



NATURE AND ROLE OF PJM CAPACITY MARKETS

Harvard Energy Policy Group
June 11, 2001

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Capacity Market Evolution

- Reliability prior to introduction of competition
 - PJM capacity requirements for member utilities
 - Utility commission requirements to maintain capacity
- Historical PJM capacity accounting
 - Penalty = peaker cost
 - Incentive to maintain capacity
 - Mechanism to spread lumpiness of capacity additions
 - Non-transparent market in capacity credits
- Retail choice
 - Capacity credit market implemented (January 1, 1999)
 - Transparent, open daily capacity markets
 - Facilitate purchase and sale of capacity by retail competitors
 - Reduce entry/exit barriers



Capacity Market Evolution

- Energy market design
 - Competitive market April 1, 1999
 - Offer cap = \$1,000
- PJM ISO responsibility for reliability
 - Reliability is a system concept with current technology
 - Costs/benefits cannot be linked to individual customers
 - Definition: 1 day in 10 years
 - Implemented via capacity obligations
- Alternative method of maintaining reliability
 - Energy market prices with higher cap (or no cap)
 - Associated cycles including periods of shortage



Capacity Obligation Basics

- LSEs required to have rights to capacity
- Capacity requirement = peak load plus reserve margin
- Meet capacity requirement:
 - Owned physical capacity
 - Bilateral purchase
 - Capacity credits
- Unforced capacity
 - Derate capacity by historical forced outage rate
 - Reduces available capacity
- ALM offset
 - Obligation reduced by active load management



Capacity Definition

- Recall rights to energy in “emergency”
 - Call option at the market
 - Emergency: expected load > economic offers
- Capacity resources must be offered into day ahead market on a financially firm basis
- No availability requirements
 - Unforced adjustment is limited incentive
 - Periodic checks of capability
- Deliverability requirement
 - Transmission
- No limitations on sale of energy off system



Capacity Market Dynamics

- Daily and monthly markets
- Penalty payment if LSE is deficient
- Capacity can be sold within or outside PJM (delisting)
 - Firm energy
 - Relative prices
 - Obligations
- Marginal cost of capacity
 - Direct costs close to zero
 - Opportunity cost: external energy markets (firm, LD)



Capacity Market Benefits

- Reliability
 - Energy recalls in 1999
- Incentives for low outage rates
 - Outage rates reduced since introduction of market
- Incentive to construct new capacity
 - PJM capacity queues
- Net revenue stream
 - Energy market
 - Ancillary services
 - Operating reserves
 - Capacity market



Capacity Market Impacts

- Existence of capacity market does not necessarily change energy market dynamics under non-emergency circumstances
 - Capacity may delist
 - Energy sold to highest price market
- Capacity market does not necessarily change probability of scarcity in real time
 - Load > economic offers in real time
 - Capacity resources not required to make offers in real time market
- Capacity market does change duration of scarcity
 - Recall of energy from capacity resources
- Capacity market does change price results of scarcity
 - Reduced duration of high prices



Capacity Market Issues

- Market power
 - Inelastic demand
 - Supply/demand balance
 - Incentives are a function of relationship between obligations/capacity
 - Divestiture (functional/actual) affects incentives
- Market design
 - Incentives to sell capacity off system
 - Incentives to sell high quality capacity (energy production)
 - Incentives to maintain capability
 - Relevant obligation period
- Variations of ICAP
 - ACAP
 - Required call options



Capacity Market Issues

- Capacity market does not guarantee reliability
 - Capacity demand can exceed supply at market clearing price
 - Result is scarcity of capacity on high demand days
 - Energy related reliability issues can result
 - Payment of penalties by LSEs does not ensure adequate capacity
 - Good market design required
- Capacity market incentives required for reliability
 - Requirement imposed on LSEs
 - Penalty is incentive to purchase capacity
 - Incentives must be aligned with alternative market opportunities for capacity



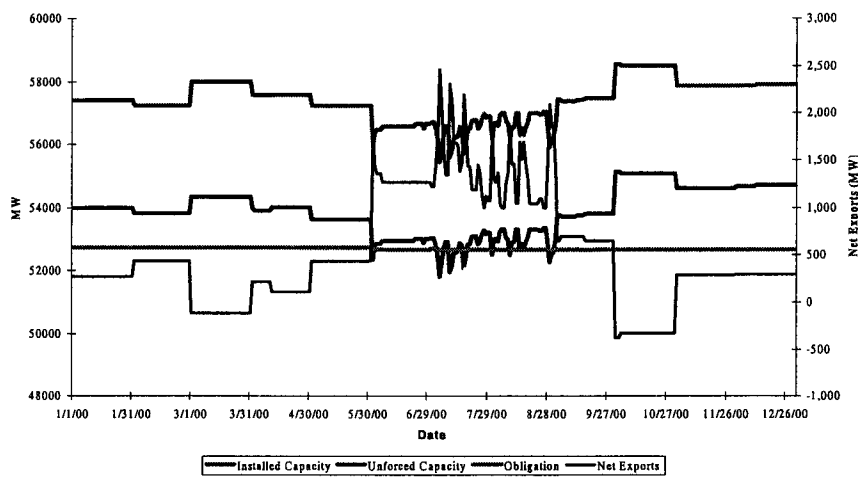
Capacity Market Results

- Supply and demand for capacity
- Prices
 - Supply and demand
 - Market power
- Outage rates
- Net revenue
- Incentives for entry



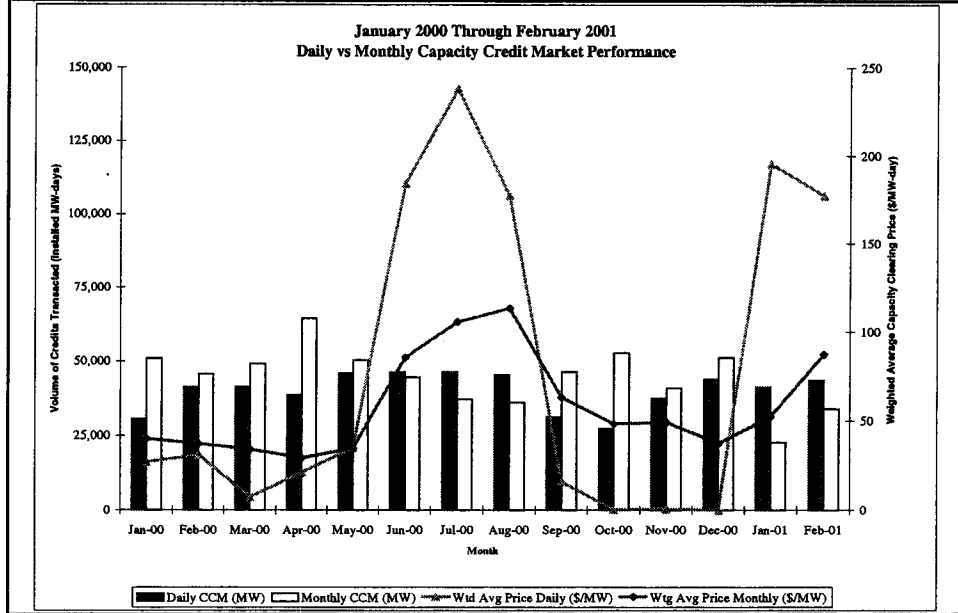
Capacity Supply

Figure 4: Capacity and Obligation
January through December 2000

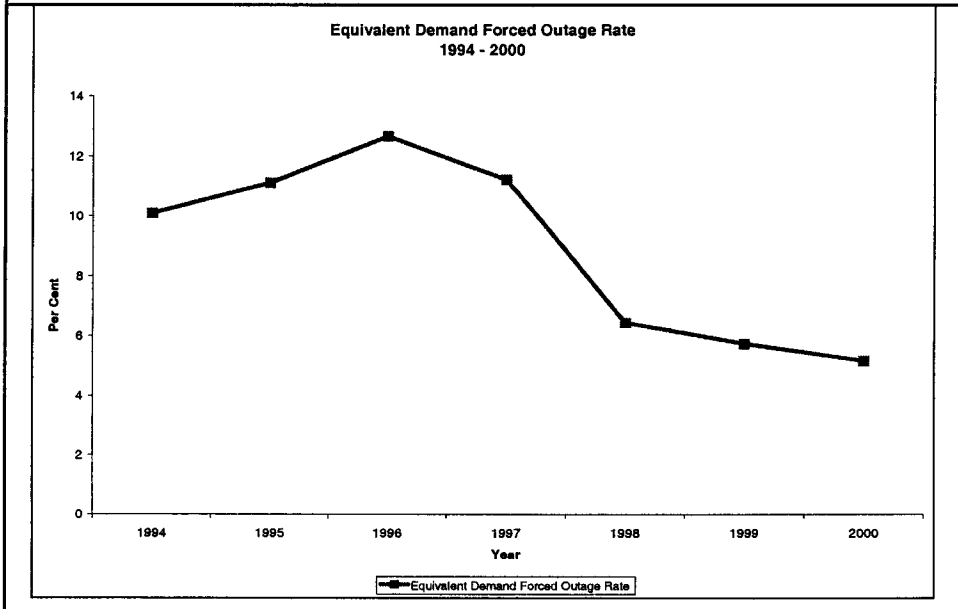




Capacity Supply and Prices



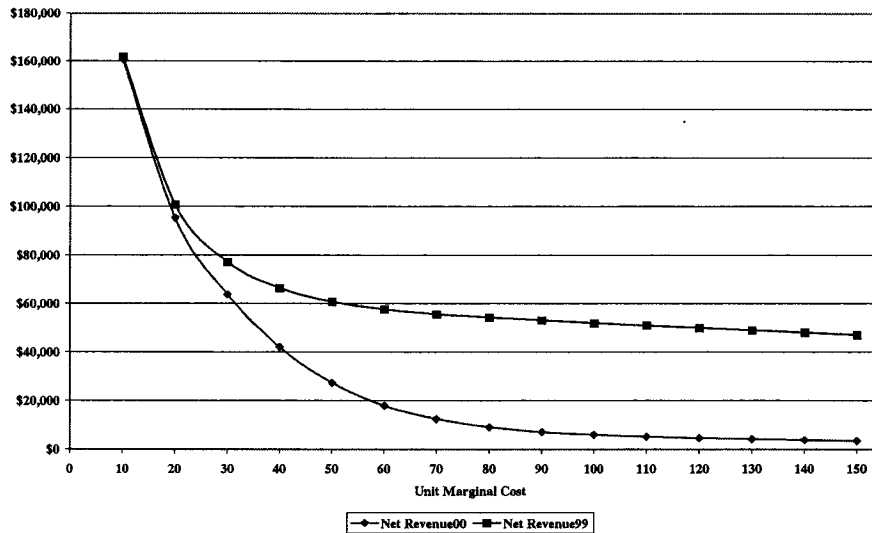
Forced Outage Rates





Net Revenue

PJM Energy Market Net Revenue - 1999 and 2000



Annual Net Revenues

- CT at \$50/MWh
 - 2000: \$27,000/MW-year from energy market
 - 2000: \$23,000/MW-year from capacity market
 - 2000: \$6,000/MW-year from ancillary services and operating reserves
 - **2000 Total: \$57,000/MW-year**
- Summary
 - 1999 net revenues from all sources greater than adequate to cover annual fixed costs of peaker
 - 2000 net revenues from all sources almost adequate to cover annual costs of peaker



IF YOU HAVE QUESTIONS

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