

An EDISON MISSION ENERGY® Company

# Do We Need ICAP? Ensuring Adequate Capacity in a Competitive Electricity Market

Abram W. Klein Director, Strategic Analysis Edison Mission Marketing & Trading

Prepared for:

PJM Regional Conference presented by Megawatt Daily

> November 5, 2001 Philadelphia, PA

# **Discussion Topics**

- Introduction
- Does PJM Need ICAP? Market performance to date.
- Policy Options To Ensure Adequate Reserves
  - *Reserve-requirements system*
  - Energy-only pricing system
  - Recent FERC Discussion Paper
- *PJM Capacity Market Dynamics*
- Impact of PJM West and ACAP



# Introduction: Why Capacity Matters





## Market Clearance The System Operator's Nightmare



• The reliability of the electricity system requires that load and generation balance in real time . . . not only on an "average" day, but also on the peak day.





## Will "Restructuring" Endanger Adequate Reserves?

- In the regulated market, installed reserves are maintained through the "regulatory bargain."
  - The monopoly utility agrees to operate and maintain the electricity system in exchange for a guaranteed rate of return
  - The utility satisfies reliability standards regarding capacity through a regulated resource planning process.<sup>1</sup>
- Under competition, all units needed for reliability must be compensated enough in the long run to recover their fixed costs and avoid closing.

<sup>&</sup>lt;sup>1</sup> For instance, the Northeast Power Coordinating Council (NPCC) sets a reliability standard of one in ten years of loss of load probability: "Resources will be planned in such a manner that after due allowances for scheduled maintenance, forced and partial outages, interconnections with neighboring areas, and available operating procedures, the probability of disconnecting non-interruptible customers due to a resource deficiency, on the average, will be no more than once in ten years."



## **Policy Options**

- There are two alternatives to ensure market clearance under competition:
  - Maintaining sufficient "excess" generating capacity that the market clears, even if the demand curve is vertical. (Reserve requirements or hourly capacity subsidy)
  - Maintaining sufficient price-responsive demand that the market clears, even if the supply curve is vertical.





## The Choice of Market-Clearance Mechanism Will Affect Market Outcomes

- The choice of a market-clearance mechanism will affect forecasts of the level of electricity market clearing prices, the payments that generators receive for providing energy and capacity and, therefore, the profitability of existing and new generation.
- The choice of market clearance mechanism is linked to other choices regarding market structure such as price caps, market mitigation and operating reserve pricing.





# Does <u>PJM</u> Need ICAP? Market Performance To Date





## **PJM Market Performance**

- Because the choice of market clearance mechanism is interrelated to other elements of market structure and performance, it is useful to assess the need for ICAP from the perspective of PJM market performance to date.
  - Is entry needed in PJM?
  - Is entry economic in PJM without capacity payments?





# Is Entry Needed in PJM?

- During the Summer 2001 peak load, PJM load was reduced over 2,400 MW through voltage reduction and interruptible load.
- Current 2002 PJM capacity balance suggests a tight supply/demand capacity situation as the new UCAP requirement comes into effect in 2002.



<sup>1</sup> Real time prices used prior to 6/1/00

## **Entry Cost**

• New entrants need to earn sufficient revenue (energy, ancillary services, capacity) to recover the cost of entry.







## **Energy-only Revenue of Merchant CC** (2000 and 2001)

- 7000 btu/kW CC optimally dispatched against PJM market prices in the east and west
- *How much would the new unit earn from day-ahead energy-only revenues in 2000 and 2001?*<sup>1</sup>
  - *Eastern CC (PECO LMP)* 
    - ► \$30/kW in 2000
    - ► \$60/kW in 2001
      - → 31% of revenue from 8/6 8/10 in 2001
  - Western CC (Western Hub LMP)
    - ► \$24.5/kW in 2000
    - ► \$38/kW in 2001
      - ► 30% of revenue from 8/6 8/10 in 2001
- Conclusion 1: Even in Summer with 1 in 10 year heat wave (8/01), PJM energy prices are not sufficient to support entry without a capacity payment.
- Conclusion 2: Eastern entrant that sells only day-ahead in 2001 needs capacity payment of approximately \$80-140/MW-day on average over the year to break even.
- Conclusion 3: No market power.



<sup>1</sup>*Real time prices used prior to 6/1/00* 

## Energy-only Revenues of Merchant CC (2002 forward market)

• Current forward market prices also do not support entry without a capacity payment

	Forwar	d Electricit	v Price *			Calculation of CC Margin					
					сс	CC On-	CC Off-	CC All-	CC On-	CC Off-	
				Natural	Average	peak	Peak	hour	peak	Peak	
			Round-	Gas Price	Cost ***	Margin	Margin	Margin	Margin	Margin	
Month	Peak	Off-peak	the-Clock	**	(\$/MWh)	(\$/MWh)	(\$/MWh)	(\$/MWh)	(\$/MW)	(\$/MW)	
1	35.7	27.1	31.1	5.0	35.8	-	-	-	-	-	
2	34.7	24.3	29.2	4.9	35.6	-	-	-	-	-	
3	32.4	21.3	26.3	4.1	30.0	2.4	-	-	800	-	
4	30.9	19.8	25.2	3.8	27.4	3.5	-	-	1,216	-	
5	35.7	22.6	28.8	3.7	26.8	8.9	-	2.0	3,141	-	
6	46.1	25.8	34.8	3.8	27.4	18.7	-	7.4	5,974	-	
7	64.8	29.3	46.1	4.0	28.8	35.9	0.5	17.3	12,649	202	
8	50.8	25.8	37.6	3.9	28.5	22.2	-	9.1	7,824	-	
9	31.3	23.0	26.7	3.9	28.1	3.2	-	-	966	-	
10	31.0	22.8	26.8	3.8	27.6	3.4	-	-	1,238	-	
11	31.2	22.9	26.6	4.1	29.7	1.5	-	-	482	-	
12	31.8	24.7	27.9	4.8	34.4	-	-	-	-	-	
* Broker quotes 10/26/01								Total	34,290	202	
** Broker quote for M3 delivery, with 4% state tax and 10 cents liquidity/LDC charge									34,492		
*** Assume 7000 btu/kw heat rate plus \$1/MWh VOM											

Merchant CC Margins on Current PJM Forward Prices (\$/MW)

- Merchant CC margin against the 2002 PJM forward curve yields \$34/kW
- *Running a spread option model to account for option value increases the value to* \$48/kW.
- Accounting for congestion value to build the unit in the East may increase the value to \$ 63/kW
- Conclusion: Forward curve suggests that Eastern entrant requires \$75-130/MW day capacity payment.



## PJM Energy Prices Market Monitoring and Rules Limits Deviations from Cost-based Pricing

- Implementation of the PJM market involves extensive tools to limit short-term energy prices from deviating from cost-based pricing.
  - For instance, cost-capping may have limited energy prices on June 27-28 when PJM issued a MaxGen alert.
- Use of side payments (uplift) to marginal slow-starting, inflexible generators suppresses energy prices.
- Conclusion: Ensuring market clearance may require ICAP as long as we have PJMstyle market monitoring, extensive regulation of short-term energy pricing and other rules designed to keep hourly energy prices low.





## **Policy Options for Assuring Adequate Capacity**



An EDISON MISSION ENERGY Company

## **Ensuring Adequate Capacity Under Competition**

• Generators will only remain in service and contributing to reliability if their market revenues cover their variable and avoidable fixed operating costs.





## Why Set a Reserve Requirement?

• Proponents of reserve requirements argue that the long-run competitive market equilibrium under energy-only pricing will have less than the socially optimal amount of capacity and more than the socially optimal amount of blackouts. They argue that energy-only pricing does not internalize the social benefit of capacity in terms of its contribution to reliability.







## Reserve Requirement Model: How Generators Stay Open

• A reserve requirement is imposed symmetrically on all LSEs, who need to demonstrate adequate reserves. To meet their requirement, LSEs must enter into explicit or implicit contracts with generators to enable the generators to recover their avoidable cost. Capacity thus takes a value in and of itself.



An EDISON MISSION ENERGY® Compan

## **Reserve Requirement Model** Market Price of Capacity

• Competition among capacity owners would cause the market-clearing payment to approximate the smallest per-MW payment that would induce just enough generation to remain available to meet the reserve requirement. All generating capacity contributing to the pool installed reserve would be paid the market-clearing price of capacity.





## Devilish Details – In Practice, ICAP Markets May Be Less Efficient than the Economic Ideal

- Critics argue that installed reserve requirements:
  - Institutionalize excess capacity
  - Cause the short-term price of electricity to be below its true opportunity cost
  - Provide inappropriate incentives to loads to stimulate creation of dispatchable demand that is seen as the key to efficient long-term reliability
  - Presents market power problems
  - Fails to ensure that capacity is built where it is needed
  - Requires complex ISO involvement in administering the system
- If "capacity" is paid for on an annual basis, critics argue, the customers in low-load hours will cross-subsidize the customers in high-load hours. However, it is the high-load customers that are responsible for the requirement in the first place.





## **Option 2 -- Explicit Capacity Adder** in Lieu of Reserve Requirement

• The UK system did not have specified reserve requirements. Rather, generators covered their avoidable fixed costs through an hourly capacity subsidy. The subsidy is paid to generators that are available in the hour, and is rolled into the hourly energy price.



- The capacity subsidy is designed to compensate for the energy-only price's theoretical failure to incorporated the social benefit of capacity.
- The advantage of this approach is that capacity subsidies are targeted to high-load hours and thus provide appropriate incentives to dispatchable demand.





## **Explicit Capacity Subsidy Increases the Energy Price During Critical Hours**



•  $V_{cap}$  is set by LOLP \* VOLL. VOLL is set at the estimated social cost of outages to yield enough excess capacity to clear the market.





# **Option 3 -- Energy-Only Pricing**

• Proponents argue that market-based energy-only pricing systems would lead to economically efficient capacity levels in the long run if prices are allowed to rise to levels that clear the market.



• Ultimately, customers would rather curtail their use of power voluntarily than pay exorbitant energy rates.





## **Market-Determined Reliability**

• The market clears through price-responsive customer demand and operating reserves, without the need for administratively determined installed reserve requirements or a separate capacity payment. Operating reserve margins would be maintained, with flexible load adjusting to high prices.



• Long-term, installed capacity decisions would be left to market incentives.

23<sup>2</sup>



## **Energy-Only Pricing: How Generators Stay Open**

• Generators would only remain in service only if their gross operating margins exceeded their avoidable fixed costs. If not, they would be either mothballed or retired.





## **Energy Price if the Market Does Not Clear**

• A penalty -- the value of lost load -- (VOLL) – can be used to set the market price if the market does not clear under energy-only pricing.



• The VOLL is set high enough to reflect the cost to society of involuntary curtailments. LSEs have the incentive to invest in capacity contracts to avoid having to pay the VOLL amount.



#### Efficient Pricing of Operating Reserves Can Help Provide Additional Revenue For Generator Fixed Costs

• "Operating reserves" refers to spinning reserve or other operating reserves that are needed by the ISO on a daily basis to operate the electricity grid safely and reliably.<sup>4</sup> The market for energy plus operating reserves will be tight in hours when the market for energy clears without much problem.



- Market rules for pricing energy and reserves when operating reserves are tight matter a great deal. It is essential in an energy-only system that prices be allowed to rise during a generation shortage, even if the shortage is of reserves and not energy.
- One of the many failures in the California ISO market design was failing to get energy/reserve pricing correct.



Operating reserve should not be confused with installed reserve which is the topic of this presentation intended to address long-term reliability.



# **Energy-Only Market Price**

• Under energy-only pricing, the location and shape of the dispatch curve would differ from the present system due to differences in the available generation. Generation would exit the market if its avoidable fixed operating costs exceeded its margin on energy and ancillary services sales.



# **Energy-Only Market Equilibrium**

- Characteristics of energy-only pricing:
  - On-peak energy prices may be quite high
  - Less capacity available than under a system with reserve requirements
  - Peak energy consumption would be lower due to demand-side response
- Energy-only systems currently exist -- and clear the market -- in both Australia's and New Zealand's competitive electricity markets.
  - Maximimum prices in Australia have hit the VoLL level, currently set at \$AUD5,000 and being increased to \$AUD10,000 in 2002 (approximately \$2,500 and \$5,000 USD respectively)
- *PJM's market designed may not be consistent with an energy only pricing system:* 
  - Extensive use of price caps, cost-capping and market mitigation
  - No separate pricing of operating reserves
  - Uplift payments to slow-starting, inflexible marginal generation.
- A fundamental principal of energy-only pricing systems is that prices must be allowed to rise high enough to clear the market.





## Barriers to Implementation of Energy-Only Pricing

- Current inadequate levels of dispatchable demand
- Lack of real-time metering
- Must-run generation





## Barriers to an Energy-Only System Adequate Dispatchable Demand

- The development of customer demand-side response is expected to be one of the dynamic benefits of moving to a competitive electricity market.
  - In the long run, the market institutions and customer incentives will exist to sustain a large amount of price-responsive load under energy-only pricing.
  - At present, however, in many control areas relatively little load is metered for time-of-use pricing, even less load has the ability to track real-time prices, and much load has a limited ability to respond to high prices either day ahead or in real time.
  - Moreover, because an installed reserve system keeps energy prices low, it tends to discourage the very customer investments that will be needed to develop additional price-responsive load.
- Inadequate levels of dispatchable demand could result in blackouts in the absences of required reserves.





## Barriers to an Energy-Only System Inadequate Real-Time Metering

- For an adequate demand-side response, the customer must see and respond to the high real-time price of electricity when capacity is scarce.
  - LDC must be able to measure electricity usage in real time, or
  - LDC bids price-responsive demand, even if customers do not have access to real-time prices, and curtails less essential loads when opportunity costs are high.
    - Customers would need to agree to some level of interruption
    - LDC circuits may need to be re-wired to segregate less essential loads, which may be expensive





# **FERC Capacity Discussion Paper**





## Are Forward Reserve Contracts a Better Alternative to ICAP?

- FERC Staff suggests an undefined system of having capacity obligations apply to reserves only.
  - *"Requirement to obtain generation which will provide reserve obligation at some time in the future," potentially years in advance.*
  - A "call option on energy."
  - Because LSEs won't know their obligations due to retail competition, "the system operator (whether ISO or RTO) could acquire reserve capacity based on what it considers necessary for the market as a whole and bill LSEs for their reserve share."
- Forward reserve contracts as FERC staff seems to be considering are likely to be both inefficient and unworkable.





## Forward Reserve Contracts are Inefficient Because They Distort Resource Allocation

- If capacity payments are targeted only to units that run infrequently, FERC will create an inefficient resource allocation mix and inflate the cost of capacity for consumers.
- In terms of market clearance, there is and can be **NO BRIGHT LINE** between the contribution of a "reserve" unit and a baseload unit -- every available MW contributes equally to market clearance on a high load day.
  - By targeting capacity payments only to "peakers," peakers will be the type of capacity constructed even when competitive forces dictate that baseload capacity is more appropriate.
  - Under current conditions, baseload new capacity in PJM would actually require a lower capacity payment, so that limiting new capacity only to "peakers" results in higher costs to consumers.
  - Targeted capacity payments to units that run infrequently, would further distort resource allocation as new "reserve" units are built, while at the same time, existing "energy" units that need a small capacity payment to survive end up being shut. I.e. a new unit may be built when the "reserve" may be provided at lower cost by an existing unit.





## Forward Reserve Contracts are Inefficient Because They Distort Resource Allocation

• Consider the following example which is based on findings from a spread-option model using current (10/26/01) 2002 PJM forward market prices

PJM Market Required Capacity Payments Illustrative Example									
	Capacity Factor	Energy Margin	Avoidable Fixed Operating Cost	Required Capacity Payment to Avoid Shutting	Avoidable Fixed Cost plus ROE	Required Capacity Payment to Provide ROE			
Type of Unit	(estimated %)	(\$/kw-yr)*	(\$/MWh)	(\$/kw-yr)	(\$/MWh)	(\$/kw-yr)			
Existing Marginal Steam	17	27	35	8	61	34			
Existing High-cost peaker	<1	12	15	3	46	34			
New Entrant CC	64	61	95	34	95	34			
New Entrant CT	6	17	60	43	60	43			

\* Based on spread-option model with PJM 2002 forward prices

- Each of the units above needs a capacity payment to stay open. Suppose ICAP payments are targeted to peakers:
  - *Note that the new CC needs a lower capacity payment than the new CT.*
  - With ICAP only available to peakers, the CC will not be built even though it requires a lower capacity payment than the new CT, distorting the resource allocation mix and raising both energy and capacity prices to consumers.
  - *Note that the existing steam unit needs a greater capacity payment than the existing peaker.*
  - With ICAP only available to peakers, the existing steam unit will close even though it needs a smaller capacity payment than the new CT, again distorting the resource allocation mix and raising both energy and capacity prices to consumers.
    - Further, closing the steam unit while building a new peaker results in no net increase in reserves.
    - The existing peaker and the new CT are both presumably paid the capacity clearing price of \$43/kw-yr. Yet both the unbuilt CC and the now closed steam unit both would provide new capacity for less.



#### Forward Reserve Contracts are Unworkable Because They Require Extensive Rulemaking to Enforce the Intended Price Discrimination

- How does the ISO target reserve payments to ensure the right capacity mix? Would the ISO now have to engage itself in integrated resource planning process to "pick" the winner of the targeted capacity payment?
- *How does the ISO decide who gets to apply for the targeted payment?*
- Does the ISO limit LSEs from self-providing reserves would a market participant that owns 125% of its peak load in non-"reserve"-units still have to pay toward the ISO/RTO's cost of purchasing targeted reserves? If not, non-reserve-designated units can obtain the capacity payment by contracting with an LSE bilaterally.





## Forward Reserve Contracts Is Price Discrimination Appropriate?

- Utility ratepayers owning existing assets that are not reserve units would see the value of the asset arbitrarily reduced.
- Owners of recently built or purchased units that assumed ROE based a competitive market with one market clearing price for all units (econ 101) would see the value of their assets taken away.
- If capacity subsidies are only paid to new entrants, over time everyone will be a new entrant and is being paid approximately its embedded cost. Sounds like regulation rather than competition, and all that is accomplished is that the capacity payment was avoided for existing assets that are "sunk" today I.e. regulators simply seized property because it was there.
- Further, what about units that would close but for ICAP payments do you let them go away and then come back as "new" units?
- ICAP markets avoid each of these thorny issues because the market will decide the resource allocation mix, and all units contributing to reserves get the same payment.
- During times of excess capacity, ICAP prices will not be sufficient to provide return on equity to all units in the market. This is appropriate and a better way to ensure adequate reserves than the quasi-regulatory process which is liable to lock in embedded cost payments to generators which the market may ultimately deem unnecessary.





## PJM Capacity Market Dynamics / Impact of PJM West and ACAP





## **Calculation of UCAP Demand**

• The table below shows the calculation of UCAP requirements, with the "factors" applied to weather-normalized peak load:

1999		2000		2001		2002		2003	
Jan.	Jun.	Jan.	Jun.	Jan.	Jun.	Jan.	Jun.	Jan.	Jun.
	108.58	108.58	107.84	107.84	107.67	107.67	108.97	108.97	109.53
	48,397	51,700	51,700	49,417	49,417	56,286	56,286		
	49,610	50,510	50,510	52,384	52,384	54,230	54,230		
	52,100	53,077	52,704	54,725	54,636	56,623	57,328		
		977	(374)	2,021	(89)	1,987	705		
		1.9%	-0.7%	3.8%	-0.2%	3.6%	1.2%		
	Jan.	1999   Jan. Jun.   108.58   48,397   49,610   52,100   9	1999     20       Jan.     Jun.     Jan.       108.58     108.58       48,397     51,700       49,610     50,510       52,100     53,077       9     977       1.9%     1.9%	1999     2000       Jan.     Jun.     Jan.     Jun.       108.58     108.58     107.84       48,397     51,700     51,700       49,610     50,510     50,510       52,100     53,077     52,704       977     (374)     1.9%	1999     2000     20       Jan.     Jun.     Jan.     Jan.     Jan.       108.58     108.58     107.84     107.84       48,397     51,700     51,700     49,417       49,610     50,510     50,510     52,384       52,100     53,077     52,704     54,725       100     977     (374)     2,021       1.9%     -0.7%     3.8%	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

#### Calculation of PJM UCAP Obligation

- UCAP Obligation will increase almost 2,000 MW on Jan. 1, 2002.
- *Note that:* 
  - The last three years have seen increases in peak load of 1.9%, 3.8% and 3.5% respectively.
  - The 1999 and 2001 actual peak was adjusted down significantly (1999 was considered a 1 in 25 hot Summer and used an "alternative weather normalization" process, 2001 is considered 1 in 10)
  - the 2000 actual peak was adjusted up significantly (2000 was considered a 1 in 15 cool Summer)





#### UCAP Supply-Demand Balance in 2000-2001

- PJM UCAP was extremely tight at times in 2000 and 2001.
  - June 2000 UCAP became tight due to capacity delisting for sales to ECAR.
  - January 2001 UCAP became tight due to the increased UCAP obligation.
  - 2001 bilateral prices were close to the cap until sufficient hedging of short positions took place.
  - What will 2002 bring?



PJM UCAP Market Supply & Demand -- Actual ata Released with Six-Month Lag





## PJM West Impact on UCAP Market Dynamics

- ACAP will result in increased volatility in the PJM UCAP market.
  - ACAP is designed to recover the vast majority of capacity payments on the high load days
  - ACAP price cap is \$12,900/MW-day.
  - UCAP is designed to spread the capacity subsidy smoothly over the year.
  - UCAP has no price cap, but deficient LSEs will pay no more than \$177/MW-day for every day of the capability period.
  - Arbitrage between the markets will result in increased volatility in the UCAP market, as capacity subsidies must now be recovered on days when both UCAP and ACAP markets are tight.
- UCAP prices when ACAP and UCAP are in short supply:
  - Deficient LSE faces \$177/MW-day for 5 months
  - Daily UCAP during short-supply periods are may reach significant multiples of \$177/MWday, as LSE attempt to obtain scarce UCAP
  - A solution for LSEs is to hedge in forward markets, where capacity prices are less volatile.

