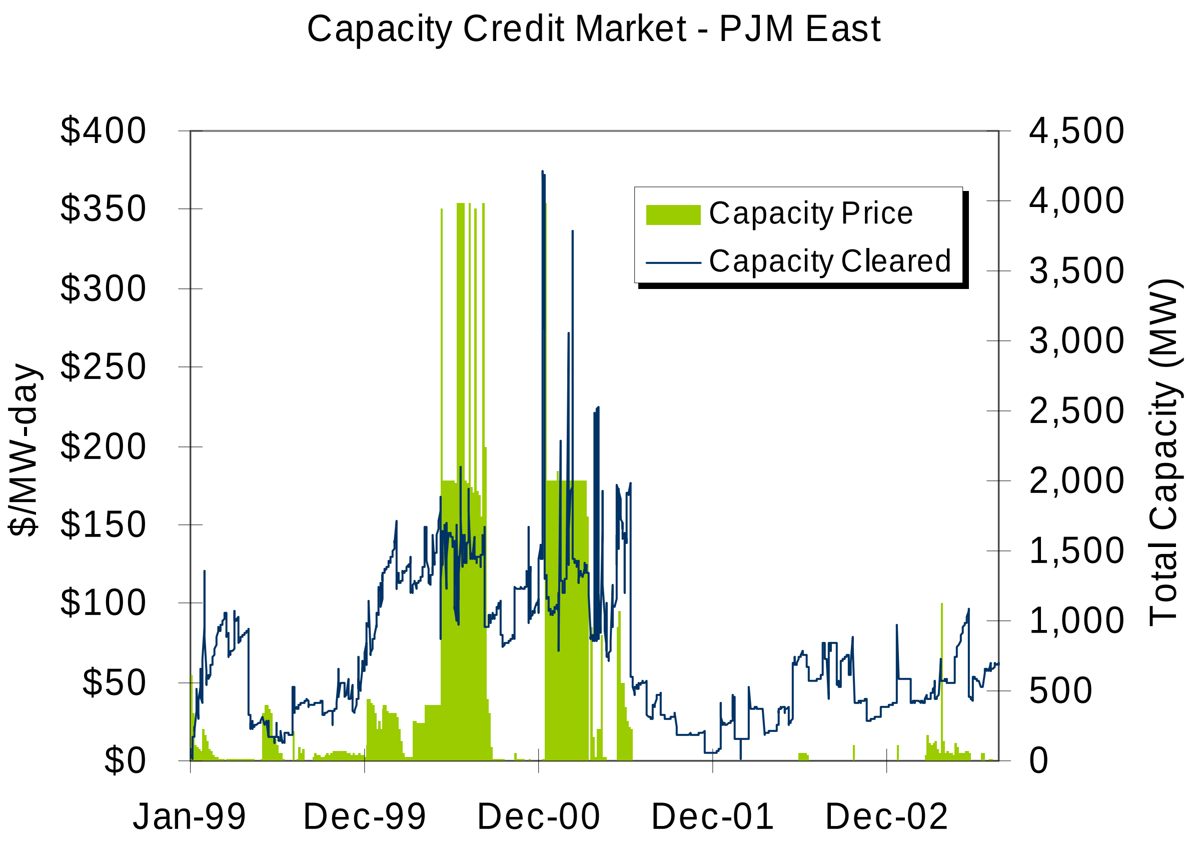
Contrasting Energy Markets

- ERCOT
  - Zonal: 4 zones
  - Bilateral market with real-time balancing
  - Portfolio scheduling and bidding
  - TCRs
- PJM
  - Real-time and day-ahead markets
  - Hourly LMPs
  - Nodal:
    - 12 transmission zones
    - 4 interfaces
    - 4 hubs
    - 1 overall load-weighted average
  - FTRs

Capacity Products

- Used to ensure that sufficient resources exist and are accessible to system to satisfy peak load *and* protect reliability
- Installed Capacity (PJM 1/1/1999 – 5/31/1999)
  - Total electricity resources required to meet peak system load over the planning period in accordance with reliability standards
- Unforced Capacity (PJM since 6/1/1999)
  - Effective available capacity of a resource when forced outages (planned and scheduled maintenance) are taken into account
  - UCAP = ICAP x Average Unforced Outage Rate
- Daily, Monthly, Multi-Month contract terms available for unforced capacity clearing market

Capacity Prices



Developing Markets

- Ancillary Services
  - Real-power Balancing (frequency stability)
  - Voltage Stability (for customers)
  - Transmission Security
  - Economic Dispatch
  - Financial Trade Enforcement
  - Black Start Capacity/Regulation
- Where will we see markets form?
  - Great interest in reducing the “socialized” nature of these services

Ancillary Service Markets (?)

- Real-power Balancing (frequency stability)
  - The most “well-developed” ancillary service market; “spinning” reserves
- Voltage Stability (for customers)
  - No possibility for bilateral market-making because of the externalities (how A and B trade with each other can affect C)
  - Centralized exchange in parallel with real-time market is possible, but difficult due to the difficulty in transmitting reactive power (highly localized; losses are about 10x greater than real power)
- Transmission Security
  - Service must be provided by the ISO
  - ISO can sell transmission rights, but physical coordination in real-time is required
  - The “security-constrained unit commitment problem” is very difficult
- Economic Dispatch
  - Centralized day-ahead power exchanges (like PJM)
- Financial Trade Enforcement
  - ISO must provide (much like CBOT’s OCC)
- Black Start Capacity/Regulation
  - Centralized market is possible

CAUTION

- Apples and Oranges: Market Comparability
  - Zonal vs Nodal Pricing
  - On- vs Off-Peak Pricing
  - Firm vs Non-Firm Pricing
  - “Into” Pricing/Congestion
- Liquidity and the informational content of prices
  - “Representative,” “Indicative,” and one-sided prices
- Past as prologue?
  - What *doesn’t* looking at the past tell us?

Using Market Data in Risk Analysis

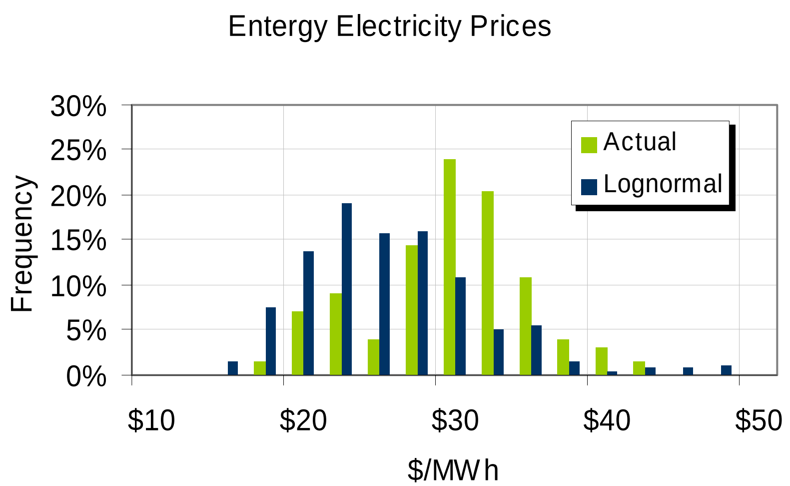
- Data Availability
- The Value of Data-Informed Risk Analysis
  - Differences between typical assumptions and actual data
  - The valuation impact of using actual market data
- Capital Expenditure and Regulatory Risk Analysis Applications Using Market Data

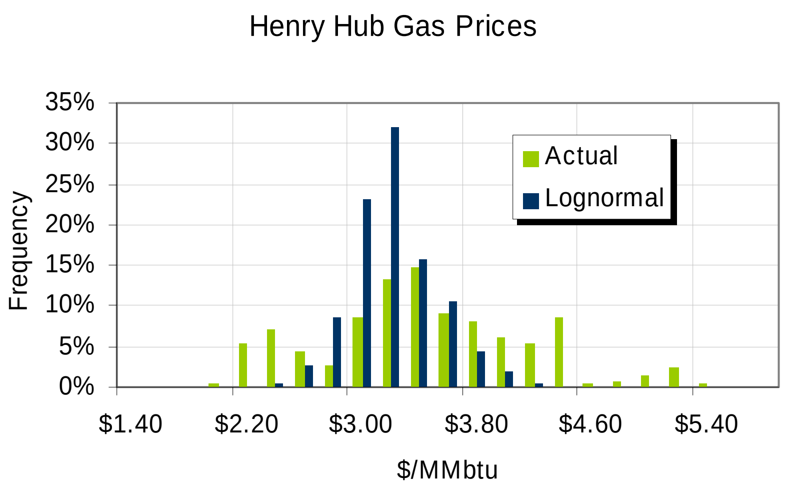
Standard Modeling Assumptions

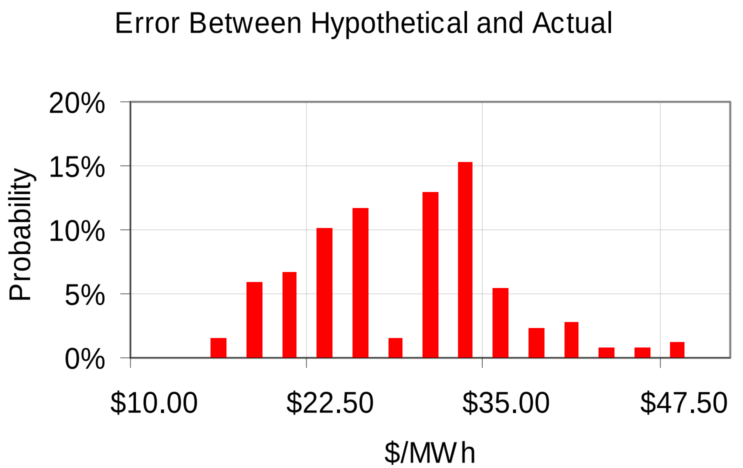
- Prices are lognormal
- Volatility is constant

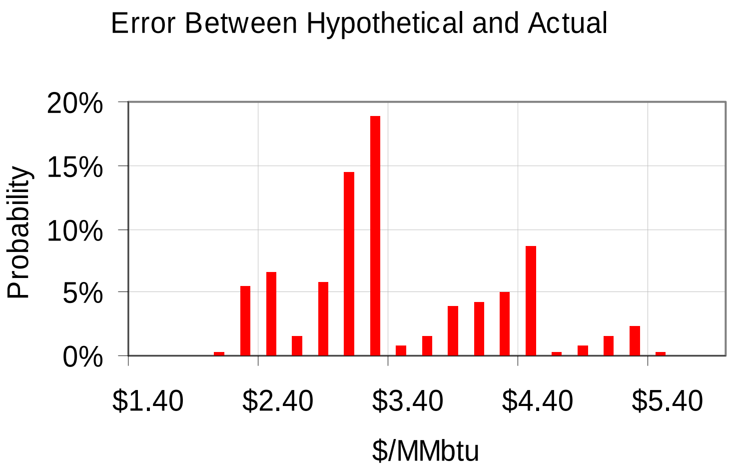
- Are these valid?
- How big are the differences?

Hypothetical vs Actual Data

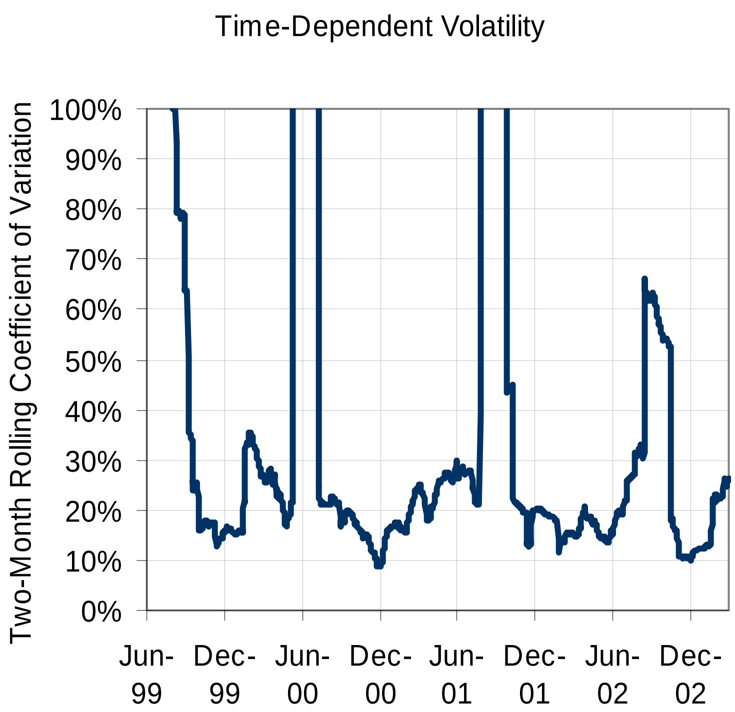


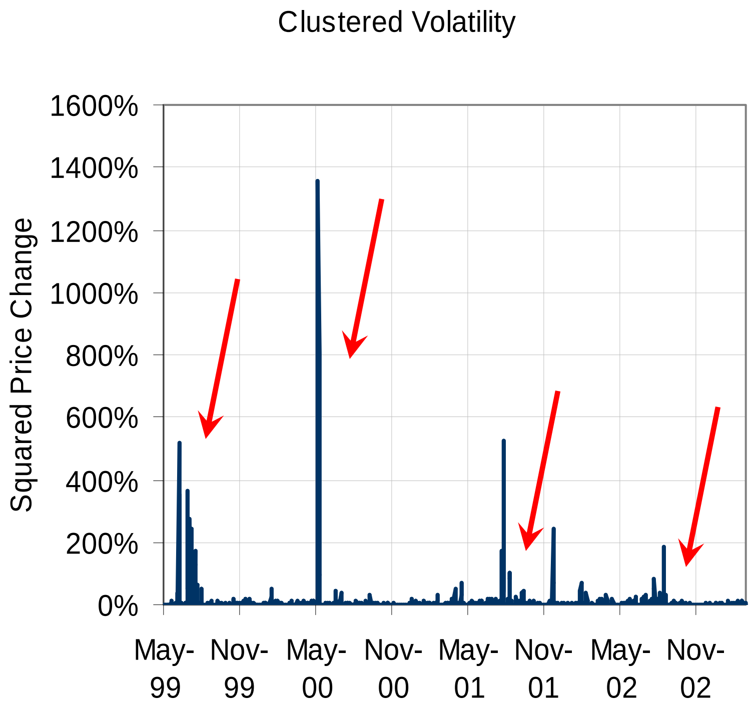




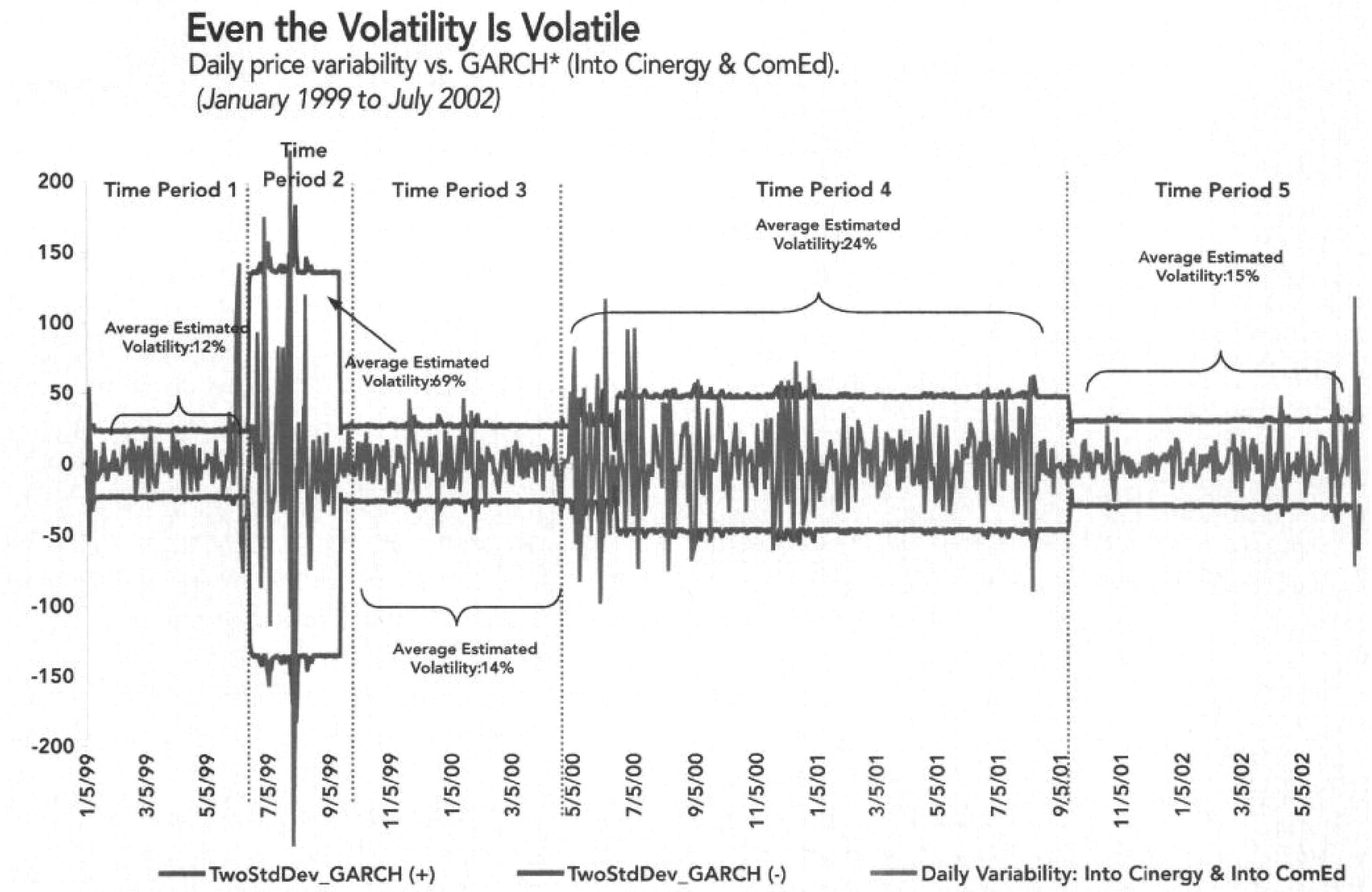


Hypothetical vs Actual Data





More on Volatility…



The Valuation Impact of Hypothetical vs Actual Data

- "…but does it matter?"

- Estimate the spark spread-determined capacity factor of a GTCC unit buying at Henry Hub and selling into Entergy
- 8500 heat rate, daily discretion
- Use *actual* 2002 data vs *traditional* assumptions
- Test against actual 2003 data (January-May)

Actual 2002 Results

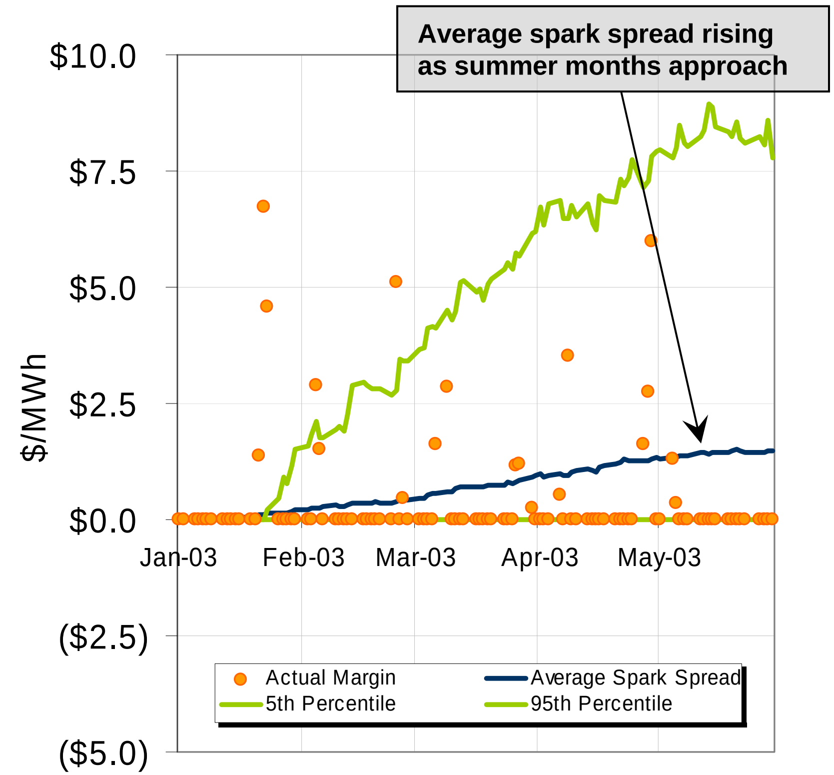
	Average	Std. Deviation
Entergy	$ 28.50	$ 5.33
Henry Hub	$ 3.36	$ 0.72

Capacity Factor	52.70%	(whole year)
Capacity Factor	56.60%	(January - May only)

…but what about 2003?

Comparative 2003 Forecasts

- Conventional "Normal" Assumption
  - Prices follow "conventional" distribution, based on 2002 mean and standard deviation
  - **Capacity Factor 49.1%**
- Simulation Approach with Historical Data
  - Prices incorporate all aspects of historical data (mean-reversion, stochastic volatility, etc.), as well as more realistic distributional forms
  - **Capacity Factor 18.5% ± 0.6%**
  - **Simulation also provides more data about plant operation**
- Actual January-May 2003 Plant Performance
  - **Capacity Factor 17.9%**



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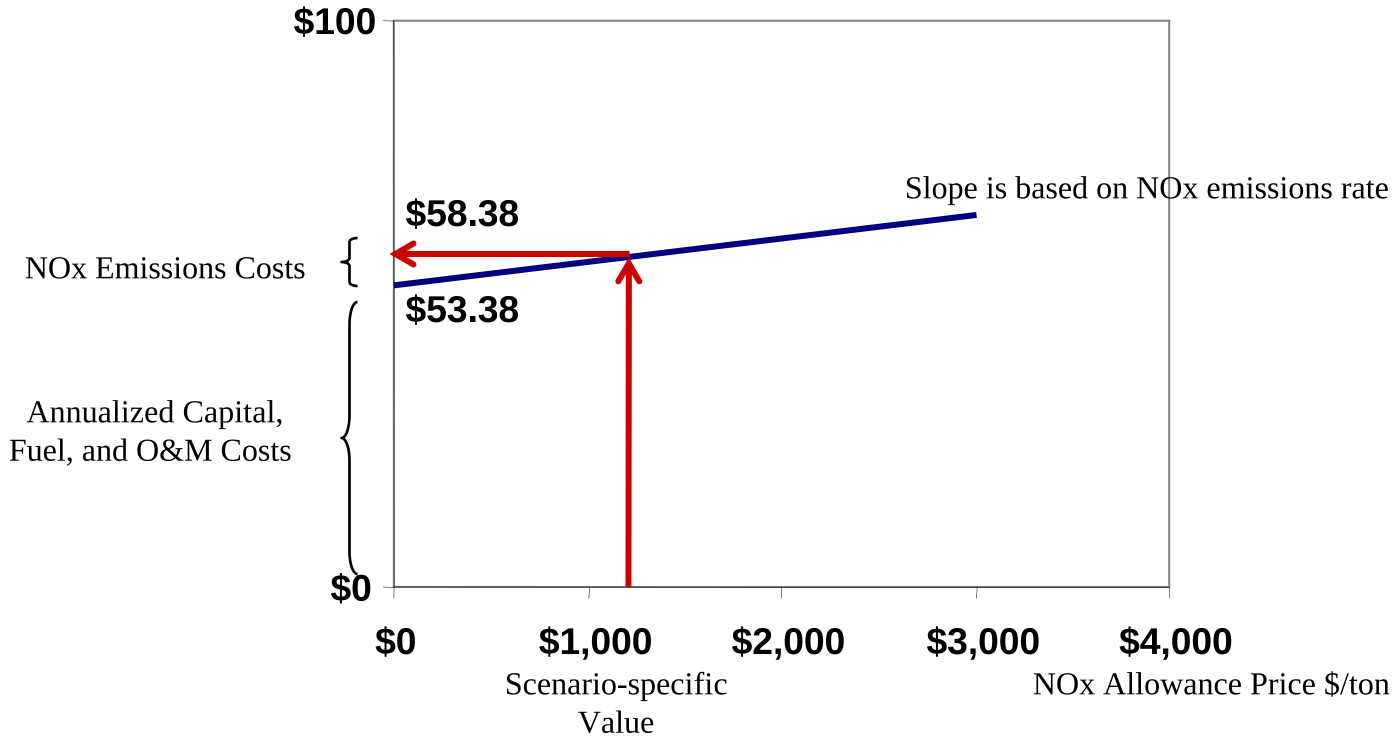
  - Economic Analysis of Emissions-Related Capital Expenditures
  - Regulatory Risk Analysis of Fleet Configuration Decision-Making

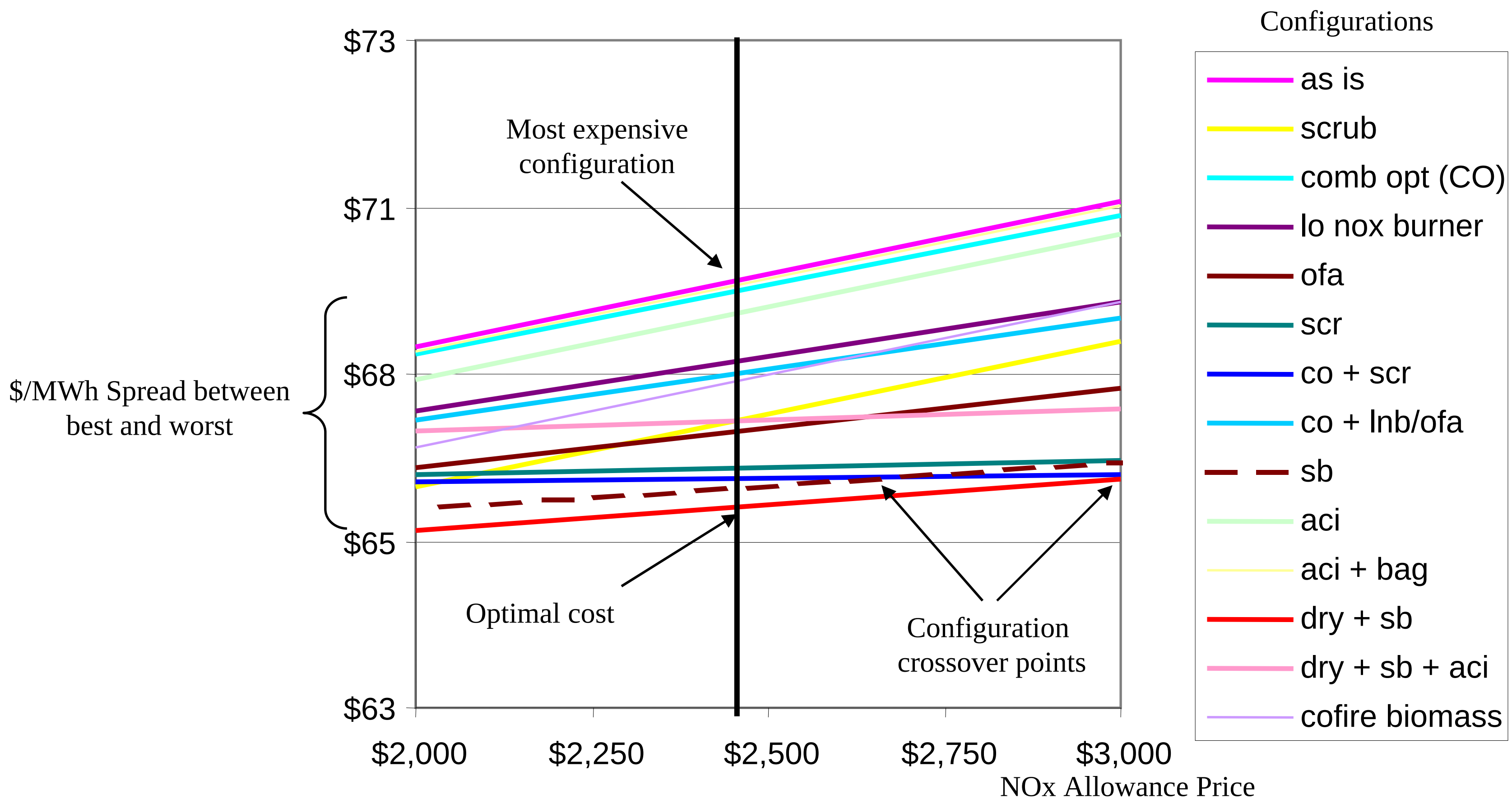
Analysis Overview

- Analysis uses classical economic marginal cost techniques coupled with actual market and operational data
  - Only install new equipment if the average total cost (including capital) is less the than marginal cost of production with the existing configuration (assumes capital is sunk for existing assets).
- Actual historical data can be incorporated for:
  - Emissions prices
  - Fuel prices
  - Operational data on emissions rates
- Questions
  - What equipment should be installed?
  - What market events would cause managers to change their decisions?
  - How do emissions-related capital expenditures affect project values?
  - How should managers allocate a limited capital budget across an entire fleet, given that future regulatory events are uncertain?

Single-Configuration, Single-Plant Example: NO_X



Analysis of Multiple Possible Configurations for a Particular Plant



Fleet-Level Regulatory Risk Analysis

Optimal Configuration in Each Scenario

	State 1	**State 2**	**State 3**	**…**	**State n**	**# Configs**
Plant 1	SB	Dry + SB	SB	…	SB	2
Plant 2	OFA	SB	OFA	…	OFA	2
Plant 3	SCR	Biomass	OFA	…	OFA	3
Plant 4	SB	Biomass	SB	…	SB	1
Plant 5	As Is	As Is	As Is	…	As Is	1
Plant 6	SCR	Biomass	SCR	…	SCR	3
Plant 7	As Is	Biomass	As Is	…	As Is	3
Plant 8	As Is	As Is	As Is	…	As Is	1
Plant 9	As Is	As Is	As Is	…	As Is	1
Plant 10	As Is	As Is	As Is	…	As Is	1

Plants with few optimal configurations
are easier to plan future operations

Dominant Strategy Regret Table

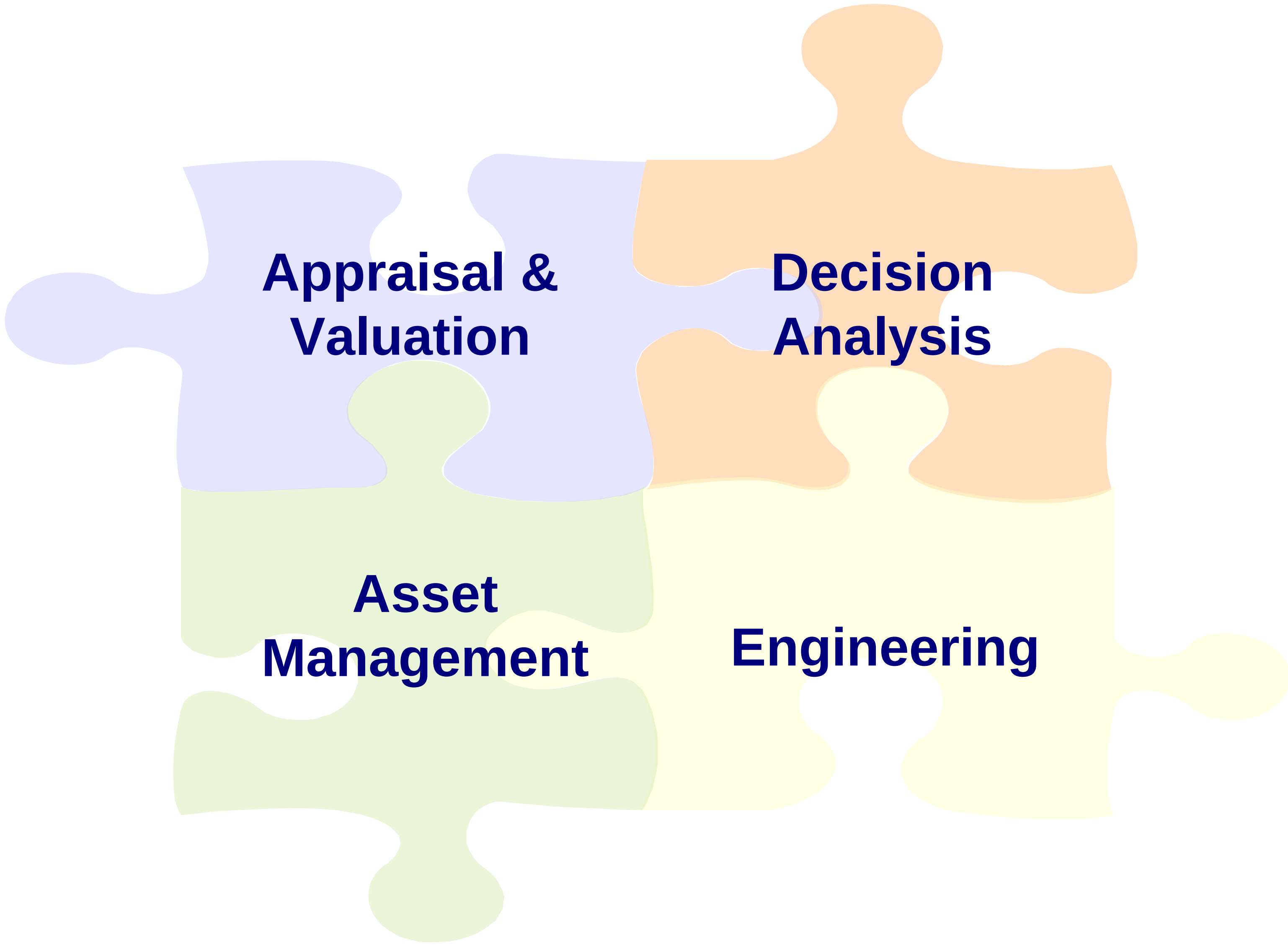
$/MWh Cost of Using Dominant Configuration in Each Scenario

	State 1	State 2	State 3	…	State n	Dominant
Plant 1	$ -	$ (0.61)	$ -	…	$ -	SB
Plant 2	$ -	$ (39.09)	$ -	…	$ -	SCR
Plant 3	$ -	$ (0.95)	$ -	…	$ -	SB
Plant 4	$ -	$ (47.37)	$ -	…	$ -	As Is
Plant 5	$ -	$ (4.05)	$ -	…	$ -	OFA
Plant 6	$ -	$ -	$ -	…	$ -	As Is
Plant 7	$ -	$ -	$ -	…	$ -	As Is
Plant 8	$ -	$ -	$ -	…	$ -	As Is
Plant 9	$ -	$ -	$ -	…	$ -	As Is
Plant 10	$ (0.29)	$ (15.70)	$ -	…	$ -	OFA
Yearly Costs	$ (199,661)	$ (41,557,347)	$ -	…	$ -	

Uncertainty over scenario probabilities can be addressed through minimizing the expected future regret given that *another* scenario were chosen. The State 2 scenario carries with it the potential for substantial regret (and is therefore deserving of considerable further analysis).

Summary

- Most regions now have a wide variety of data available
- New players in energy markets are used to using historical data in their analyses – generators will be judged increasingly by data-intensive metrics, rather than by strategic value
- As markets continue to evolve, new sources of data will become available, providing investors with new ways of analyzing investment values and risks
- Careful use of historical data can <u>significantly</u> improve decision-making accuracy
- Data availability facilitates quantitative risk analysis and simulation-based valuation techniques; these are the new standards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