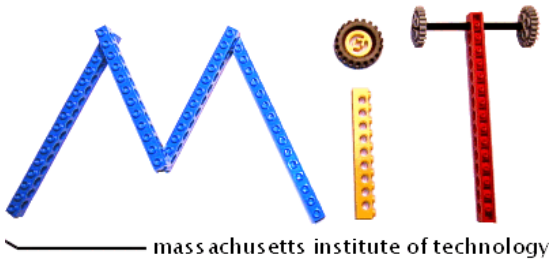
RESOURCE ADEQUACY (AGAIN)

Paul L. Joskow

http://web.mit.edu/pjoskow/www/



PUBLIC INTEREST GOALS FOR ELECTRICITY SECTOR LIBERALIZATION

- Provide long run benefits to consumers
- Better incentives for controlling operating costs of existing fleet of generating capacity
  - O&M costs
  - Availability
  - More efficient utilization of regional generating capacity
  - More efficient retirement and mothballing decisions
- Stimulate more efficient investment in new generating capacity and shift risks of costly generation investment "mistakes" to suppliers and away from consumers
  - Retail customers paid for persistent excess capacity under old regime
  - Retail customers paid for construction cost overruns
  - Retail customers took the risks associated with technology choice
- Encourage efficient innovation in power supply technologies

PUBLIC INTEREST GOALS FOR ELECTRICITY SECTOR LIBERALIZATION

- Provide enhanced array of retail service products, risk management, demand management, and opportunities for service quality differentiation based on individual consumer preferences
- Facilitate better regulation of residual T&D monopoly services to enhance efficiency incentives and reduce costs (broadly defined)
- Average retail prices will decline to reflect cost savings compared to what they would have been under regulated monopoly alternative (counterfactual)
- While maintaining or enhancing system reliability with support from market signals and incentives
- Consistent with environmental improvement goals

- Do resource adequacy policies advance these goals?

RESOURCE ADEQUACY

- In most markets “resource adequacy” is not an issue since prices balance supply and demand and provide incentives for investment
  - “stockouts” may occur but they are usually short-lived and are not accompanied by large price spikes nor adversely affect the stability of the delivery system
  - Longer term shortages are typically the result of government price controls
- Why are electricity market different?
  - Demand side does not participate in the spot market
  - There is administrative rationing of demand and cost of shortages is thought to be very high
  - There are system operators whose operating decisions can dramatically affect prices
  - There are binding administrative reliability rules that are not well connected to market mechanisms or justified by consumer valuations but may be necessary on “public goods” grounds due to the threat of costly network collapse
  - There are imperfections in wholesale spot markets
  - There are imperfections in retail markets
  - There are regulatory interventions that affect prices
  - There is continuous market redesign that affects investment incentives
  - Investors are concerned about regulatory “hold-ups”
  - Capital markets have not fully adapted to the attributes of competitive electricity markets
- Most of these problems can be fixed but it will take time to get it all right

NEW U.S. GENERATING CAPACITY

YEAR	CAPACITY ADDED (MW)
1997	4,000
1998	6,500
1999	10,500
2000	23,500
2001	48,000
2002	55,000
2003	50,000
2004	20,000
	217,5000

Source: EIA

PJM

Table 2-31 - New entrant gas-fired combustion turbine plant (Dollars per installed MW-year): Theoretical net revenue for calendar years 1999 to 2004

Year	Energy	Capacity	Spin	Regulation	Reactive	Total
1999	$62,065	$16,677	$0	$0	$2,390	$81,131
2000	$16,476	$20,200	$0	$0	$2,390	$39,066
2001	$39,269	$30,960	$0	$0	$2,390	$72,619
2002	$23,232	$11,516	$0	$0	$2,390	$37,139
2003	$12,154	$5,554	$0	$0	$2,390	$20,099
2004	$8,063	$5,376	$0	$0	$2,390	$15,829
Average:	$26,876	$15,047			$2,390	$44,313

Annualized First-year Fixed Cost: $62,000

Source: PJM State of the Market Report 2004

PJM

Table 2-34 - Energy market net revenues for a combustion turbine plant under two dispatch scenarios(Dollars per installed MW-year)

	Perfect Economic Dispatch	Peak Hour Economic	Difference
1999	$62,065	$55,612	$6,452
2000	$16,476	$8,498	$7,978
2001	$39,269	$30,254	$9,015
2002	$23,232	$14,496	$8,736
2003	$12,154	$2,763	$9,390
2004	$8,063	$919	$7,144
Average	$26,876	$18,757	$8,119

Source: PJM State of the Market Report 2004

PJM

Table 2-32 - New entrant gas-fired combined-cycle plant (Dollars per installed MW-year): Theoretical net revenue for calendar years 1999 to 2004

Year	Energy	Capacity	Spin	Regulation	Reactive	Total
1999	$89,600	$16,999	$0	$0	$3,816	$110,416
2000	$42,647	$19,643	$0	$0	$3,816	$66,106
2001	$68,949	$29,309	$0	$0	$3,816	$102,074
2002	$51,639	$10,492	$0	$0	$3,816	$65,948
2003	$50,346	$5,281	$0	$0	$3,816	$59,443
2004	$49,600	$5,241	$0	$0	$3,816	$58,657
Average	$58,796	$14,500			$3,816	$77,112

Annualized First-Year Fixed Cost: $80,000

Source: PJM State of the Market Report 2004

PJM

Table 2-35 - Energy market net revenues for a combined cycle plant under two dispatch scenarios (Dollars per installed MW-year)

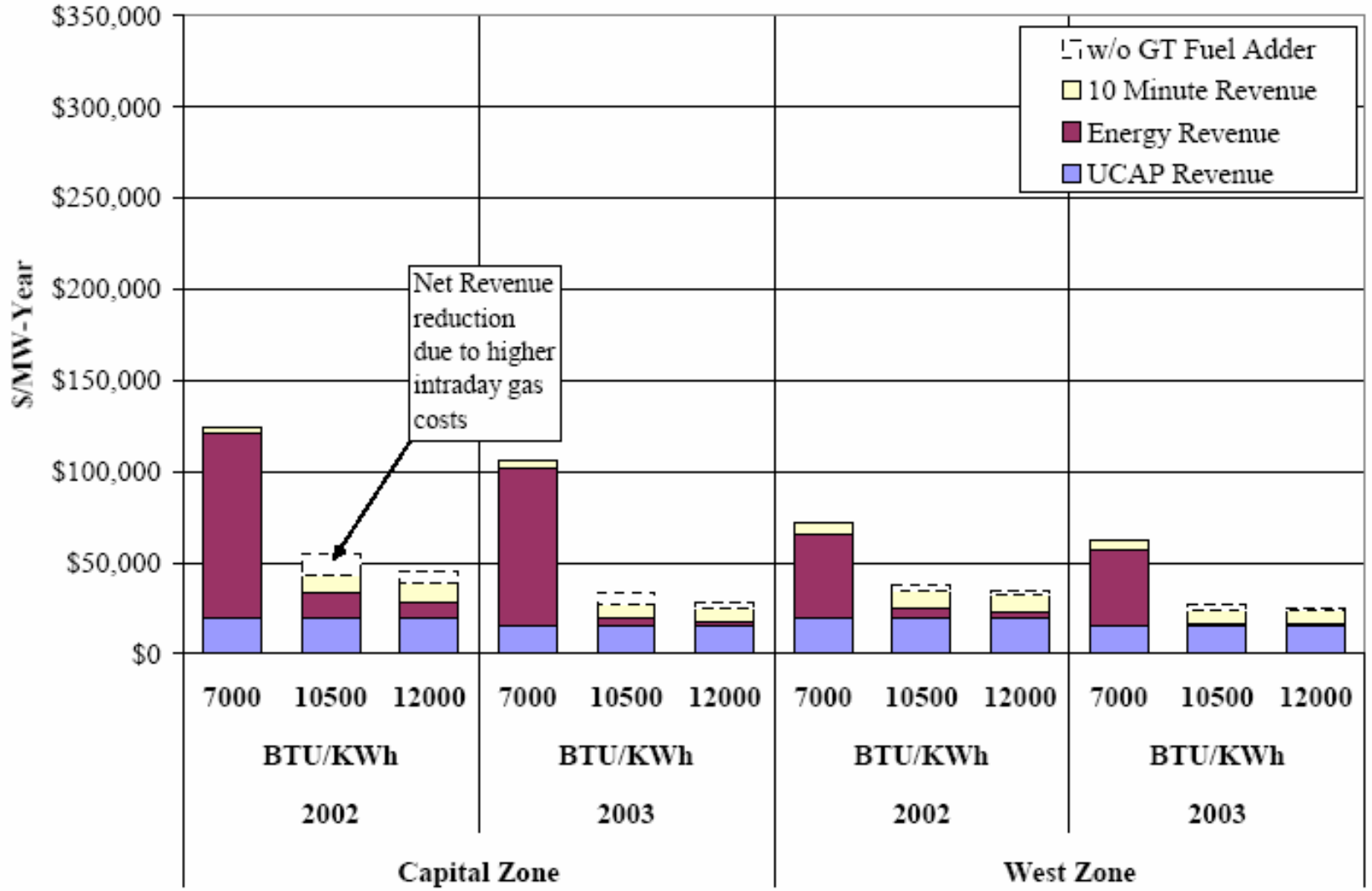
	Perfect Economic Dispatch	Peak Hour Economic	Difference
1999	$89,600	$80,546	$9,055
2000	$42,647	$24,794	$17,854
2001	$68,949	$54,206	$14,743
2002	$51,639	$38,625	$13,015
2003	$50,346	$27,155	$23,191
2004	$49,600	$27,389	$22,211
Average	$58,797	$42,119	$16,678

Source: PJM State of the Market Report 2004

SCARCITY RENTS PRODUCED DURING OP-4 CONDITIONS ($1000 Price Cap) ($/Mw-Year)

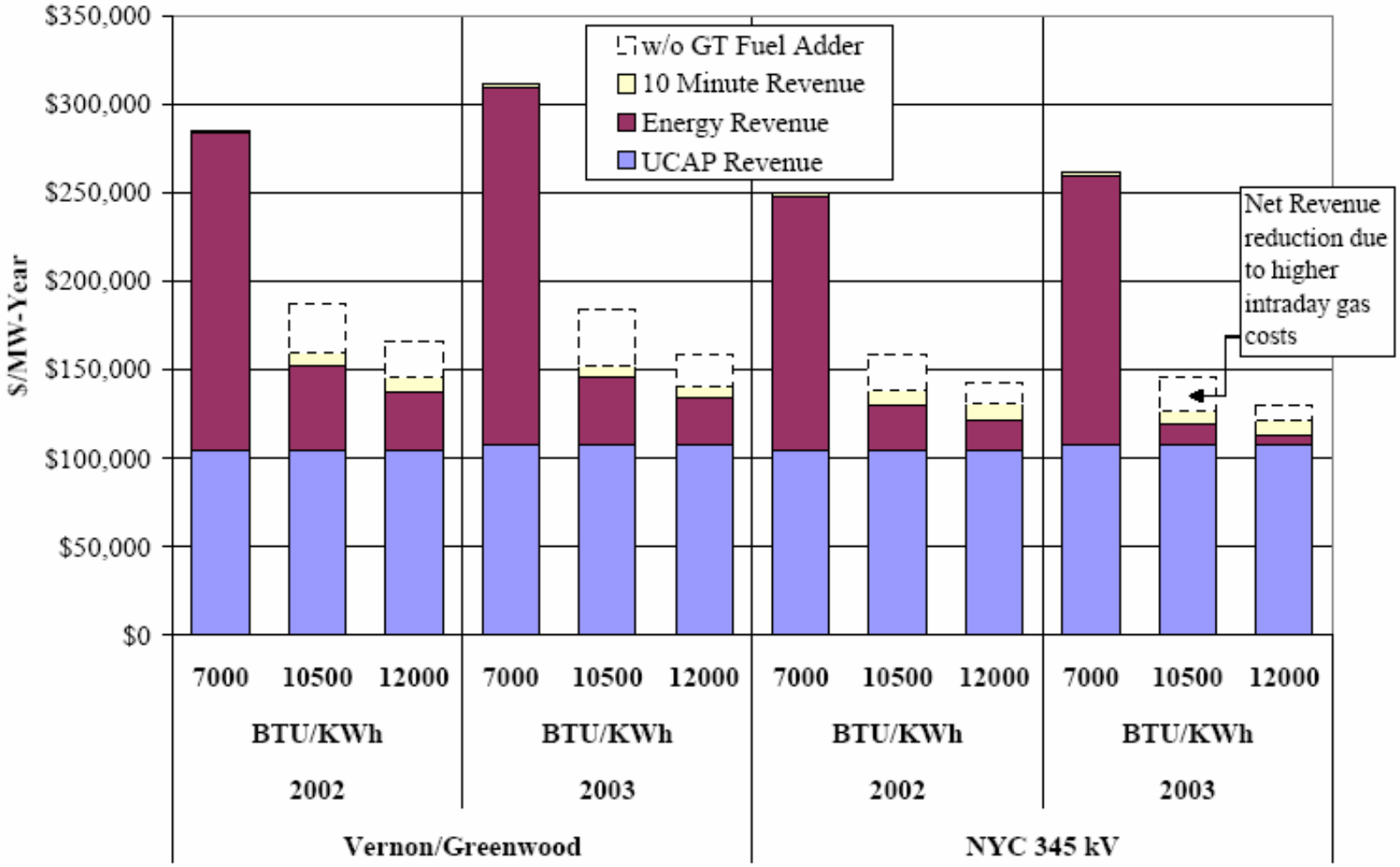
YEAR	ENERGY		OPERATING	OP-4 HOURS/
	MC=50	MC=100	RESERVES	(Price Cap Hit)
2002	$ 5,070	$ 4,153	$ 4,723	21 (3)
2001	$15,818	$14,147	$11,411	41 (15)
2000	$ 6,528	$ 4,241	$ 4,894	25 (5)
1999	$18,874	$14,741	$19,839	98 (1)
Mean	$ 11,573	$ 9,574	$10,217	46 (6)

Peaker Fixed-Cost Target: $60,000 - $70,000/Mw-year



Source: New York ISO (2004)

Figure 14: Estimated Net Revenue in the Day-Ahead Market
2002 - 2003



Source: New York ISO (2004)

GENERATING CAPACITY UNDER CONSTRUCTION
January 2005

ISO-NE	3 Mw
NY-ISO	3,700 Mw
PJM (traditional)	1,800 Mw

Source: Argus

WHAT ARE THE CAUSES?

- There is excess generating capacity
  - With capacity significantly in excess of optimal reserve margins capacity values should be very low
  - That's life in competitive markets
  - Excess exuberance during boom/bubble
  - Restrictions on retirements
- Imperfections in wholesale spot markets
- Never-ending market redesign and investor concern about "hold-ups"
- Imperfections/changes in financing markets
  - Hedging beyond a couple of years is difficult/costly
  - Slow evolution of retail markets and short-term utility procurement policies
  - Burned too often
  - Project financing model may be dead
  - Balance sheet financing model emerging

FIGURE 1

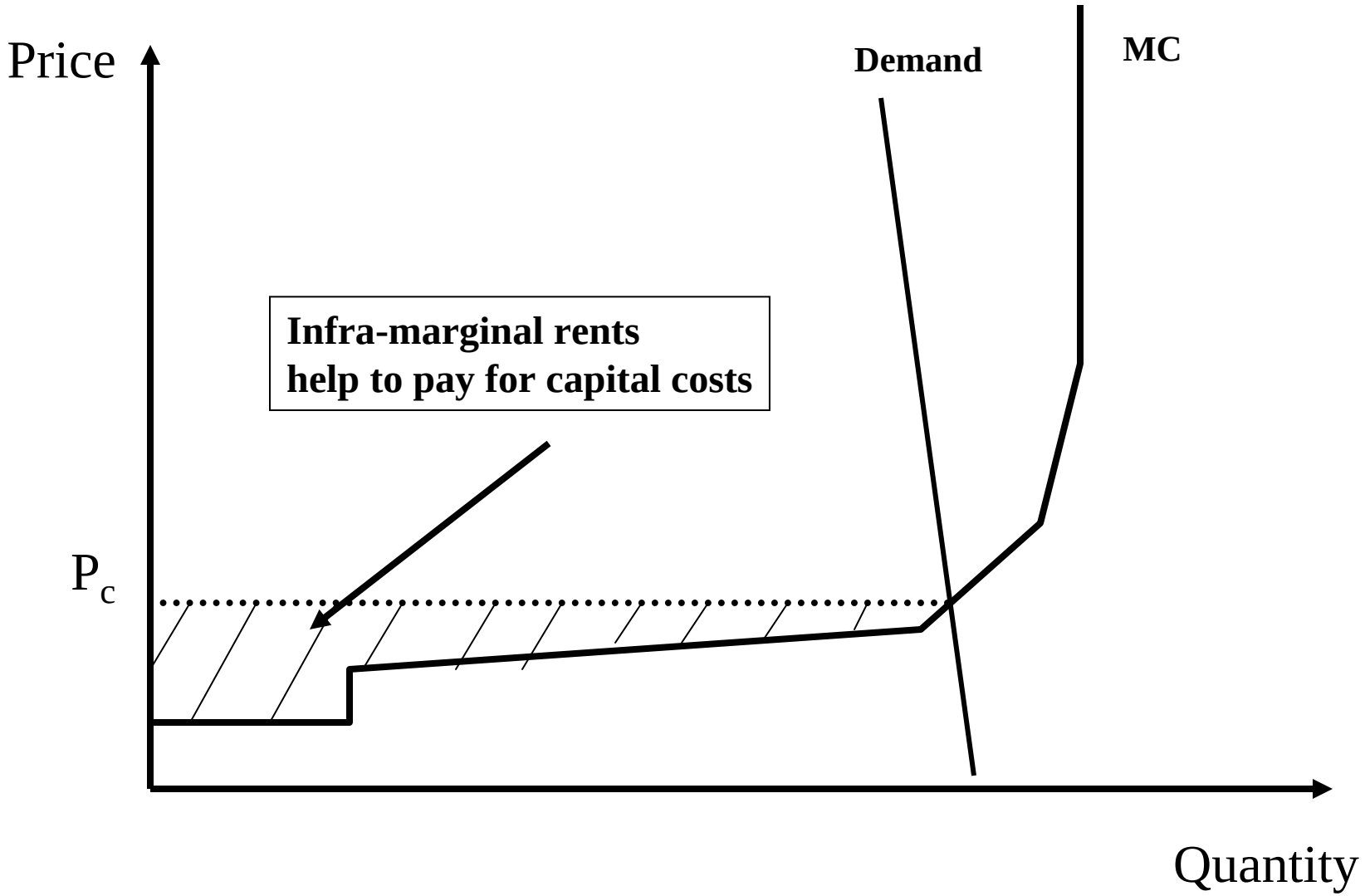
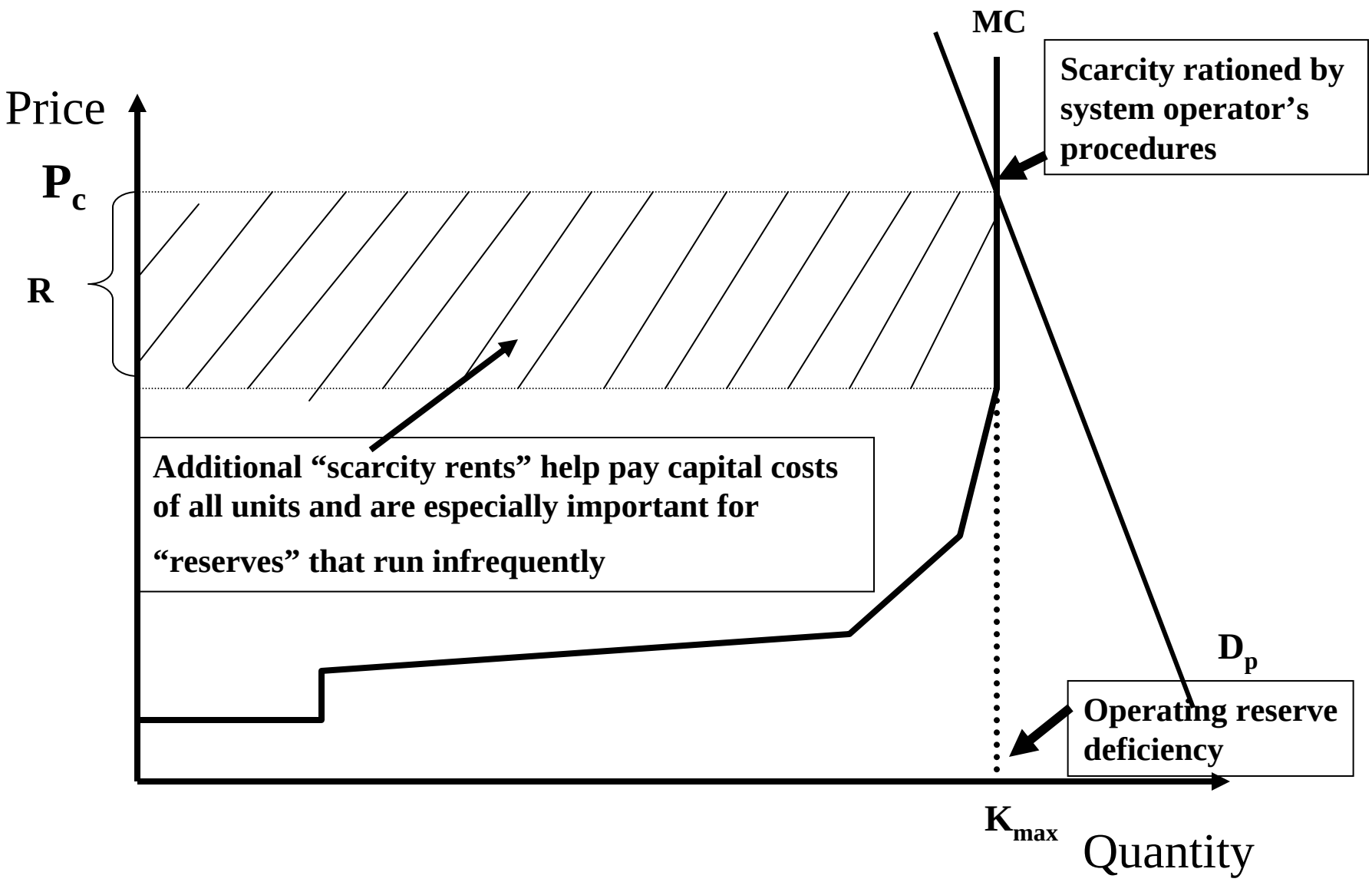
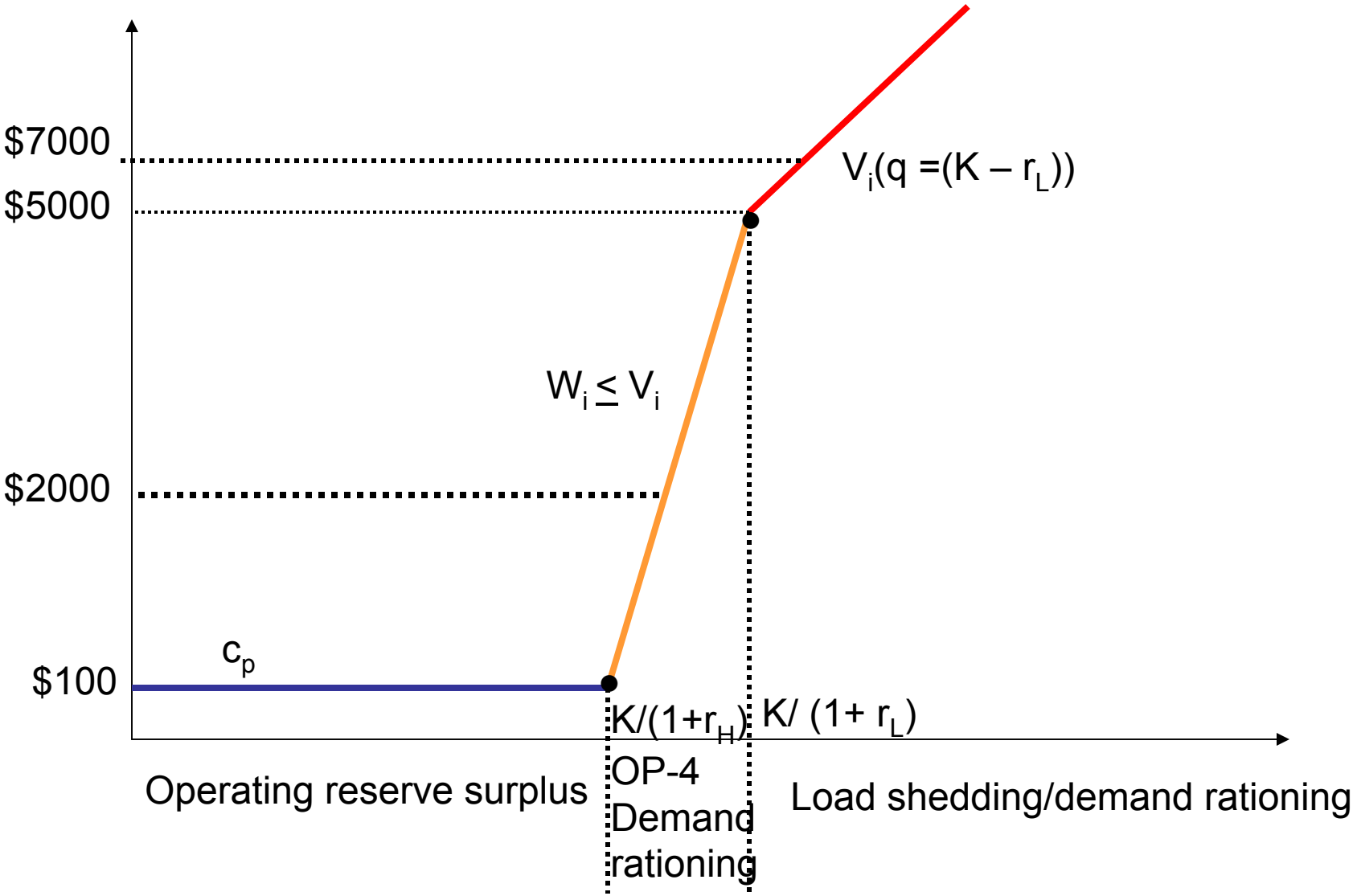

Price
Demand
MC
Infra-marginal rents
help to pay for capital costs
P_c
Quantity

FIGURE 2


MC
Scarcity rationed by system operator's procedures
Price
P_c
R
Additional "scarcity rents" help pay capital costs of all units and are especially important for "reserves" that run infrequently
D_p
Operating reserve deficiency
K_{max}
Quantity

IDEALIZED "PEAK PERIOD" WHOLESALE MARKET PRICE PATTERNS



LONG RUN EQUILIBRIUM "PEAKER" INVESTMENT CONDITIONS (oversimplified)

Investment:

$$C_k = \Sigma(p_i - c) = E(w_i) + E(v_i)$$

Marginal cost = expected marginal net revenue (rent)

Demand/supply balance during "scarcity" conditions:

$p_j = w_j(q_j, X_j, r_j, K)$ [operating reserve deficiency]
$p_i = v_i(q_i, X_i, r_L, K)$ [load shedding]

An optimal level of capacity K* and associate "planned Reserve Margin" R = K – E(qp) is implied by the above relationships and the probability distribution of peak demand realizations and generating unit availability

WHY DON'T "ENERGY-ONLY" MARKETS PROVIDE ADEQUATE PRICE SIGNALS?

- Several factors "truncate" the upper tail of the distribution of spot energy prices
  - Price caps and other market power mitigation mechanisms
    - Where did $1000/Mwh come from?
  - Prices are too low during operating reserve deficiency conditions
  - "Reliability" actions ahead of market price response
  - SO dispatch decisions that are not properly reflected in market prices (OOM; too few "products" to manage the network?)
  - Administrative rationing of scarcity rather than demand/price rationing of scarcity depresses prices
- Consumer valuations may be inconsistent with traditional reliability criteria
  - The implicit value of lost load associated with one-day with a load curtailment event in ten-year criterion is very high
  - Administrative rationing increases the cost of outages to consumers

WHAT TO DO?

- Continue to improve the performance of the spot market for energy and operating reserves
  - Raise the price caps to reflect reasonable estimates of VOLL
  - Allow prices to rise faster and higher under OP4 conditions
  - Minimize use of OOM or define a wider array of wholesale market products that are fully integrated with markets for related products
  - Continue efforts to bring active demand side into the spot market for energy and reserves
  - Re-evaluate reliability criteria to better reflect consumer valuations

WHAT TO DO?

- Implement "capacity price" mechanism as a "safety valve" to produce adequate levels to support investment consistent with reliability criteria
  - "safety valve," not be a permanent major source of net revenues
  - Consistent with continued evolution of spot wholesale markets and demand side participation
  - Capacity values (peaker rents) should be low when actual capacity is greater than K*
  - Capacity values (peaker rents) should be high when actual capacity is significantly less than K*
  - On average (expected value) capacity price should work out to the cost of a peaker C_k .
  - Smoothing around K* makes sense since there is reliability value when K > K*
  - Capacity payment target should net out peaker scarcity rents that are produced by the spot market (C_k – peaker scarcity rents)
  - Demand side should see a price (payment) consistent with the VOLL that underlies the reserve margin and peaker construction and carrying cost assumptions
  - Easier to adjust capacity prices up rather than down without creating regulatory credibility problems