

## **ELMO -- Electric Market Optimization Model for Analysis of Strategic Behavior and Market Power**

Synapse Energy Economics, Inc. has developed a computer model to simulate the strategic pricing behavior of participants in wholesale electricity markets. The ELMO system can be used to assess the extent to which market power will be a problem in specific situations, and the extent to which various policies will be effective at mitigating the market power of dominant firms.

### **Market Power in Electricity Generation**

Analysis of opportunities for strategic anti-competitive market behavior should be an essential part of assessing electric utility mergers and/or the removal of economic regulation in electricity markets. Electric industry restructuring will only produce benefits for consumers if truly competitive markets replace cost-based regulatory pricing. In a competitive market, suppliers are “price-takers,” that is, their pricing and operating decisions do not significantly influence the market price. However, if a dominant supplier, or group of suppliers, can control market prices -- perhaps by withholding capacity from the market or by strategically bidding some generating units high in certain hours -- then customer may be harmed by deregulation.

ELMO can help assess the extent of market power the effectiveness of policy options such as (1) limiting the ownership of generating capacity, (2) putting certain supply resources under long-term contract, (3) increasing transmission capability, (4) promoting demand-side price response, (5) fixing supply bids for various periods (e.g., day-ahead, week-ahead), (6) and capping bids at various levels.

### **Input Data Requirements**

The data required for analysis of market power using ELMO include hourly customer loads, capacity and operating costs for generating units, ownership and control of generation, and transmission intertie capability. In addition, policies can be simulated:

- decreasing market concentration by breaking up ownership of capacity (or precluding a merger),
- requiring that bids be fixed a day (or more) ahead,
- requiring that bids be capped at a specific level (absolute or relative to cost),
- increasing intertie capacity, and
- providing for demand participation in the market.

Quantitative analysis of such policies can help to determine whether and to what extent they might be effective in addressing market power concerns.

### **Simulation Modes**

The simplest simulation mode is for single-owner strategy at specified levels of demand. Operating profits for that owner are calculated for a range of bids. This can be useful in

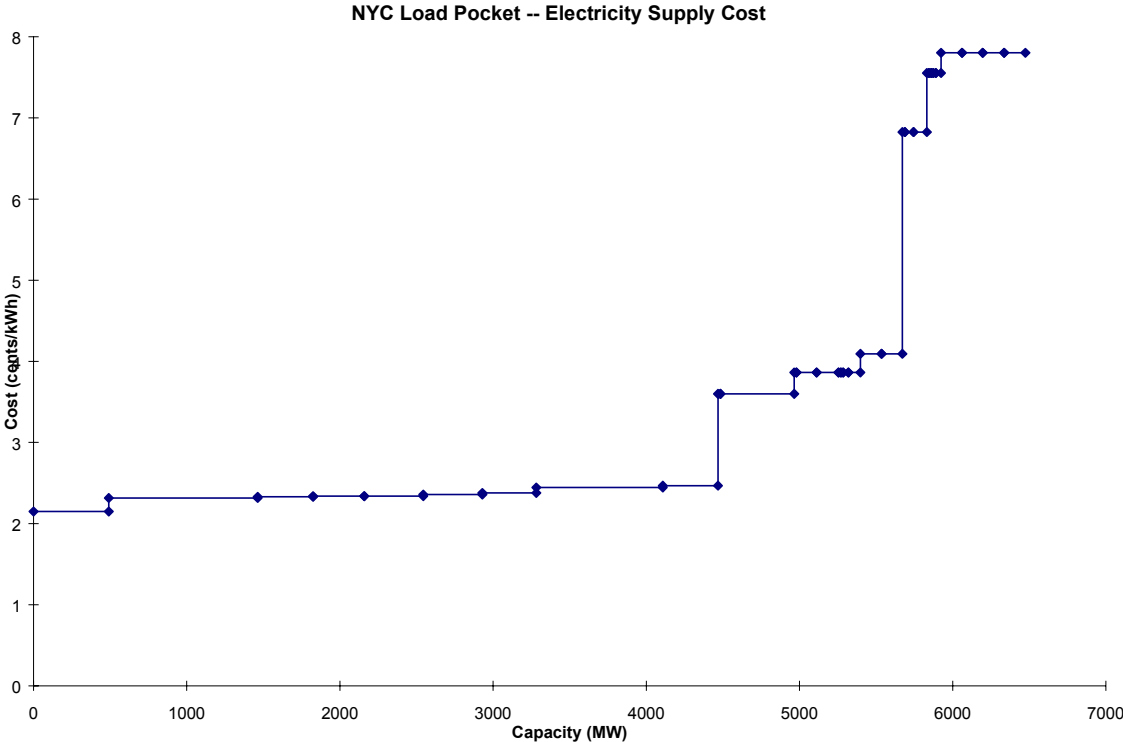
understanding whether a particular firm is likely to have opportunities to increase its profits by bidding above cost or withholding capacity from the market.

Similar simulations can be run using hourly loads, in order to assess the potential impacts of market power over the course of a year. For these cases, it is generally assumed that the market leader bids to maximize its operating profit.

More complex strategies can also be simulated, in which market participants optimize their bids in light of the bidding strategies of others. Also, ELMO can be used for policy analysis, exploring the effects upon market prices of bidding rules of the Independent System Operator such as day- or week-ahead bidding.

### **Model Developers**

ELMO was developed by Bruce Biewald and David White. Mr. Biewald, President of Synapse Energy Economics, Inc., has 16 years of research and consulting experience on energy economics, including electric system simulation and industry restructuring. Dr. White, Associate with Synapse, holds a Ph.D. in Engineering Systems from MIT, and has over 20 years of experience with energy systems and computer software, including 5 years at the MIT Energy Laboratory. For more information, contact Bruce Biewald at Synapse Energy Economics, Inc., 101 Chilton Street, Cambridge, MA 02138.



## Summary of Results

### Divestiture Analysis:

	Total Net Revenue Difference <u>(Million \$)</u>	Leader's Net Revenue Difference <u>(Million \$)</u>
ConEd Monopoly Case	396.5	69.1
Divestiture Cases:		
Ravenswood+ Astoria	157.7	15.7
ConEd Keeps 2929 MW	86.0	9.5
ConEd Keeps 2929 MW plus NUGs and Cogen	139.4	21.9
Ravenswood Leader	30.5	2.1
Astoria Leader	11.0	0.5
Arthurkill Leader	8.7	0.5
Multi-Owner Interaction	34.4	2.2 (Ravenswood)
Ravenswood Steam Only	22.7	1.9

### Sensitivity Analysis:

	Total Net Revenue Difference <u>(Million \$)</u>	Leader's Net Revenue Difference <u>(Million \$)</u>
Ravenswood Leader	30.5	2.1
Input Sensitivity Cases:		
Forced Outage	97.3	7.7
Fuel Price Increase	40.8	3.7
Heat Rate Decrease	39.1	3.2
Demand Response	22.3	1.7
Policy Cases:		
Intertie Addition	8.4	0.6
Limit Bid Adders	19.6	1.8
Fixed Bids -- 24 hours	30.9	1.3
Fixed Bids -- 1 week	23.7	0.9

Notes: Net revenue differences reported above are relative to the fully competitive market situation. They are calculated based on the difference between the variable plant operating costs and the market price. The totals are the combined impact upon all of the suppliers, the right-hand column lists the impact upon the market leader.

### ConEd Net Revenue Curves

