

Evaluating the Merits of Coal Projects in a Competitive Electric Market

**DOE
GEM-SET:**



Government
Energy
Market
Segment
Evaluation
Tool

*Presented at:
27th International
Technical Conference on
Coal Utilization and
Fuel Systems
Clearwater, Florida -- March
4-7, 2002*

PARSONS

Richard E. Weinstein, P.E.

Co-Authors

Patricia A. Rawls

National Energy Technology Laboratory

Pittsburgh PA campus



Albert A. Herman, Jr.

James J. Lowe

Parsons Corporation

PARSONS

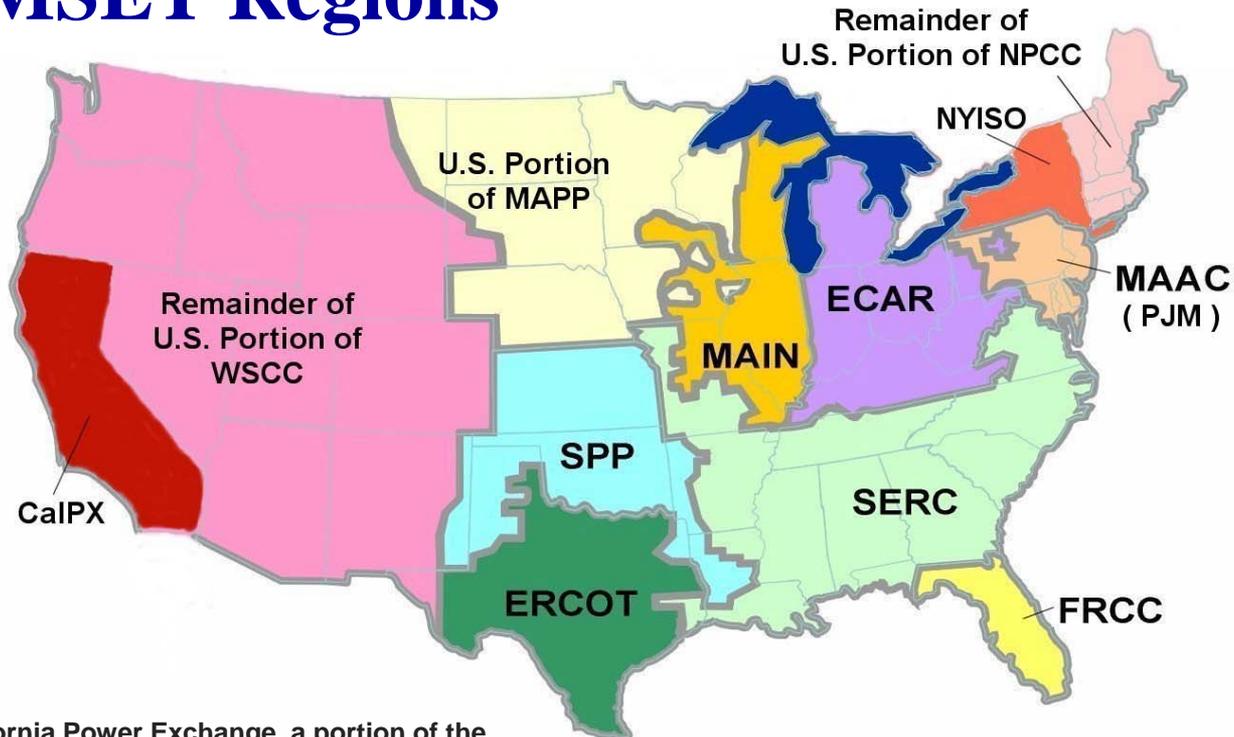
Fleet Modeling Under Different Scenarios

The problem:

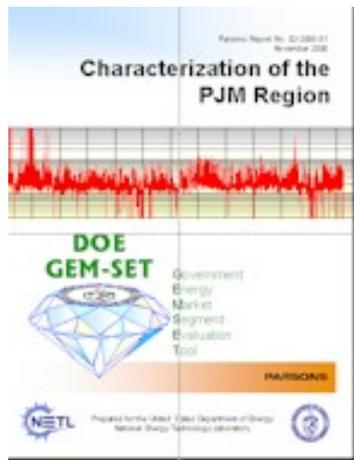
- Estimate demand
- Estimate fuel and operational costs
- Estimate change in revenue
- Estimate change in capacity factor

How?

The GEMSET Regions



- **CALPX** - The California Power Exchange, a portion of the NERC's Western Systems Coordinating Council (WSCC).
 - East Central - East Central Area Reliability Coordination Agreement (ECAR).
- **Florida** - Florida Reliability Coordinating Council (FRCC).
 - Mid-America - Mid-America Interconnected Network (MAIN).
 - Mid-Continent - the U.S. portion of the Mid-Continent Area Power Pool (MAPP).
- **Northeast** - the U.S. portion of NERC's Northeast Power Coordinating Council (NPCC), excluding New York.
 - ■ **NYISO** - The New York ISO, a portion of NERC's Northeast Power Coordinating Council (NPCC).
 - ■ **PJM** - the Pennsylvania, New Jersey, Maryland Interconnect, which comprises the NERC's Mid Atlantic Area Council (MAAC).
 - Southeast - Southeast Electric Reliability Council (SERC).
 - Southwest - Southwest Power Pool (SPP).
- **Texas** - Electric Reliability Council of Texas (ERCOT).
 - **Western** - the U.S. portion of the NERC's Western Systems Coordinating Council (WSCC), excluding California.

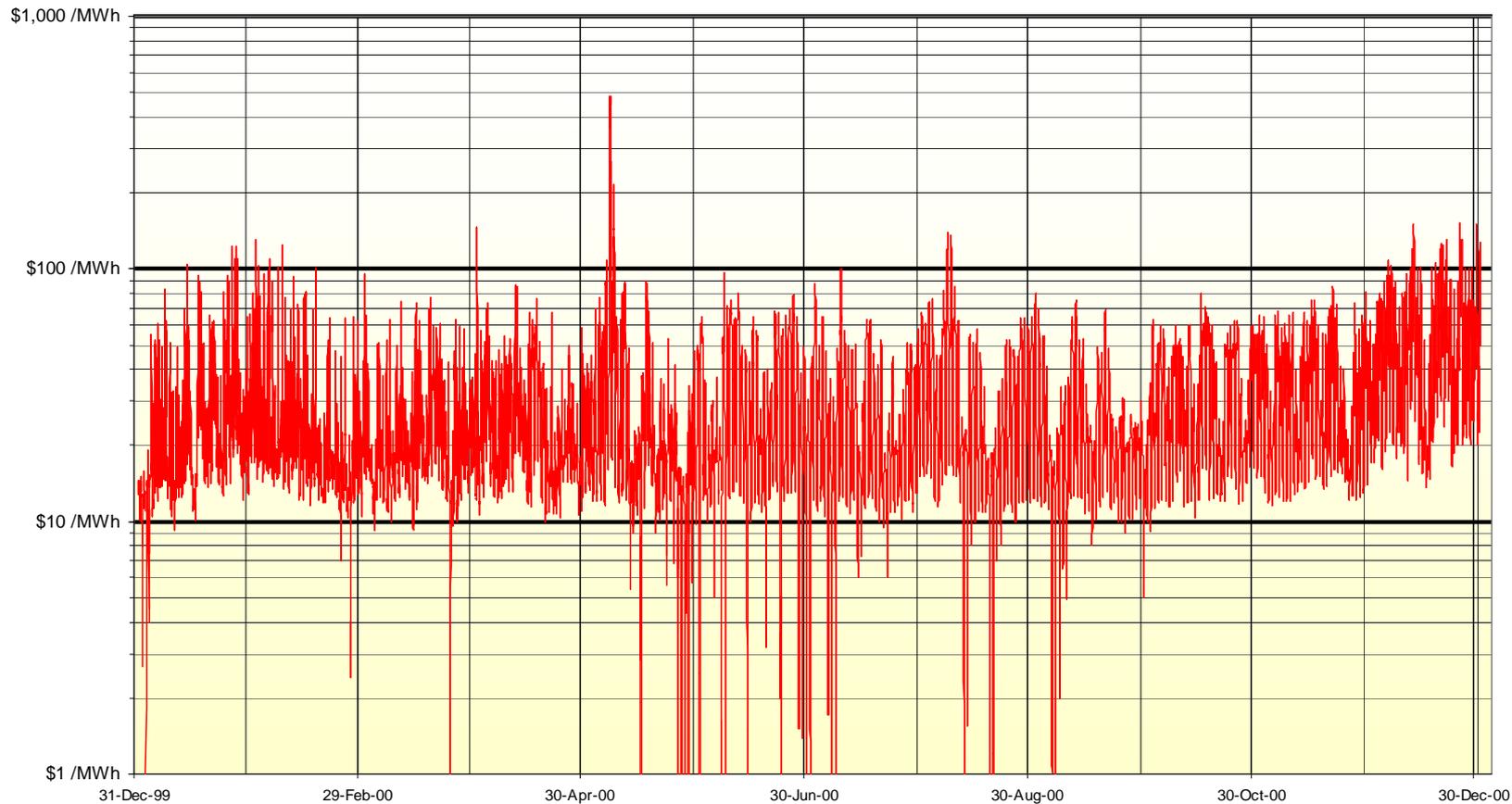


PJM Highlights

- **Competitive Market appears to be working in this region**
- **Demand/Energy forecast is less than 2% through 2015**
- **Approx. 20-25% of energy sold on hour-by-hour, the remaining through bi-laterals**
- **New plants being added to Fleet through an orderly process (a Queue)**
- **Customer savings are minimal from established tariffs (Set by PUC's)**

PJM Day-Ahead Price

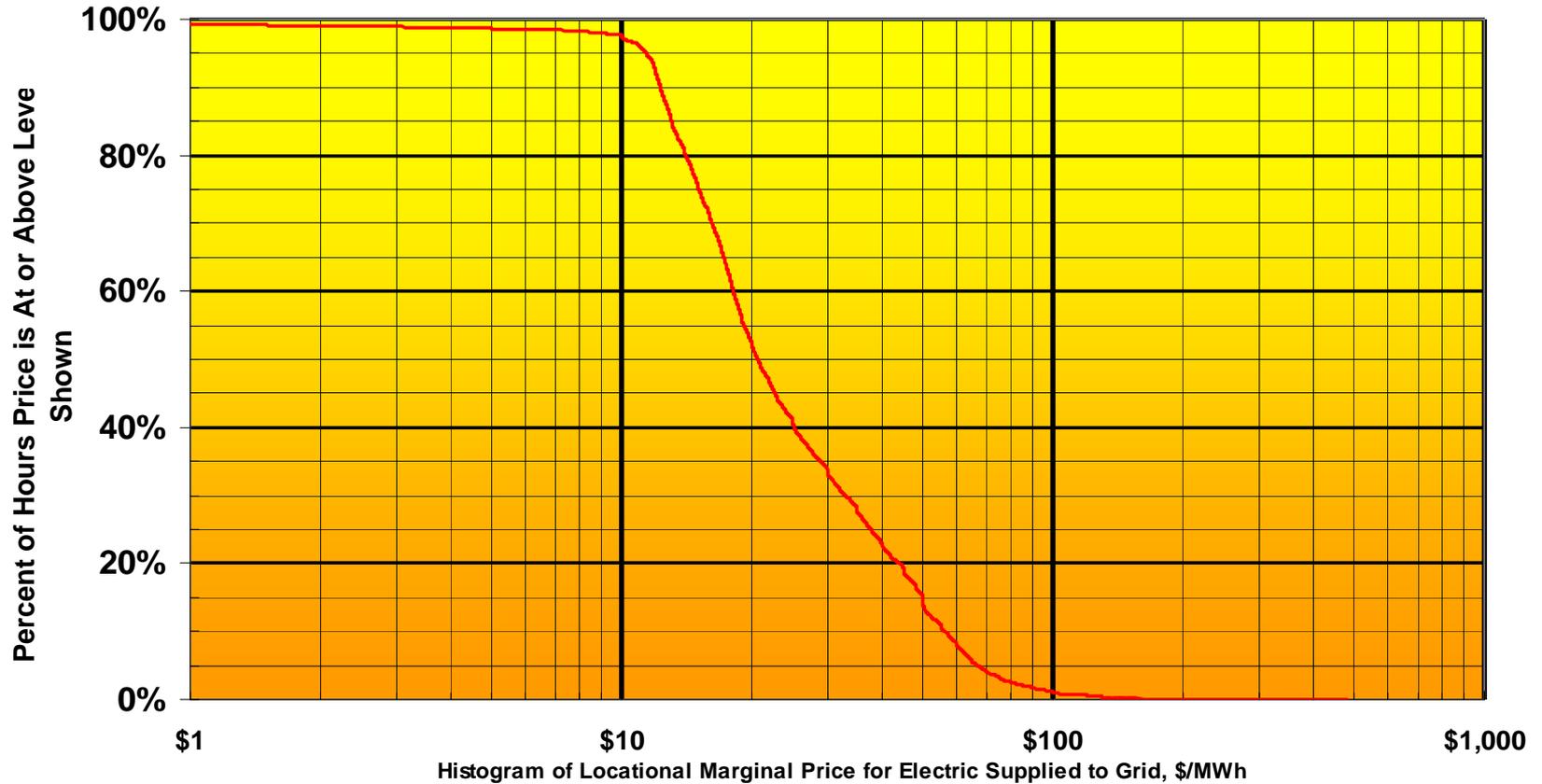
PJM Locational Marginal Price: PJM ZONE January 2000-December 2000



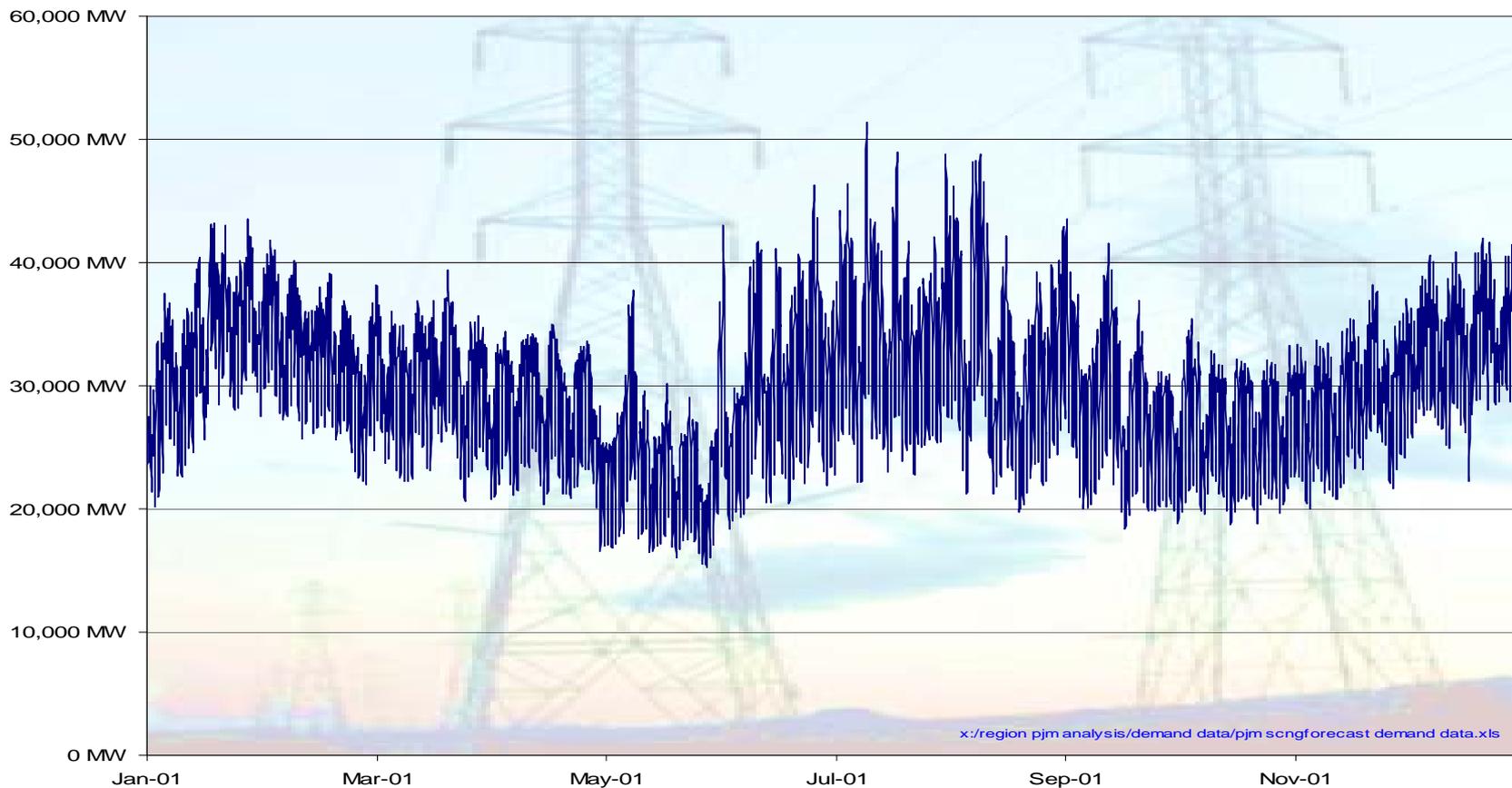
PJM Price Duration Histogram

PJM Locational Marginal Price

January 2000-December 2000

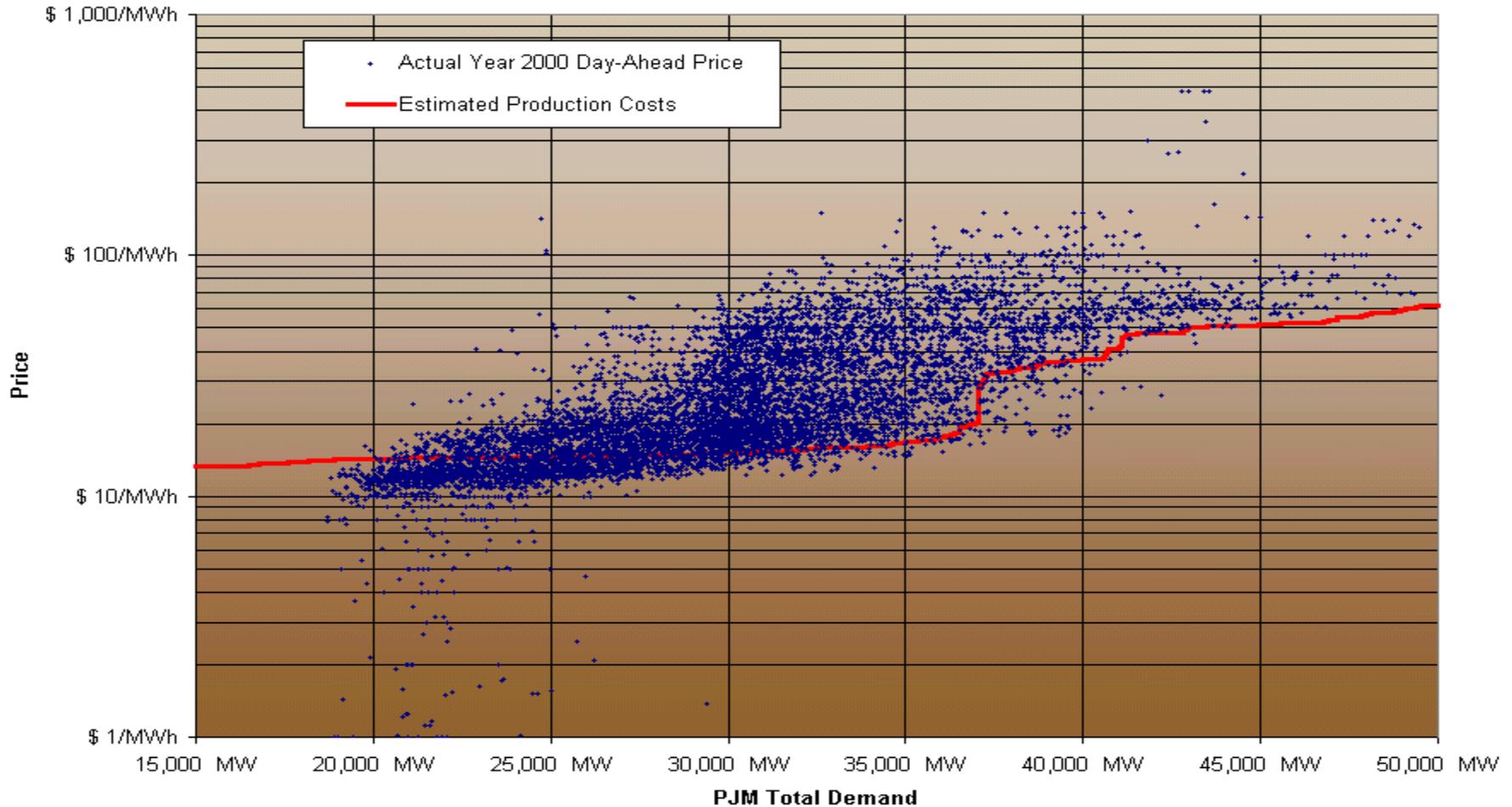


PJM Hourly Demands - 2001



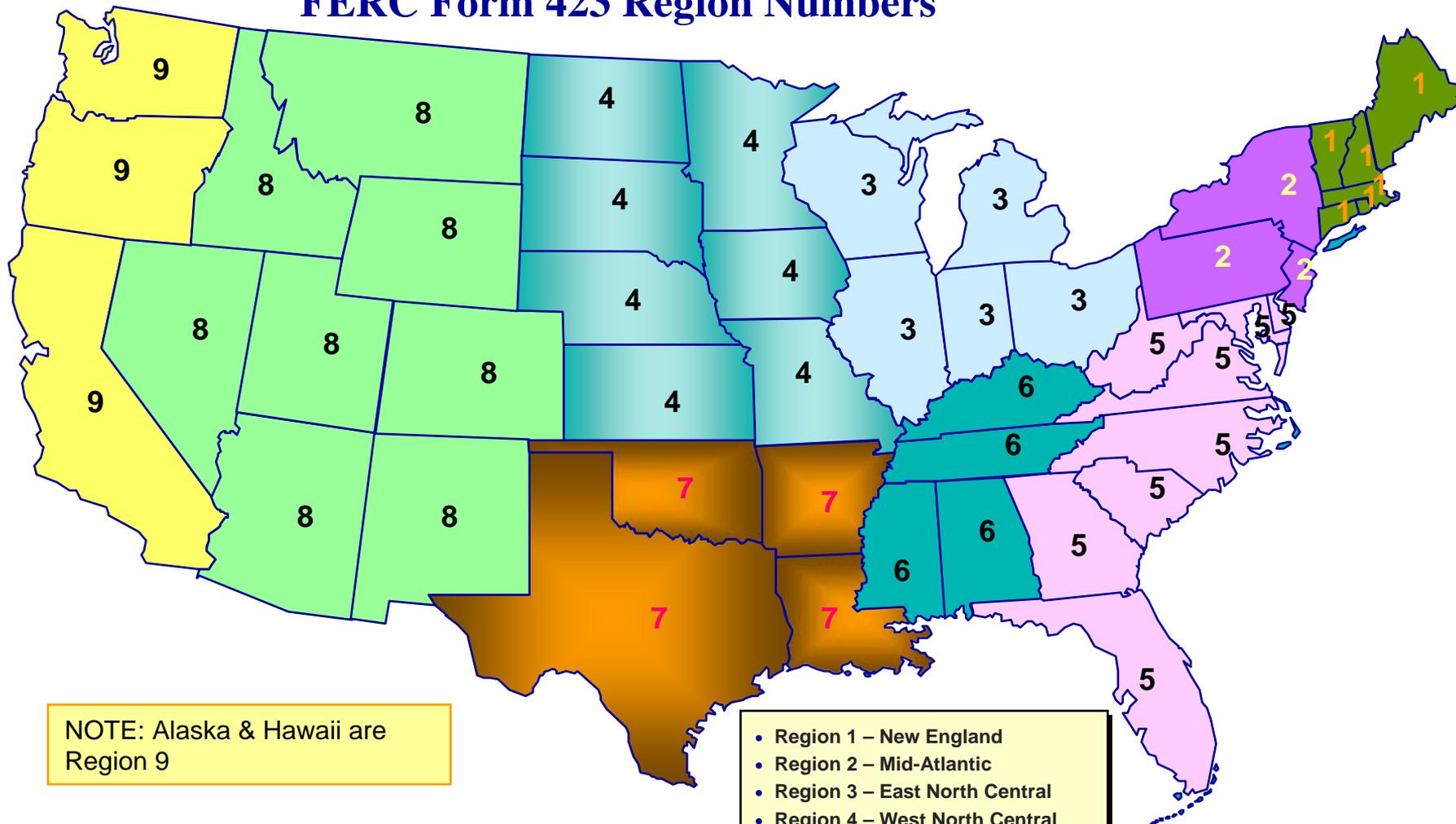
PJM Price vs. Demand Correlation

PJM Price vs. Demand for the Year 2000 Compared to Estimated Production Cost vs. Demand



GEMSET Fuel Regions

FERC Form 423 Region Numbers



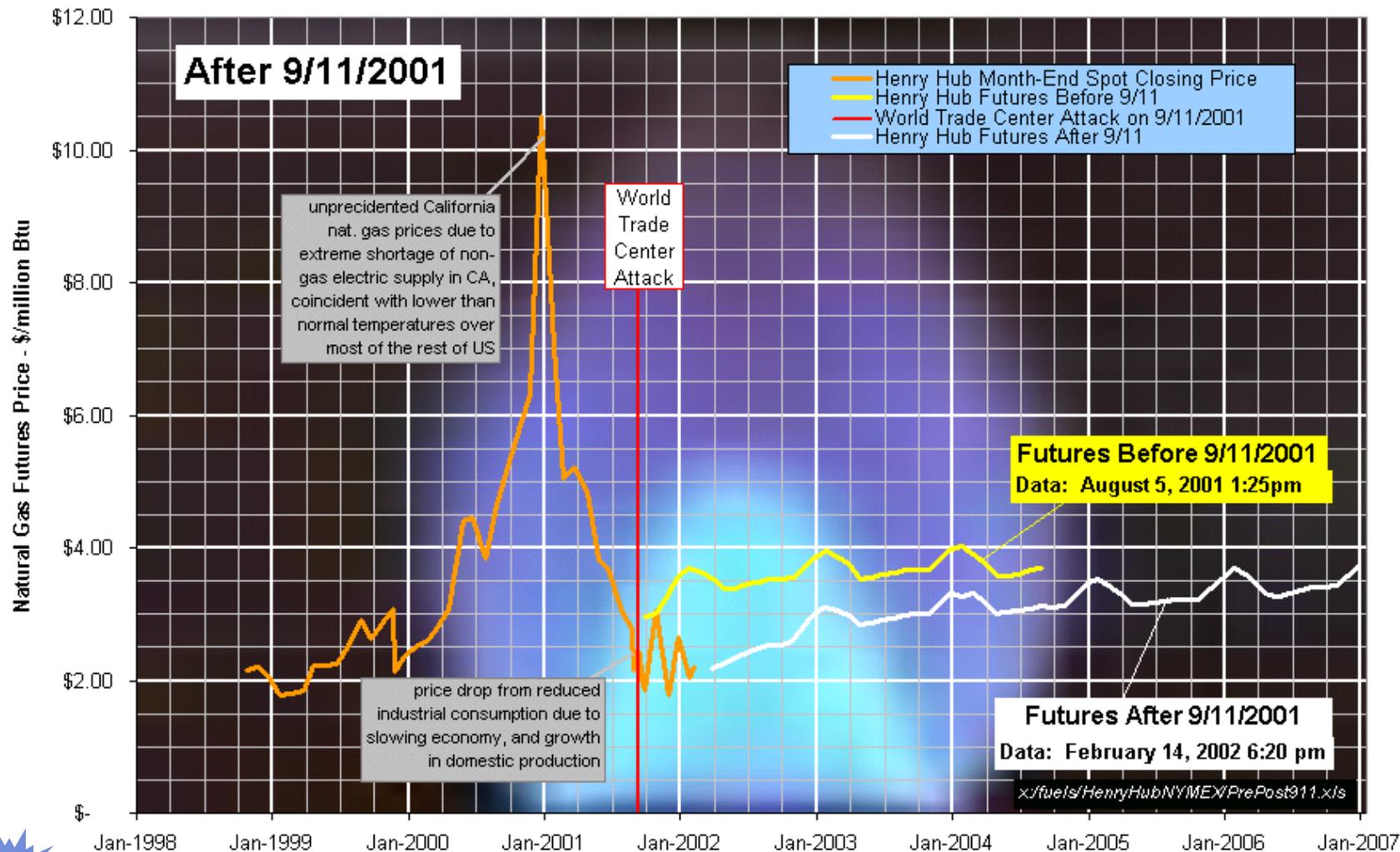
NOTE: Alaska & Hawaii are Region 9

- Region 1 – New England
- Region 2 – Mid-Atlantic
- Region 3 – East North Central
- Region 4 – West North Central
- Region 5 – South Atlantic
- Region 6 – East South Central
- Region 7 – West South Central
- Region 8 – Mountain
- Region 9 – Pacific

Recent Henry Hub Trading

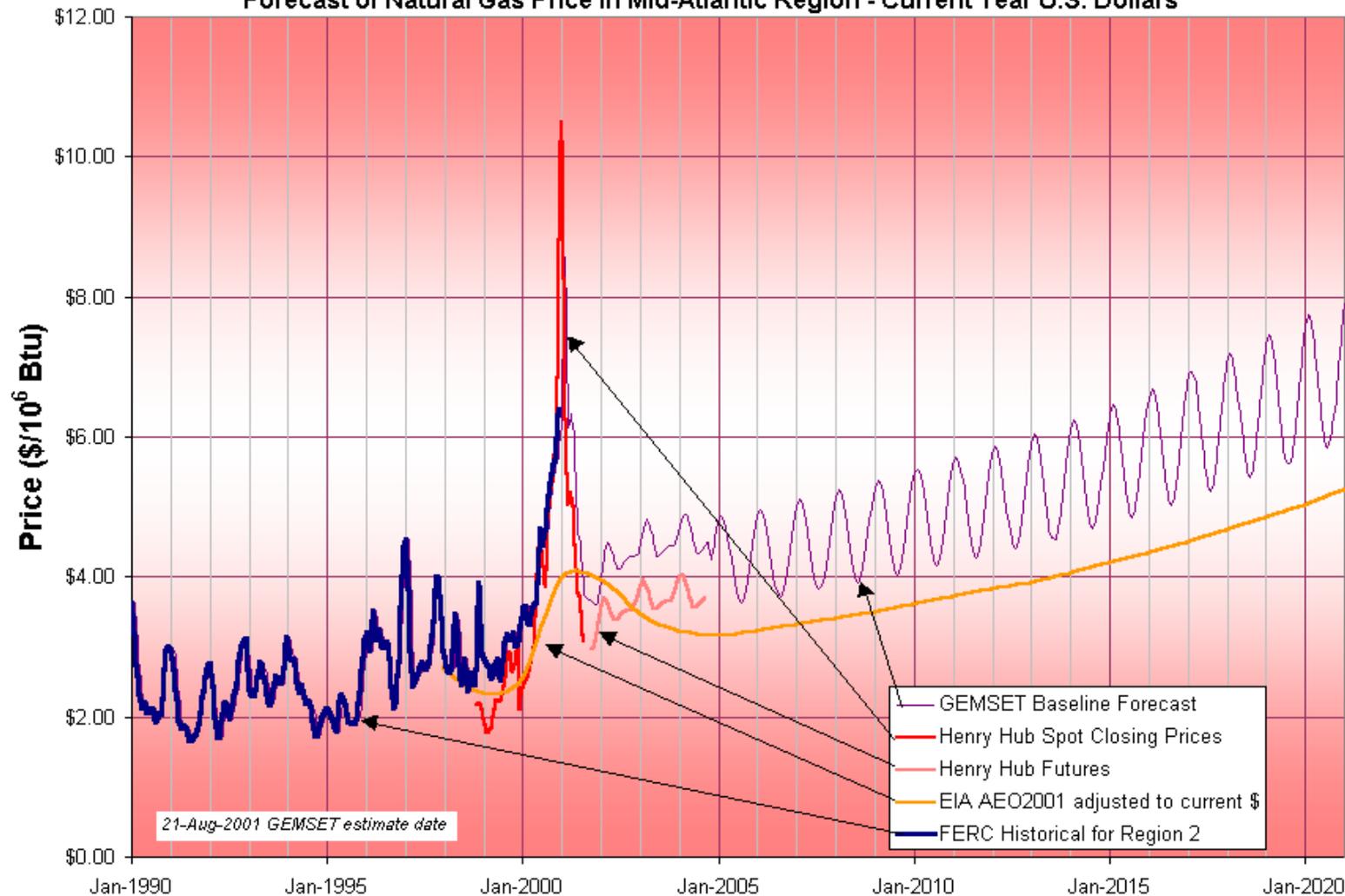
New York Merchantile Exchange (NYMEX) Henry Hub Natural Gas Futures Market

<http://www.nymex.com/markets/newquotes.cfm?showAll=on&contract=NG#NG> 14 Feb 2002 6:20 pm

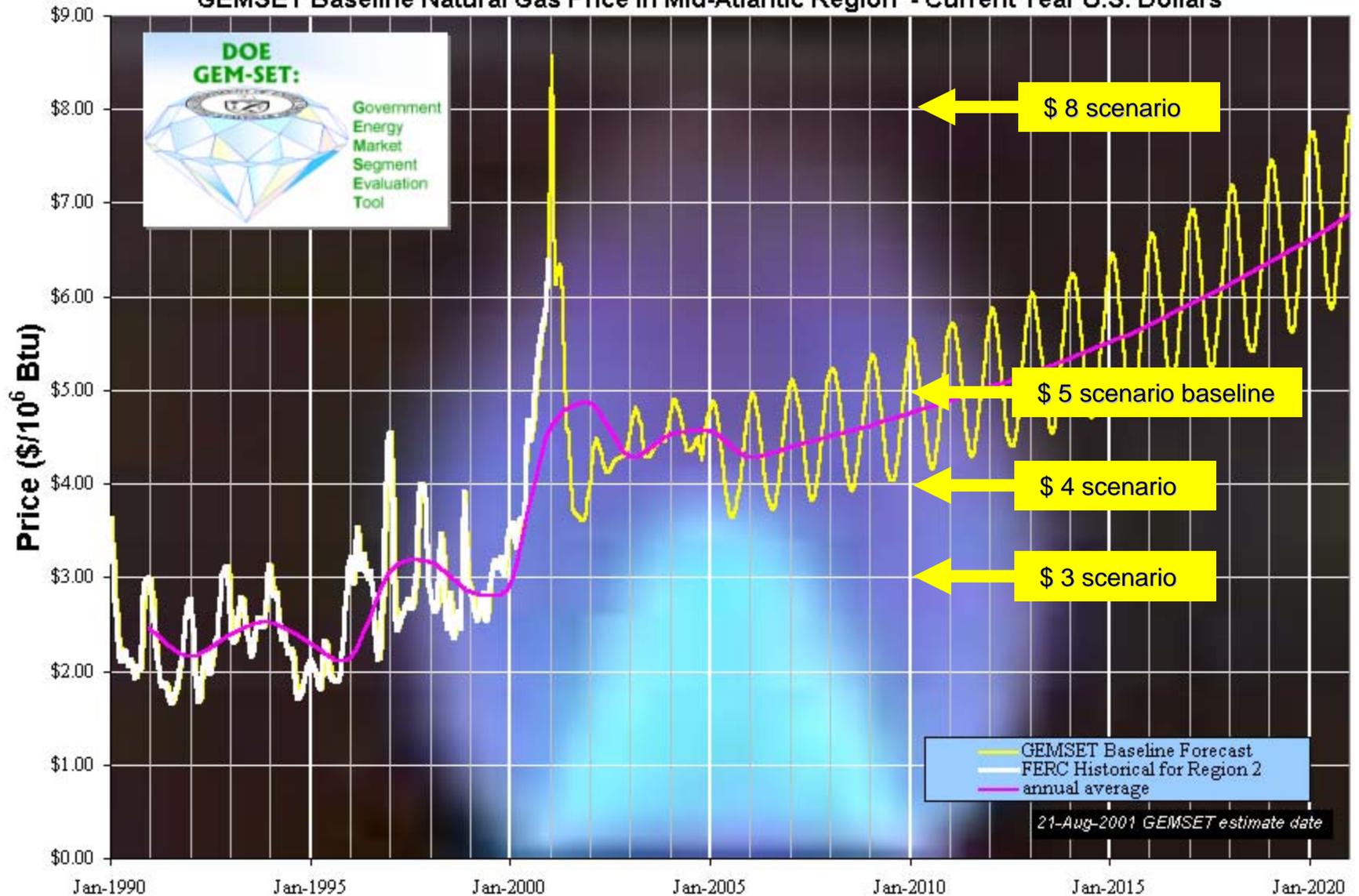


Estimating Fuel Price

Forecast of Natural Gas Price in Mid-Atlantic Region - Current Year U.S. Dollars

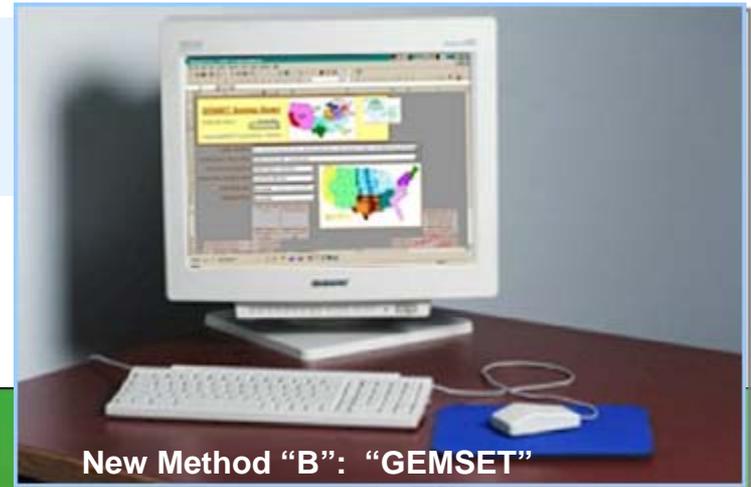


GEMSET Baseline Natural Gas Price in Mid-Atlantic Region - Current Year U.S. Dollars

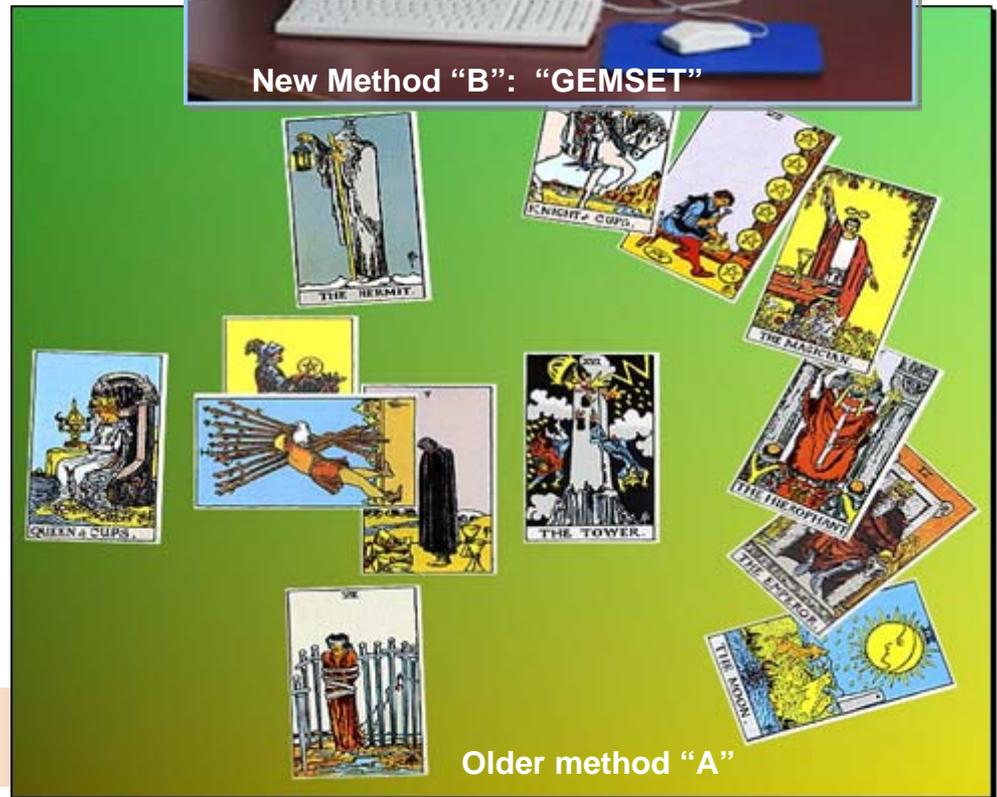


How GEMSET Forecasts the Future

GEMSET Support for Sub-Policy Planning

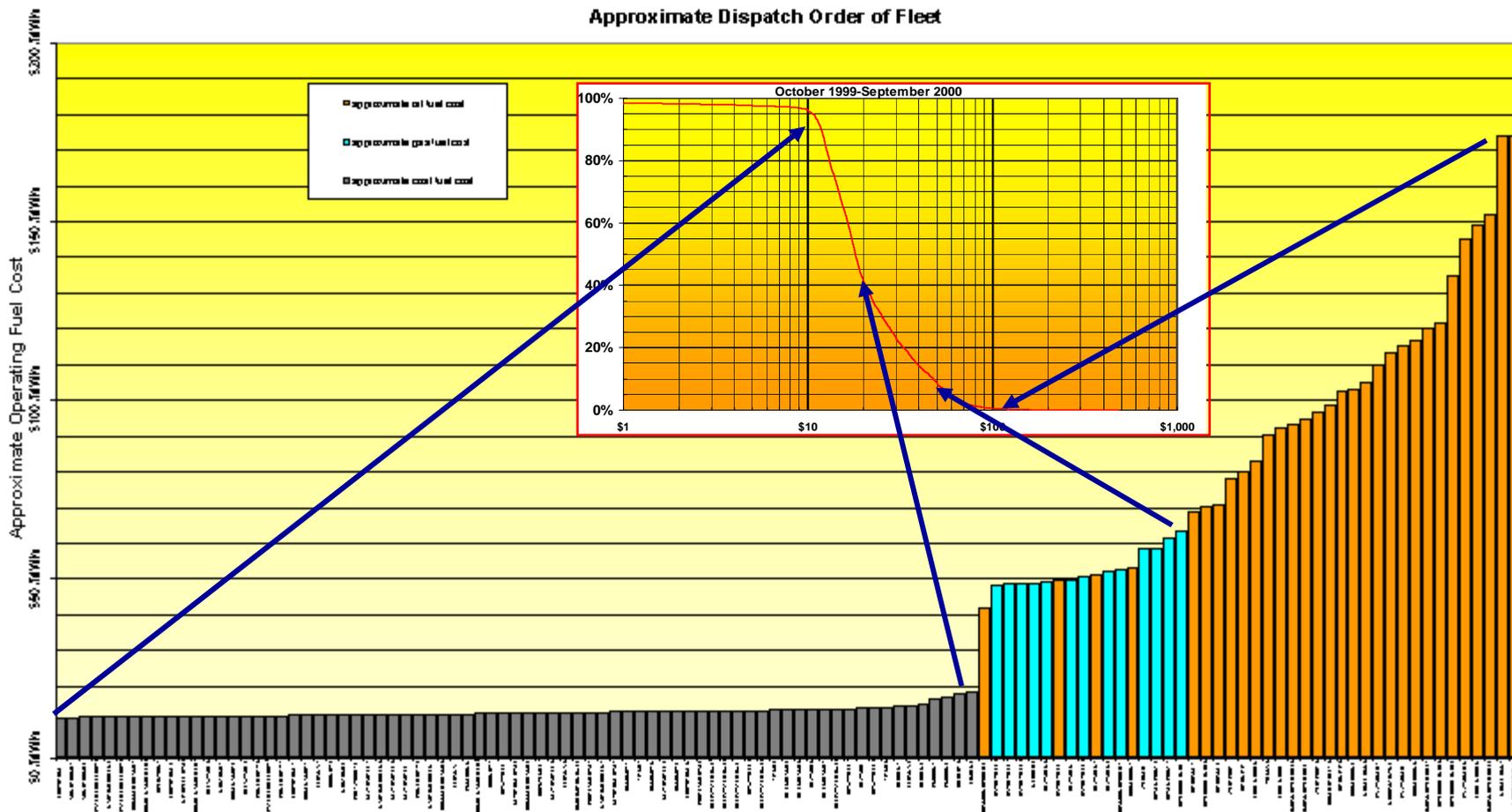


New Method "B": "GEMSET"



Older method "A"

Build Region from Existing Fleet



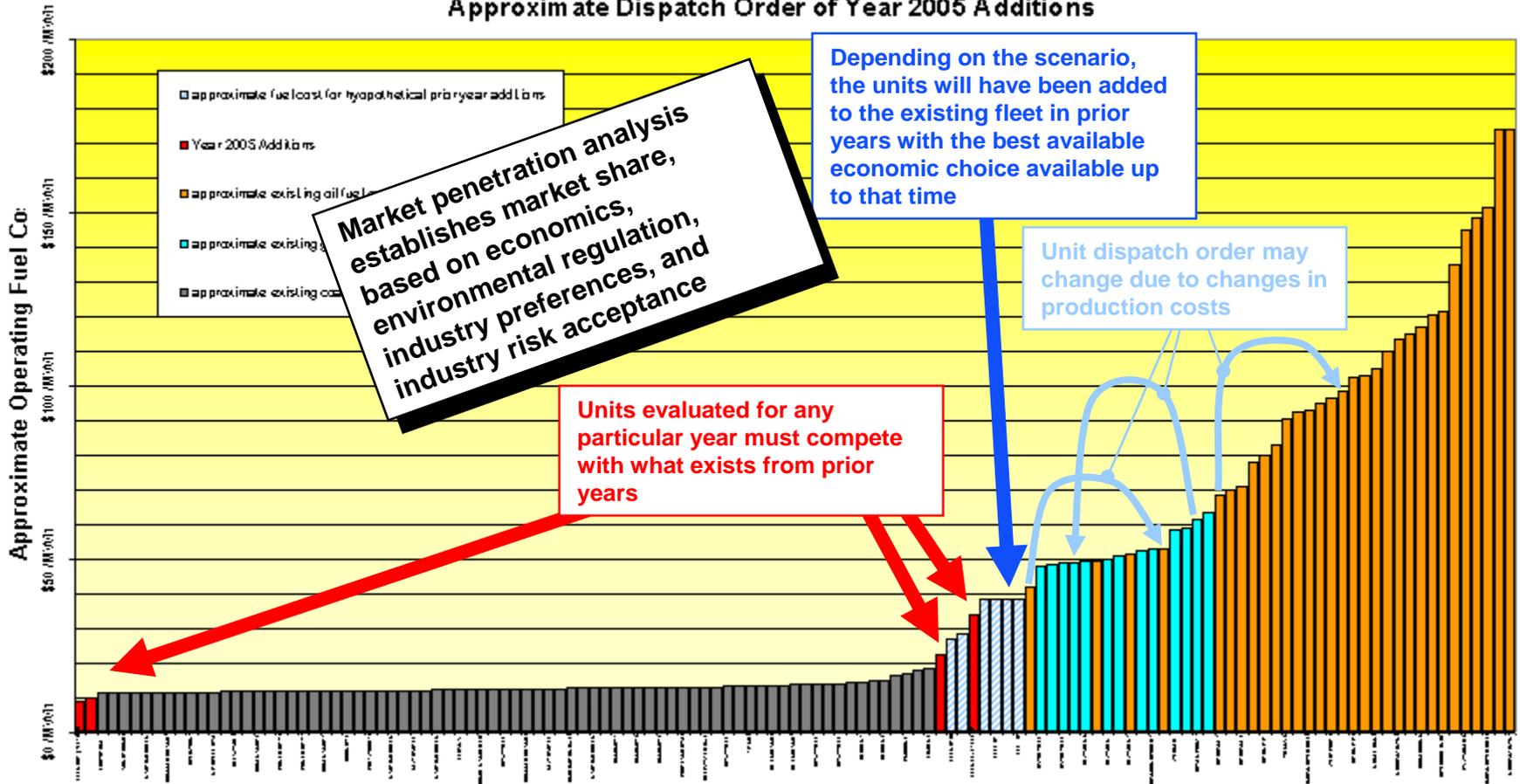
Units Arranged in Threshold Bid Price Order

The Economics of Gas Turbines in the PJM Region
Exhibit 6-1. GEMSET Baseline Threshold Bid Price Ranking Order of Existing Units in the PJM Fleet (continued)
 Baseline \$1.35/10⁶ Btu coal -- \$5.00/10⁶ Btu gas

Utility	Plant Name	Unit Type	Fuel	Summer kW	Cumulative MW
Dover City Of	General Foods	ST	COL	16,100	36,525
Pennsylvania Power & Light Co.	Montour	ST	COAL	15,000	36,540
Potomac Electric Power Co.	Potomac River	ST	COAL	102,000	36,842
Potomac Electric Power Co.	Potomac River	ST	COAL	102,000	36,744
Pennsylvania Power & Light Co.	Holtwood	ST	COAL	-	36,744
UGI Corp.	Hunlock Power Sta	ST	COAL	48,000	36,792
Sithe Power Marketing, L. P.	Warren	ST	COAL	41,000	36,833
Sithe Power Marketing, L. P.	Warren	ST	COAL	41,000	36,874
Atlantic Electric / Conectiv	Warren	ST	COAL	10,700	36,885
Atlantic Electric / Conectiv	Mobil NUG	ST	COL	10,700	36,896
Sithe Power Marketing, L. P.	Mobil NUG	ST	COL	136,000	37,033
Public Service Electric & Gas Co.	Seward	ST	COL	445,000	37,478
Pennsylvania Power & Light Co.	Bergen	CT	GAS	2,500	37,480
Pennsylvania Power & Light Co.	Martins Creek	IC	FO2	2,500	37,483
Public Service Electric & Gas Co.	Martins Creek	IC	FO2	230,000	37,713
Public Service Electric & Gas Co.	Bergen	CW	GAS	184,000	37,925
Public Service Electric & Gas Co.	Burlington	GT	NG	195,000	38,145
Public Service Electric & Gas Co.	Eagle Point	CC	GAS	168,000	38,339
Potomac Electric Power Co.	Essex	GT	NG	139,000	38,506
Potomac Electric Power Co.	Dickerson	GT	NG	139,000	38,673
Public Service Electric & Gas Co.	Dickerson	GT	NG	134,000	38,832
Public Service Electric & Gas Co.	Kearny	GT	NG	149,000	38,991
Public Service Electric & Gas Co.	Kearny	GT	NG	134,000	39,150
Public Service Electric & Gas Co.	Camden	CC	GAS	134,000	39,150

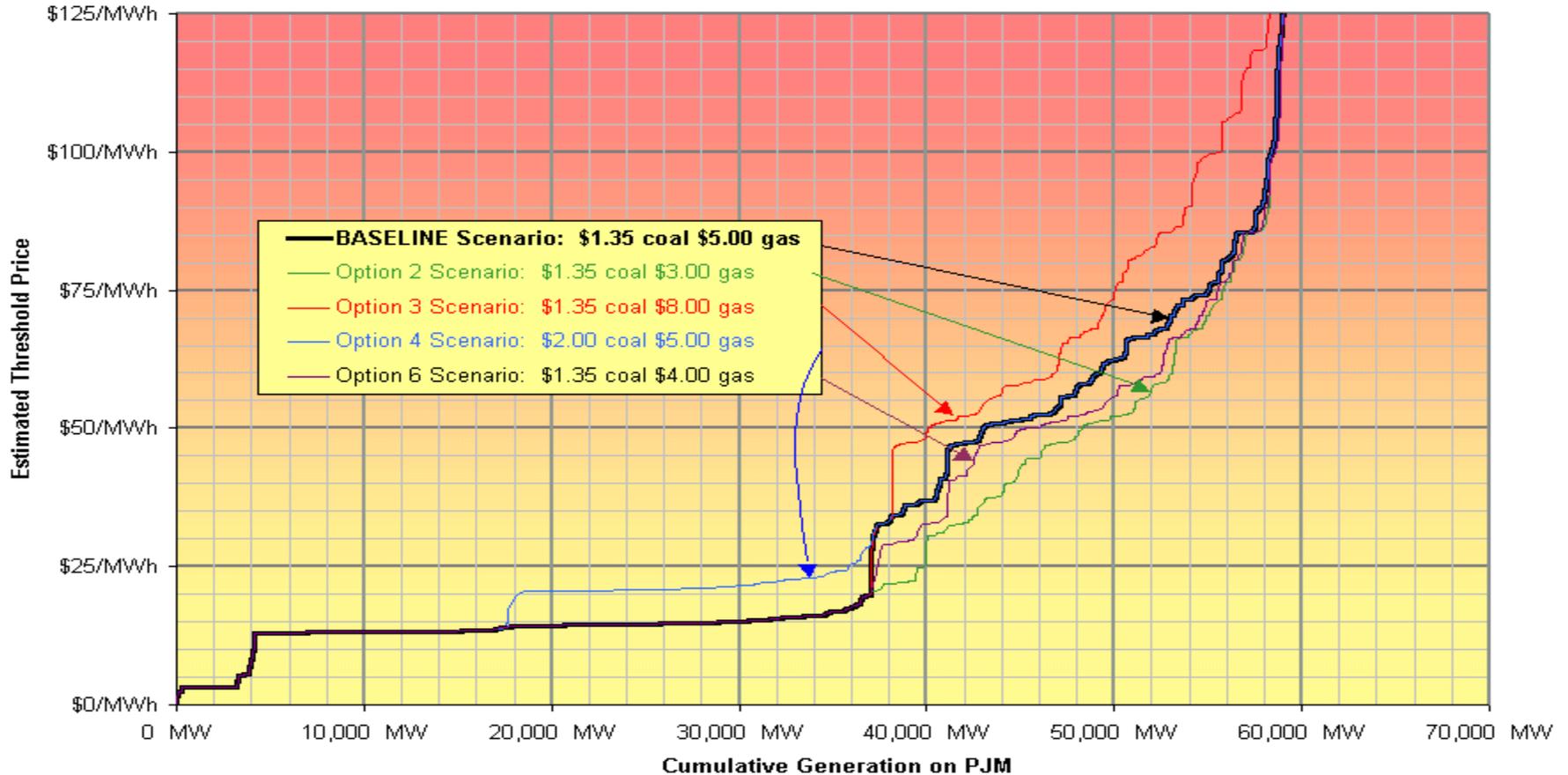
Build Region from Existing Fleet

Approximate Dispatch Order of Year 2005 Additions



Production Cost Estimates

Comparison of Production Cost Histograms Estimated for PJM
 Year 2000 GEMSET Estimates Under a Range of Fuel Cost Scenarios



GEMSET Methodology for Study

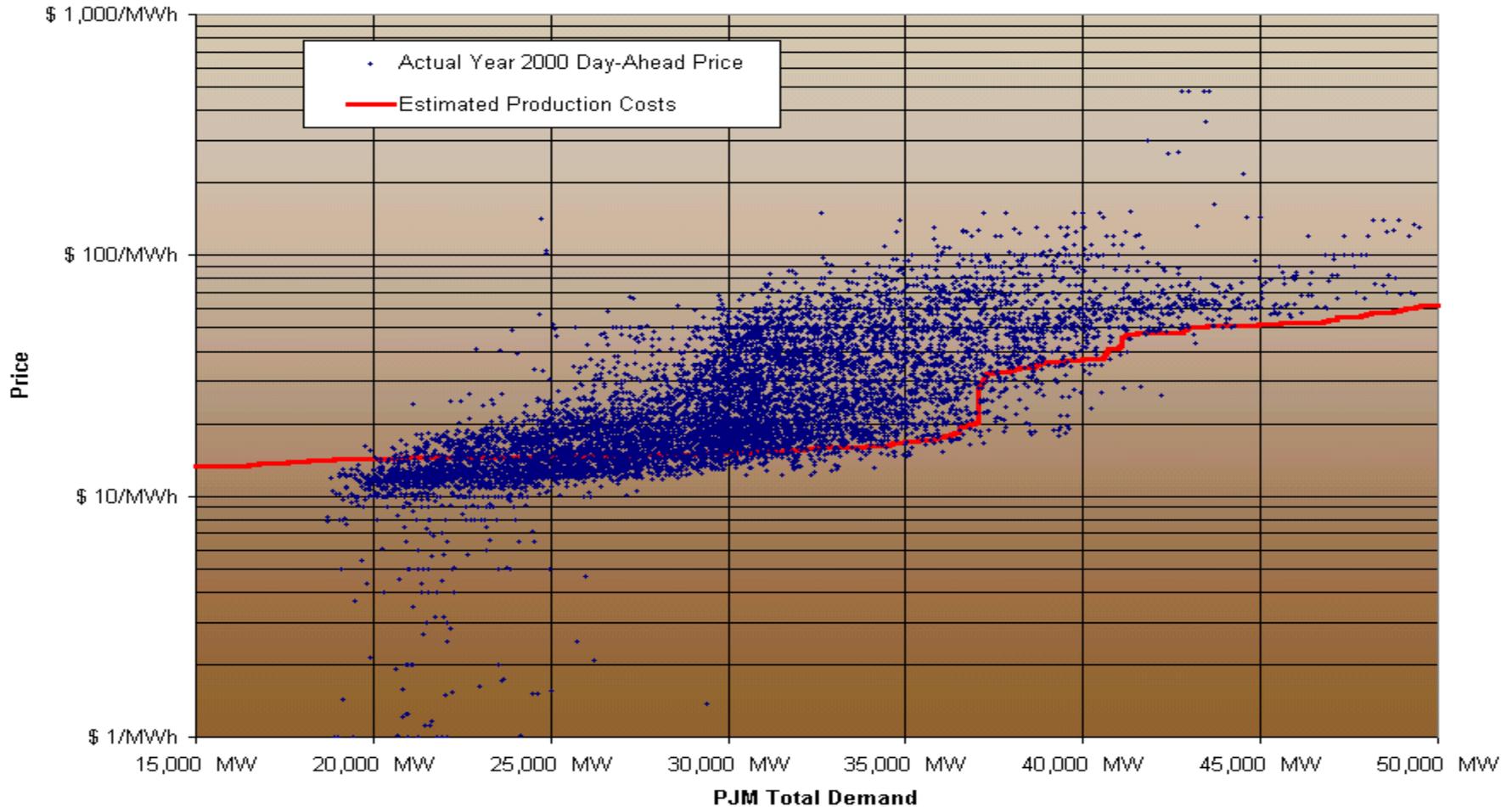
Estimating the Effects of Competition

Relating Demand and Production Costs to Threshold Bid Price

- An unmanipulated market is a random walk
- Gamesmanship establishes bid price, but all owners are constrained by their production costs
- No model can predict the hour-by-hour variation
- Expectation is that the amount of volatility and variability of bid prices to estimated production costs will over a year be about the same
- An “inferred competition ratio” for each hour maps a bid strategy that in aggregate models bidding under the various scenarios

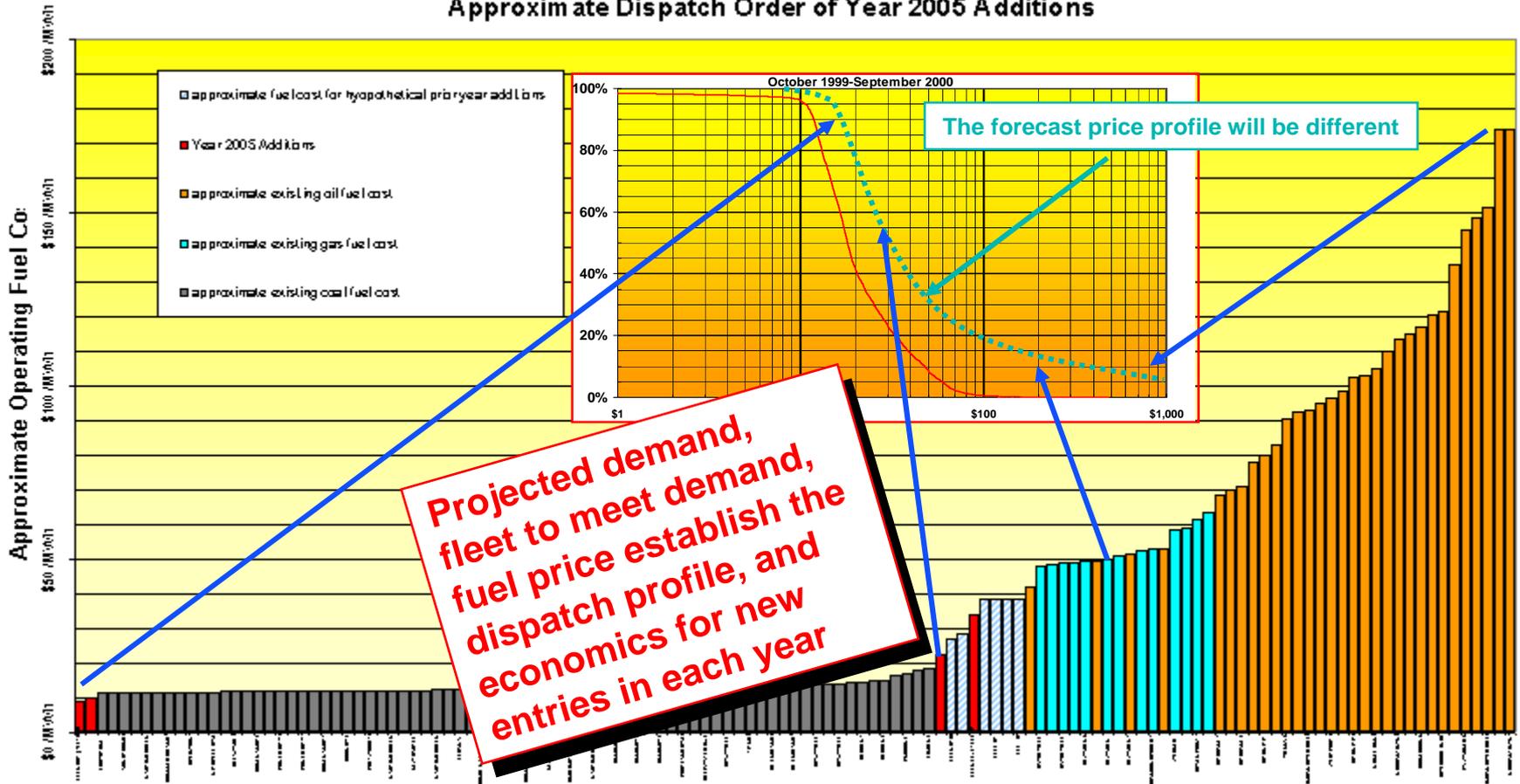
PJM Price vs. Demand Correlation

PJM Price vs. Demand for the Year 2000 Compared to Estimated Production Cost vs. Demand



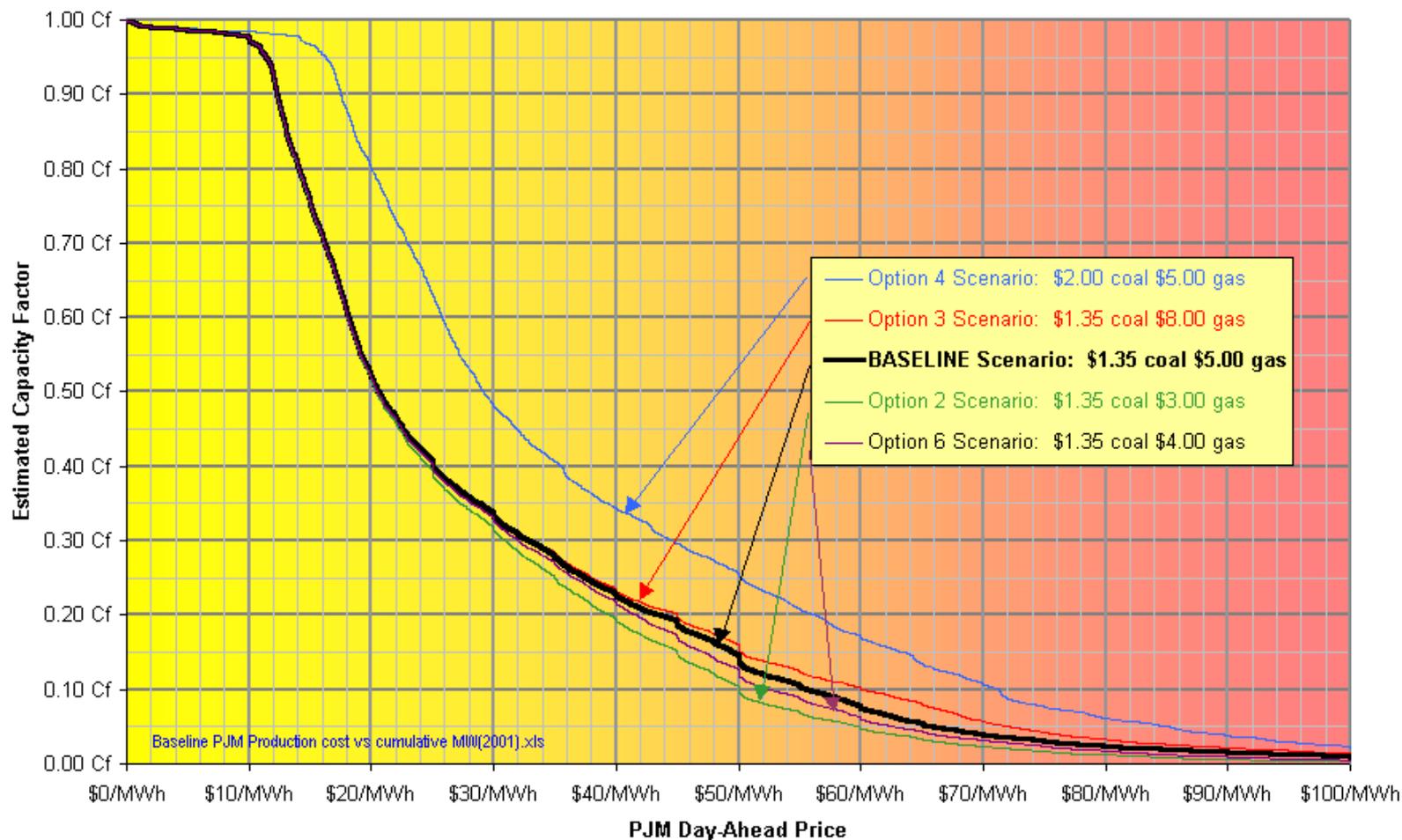
Forecast Prices and Dispatch for the New Scenario

Approximate Dispatch Order of Year 2005 Additions



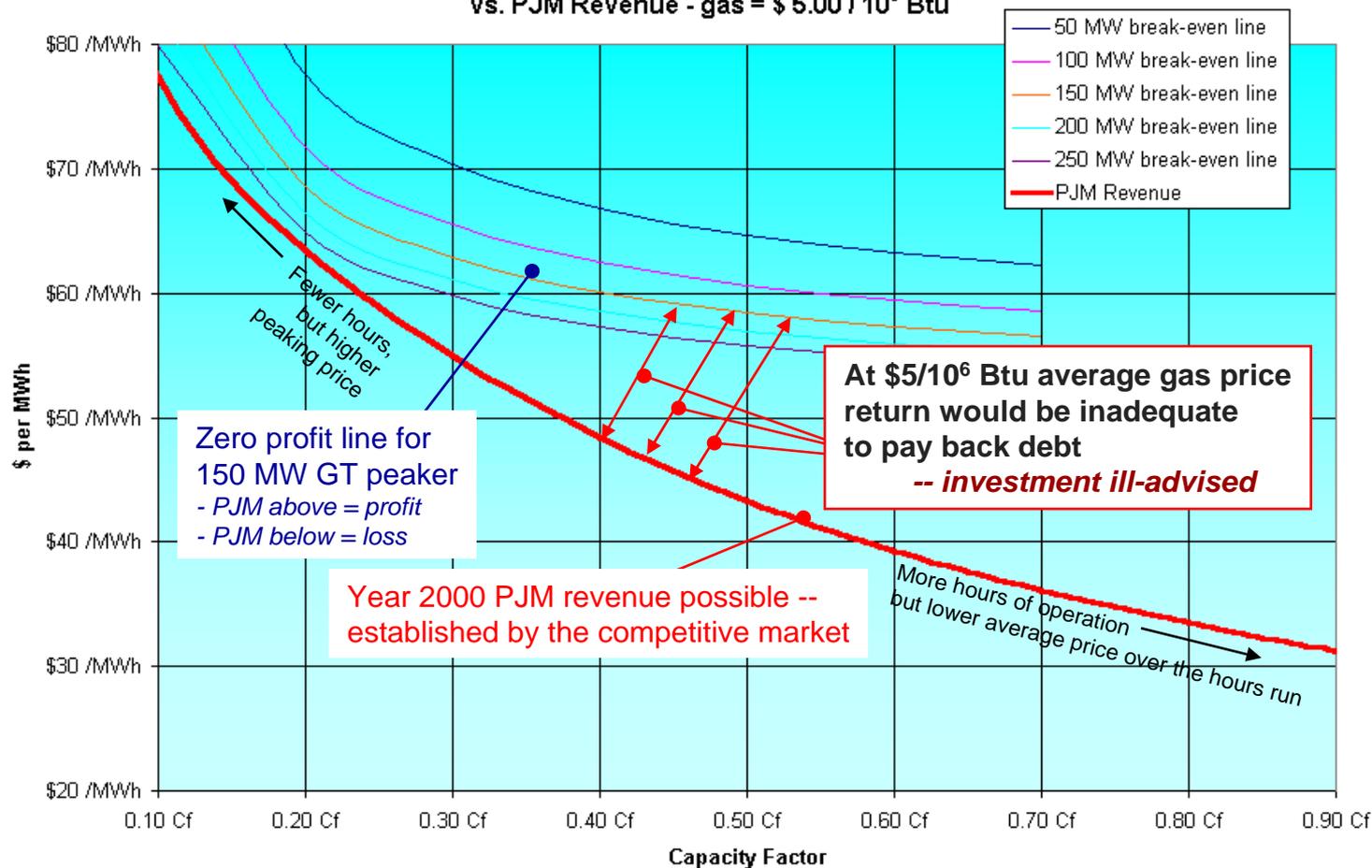
Estimated CF vs. Threshold Bid Price for Each Scenario

Estimated Capacity Factor Under Different Fuel Price Scenarios
PJM Year 2000



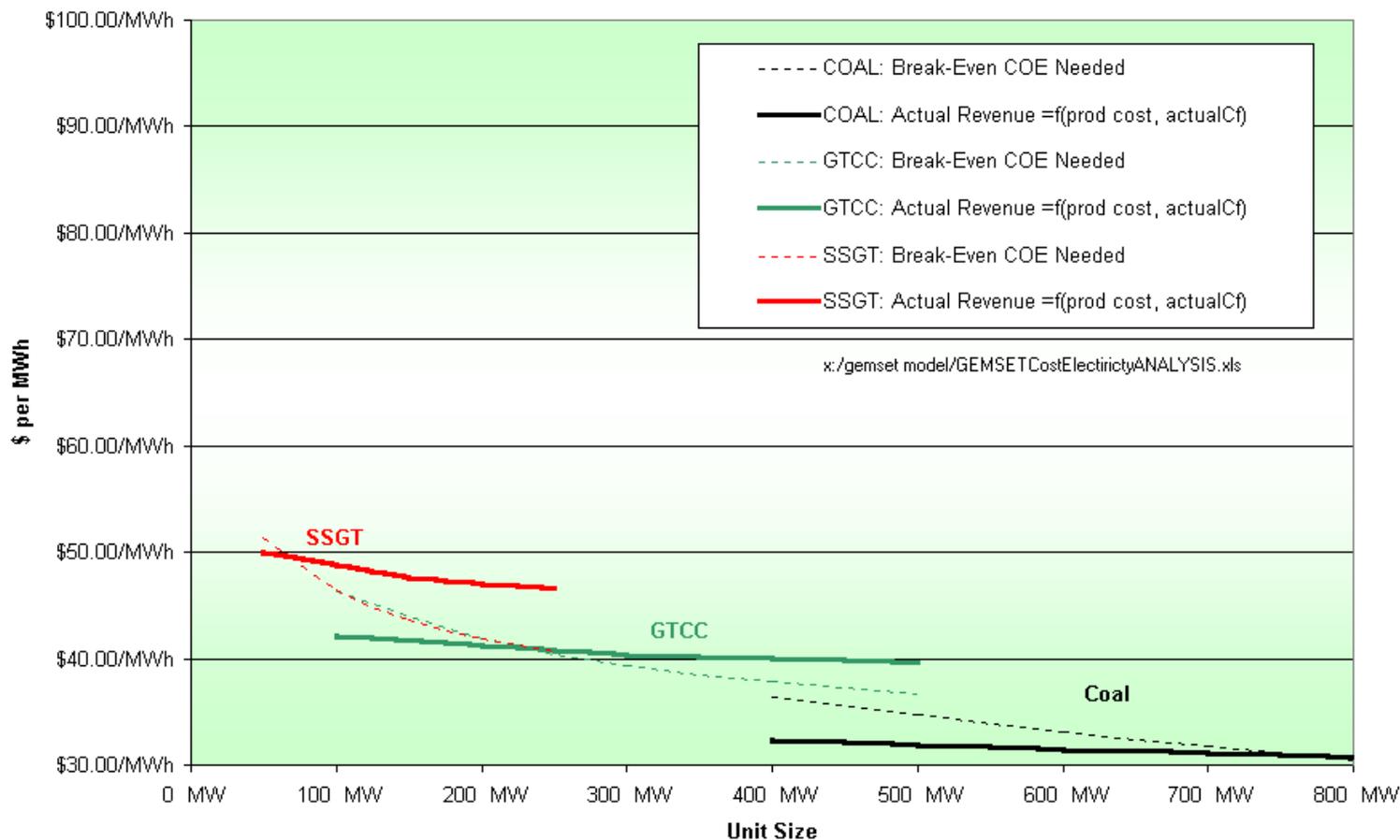
HIGHER RISK -- Owner's Return Depends on Uncertain Market Conditions

Baseline PJM Year 2000: Break-Even COE for Simple Cycle Gas Turbine Peakers
vs. PJM Revenue - gas = \$ 5.00 / 10⁶ Btu



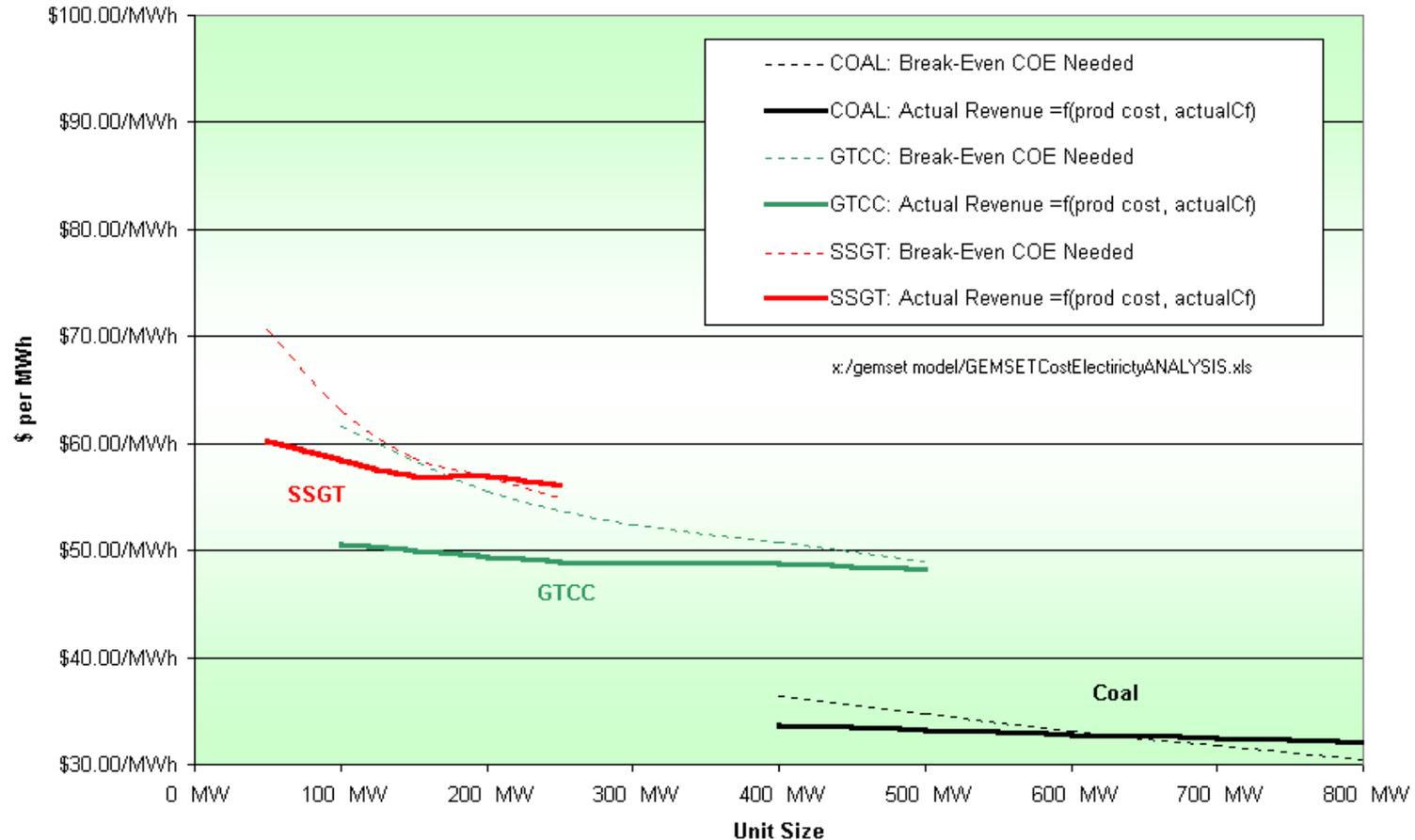
Economics: \$ 3 / 10⁶ Btu Natural Gas

Scenario 2 PJM Year 2000: Comparison of Coal Break-Even COE vs. Revenue Expectation
 coal=\$1.35/10⁶ Btu gas=\$3.00/10⁶ Btu



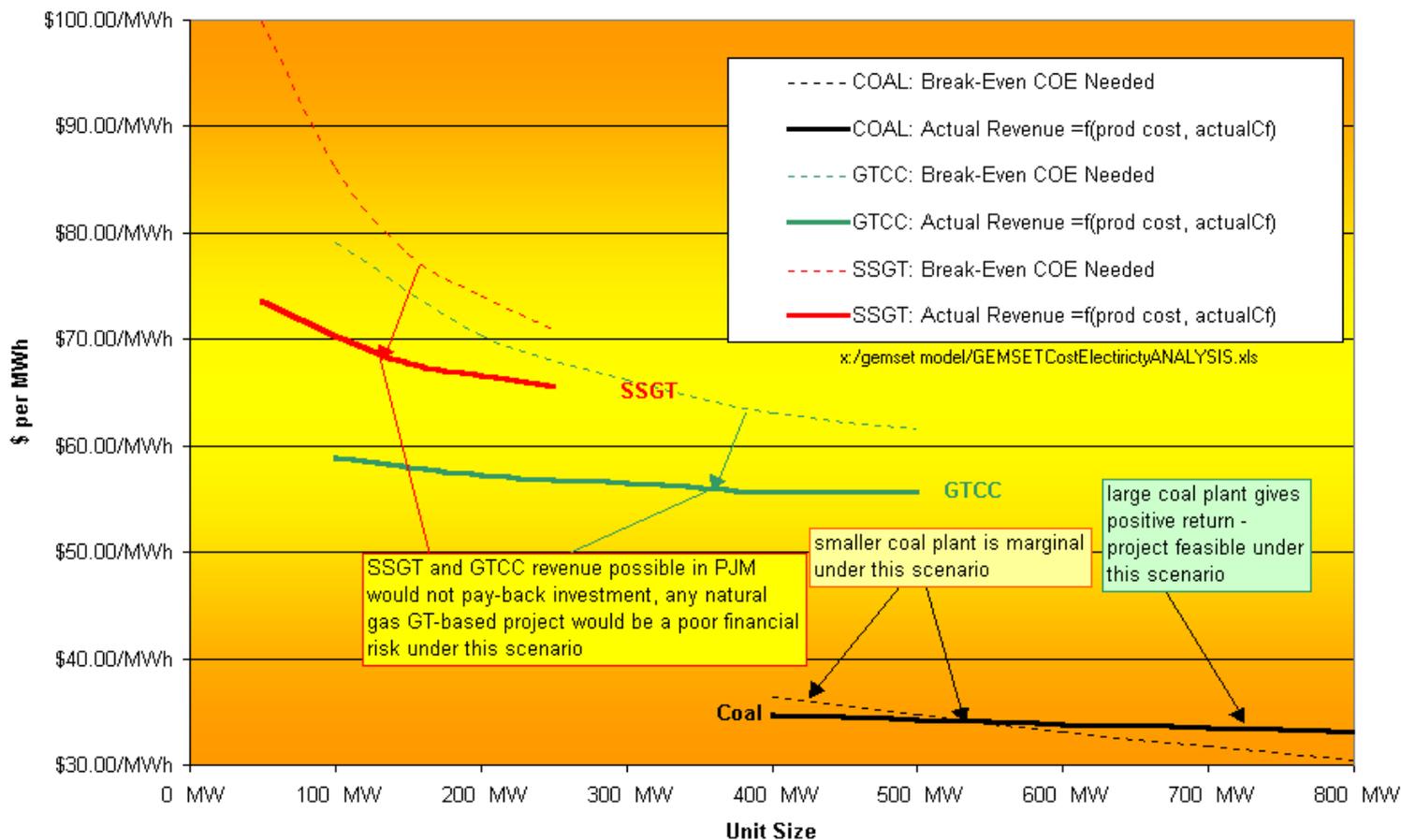
Economics: \$ 4 / 10⁶ Btu Natural Gas

Scenario 6 PJM Year 2000: Comparison of Break-Even COE vs. Revenue Expectation
coal=\$1.35/10⁶ Btu gas=\$4.00/10⁶ Btu



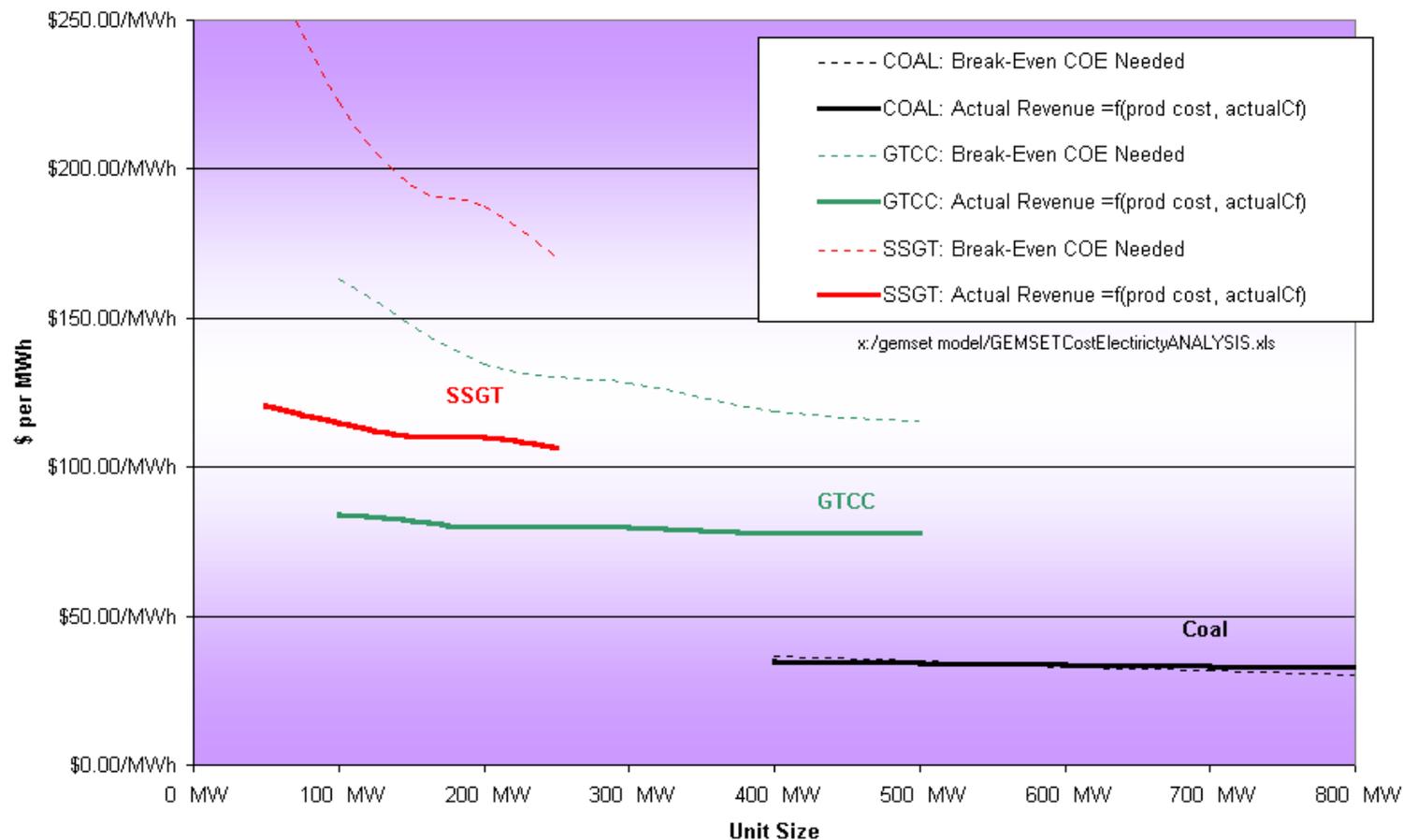
Economics: \$ 5 / 10⁶ Btu Natural Gas

Baseline PJM Year 2000: Comparison of Break-Even COE vs. Revenue Expectation
coal=\$1.35/10⁶ Btu gas=\$5.00/10⁶ Btu



Economics: \$ 8 / 10⁶ Btu Natural Gas

Scenario 3 PJM Year 2000: Comparison of Break-Even COE vs. Revenue Expectation
 coal=\$1.35/10⁶ Btu gas=\$8.00/10⁶ Btu



Profit vs. Natural Gas Price in PJM

