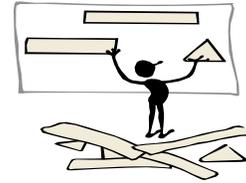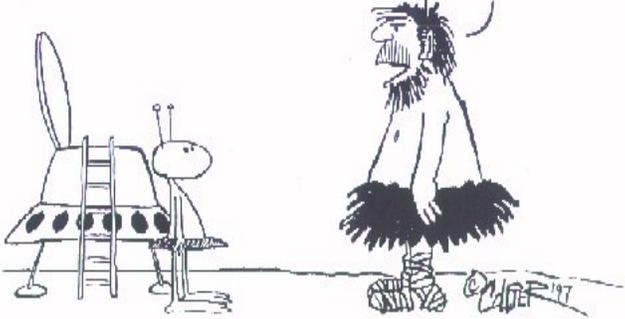NO, WE DIDN'T NUKE OUR-SELVES BACK INTO THE STONE-AGE. WE DEREGULATED OUR ELECTRIC UTILITIES...

The Convergence of Market Designs for Adequate Generating Capacity

Peter Cramton and Steven Stoft
22 March 2006
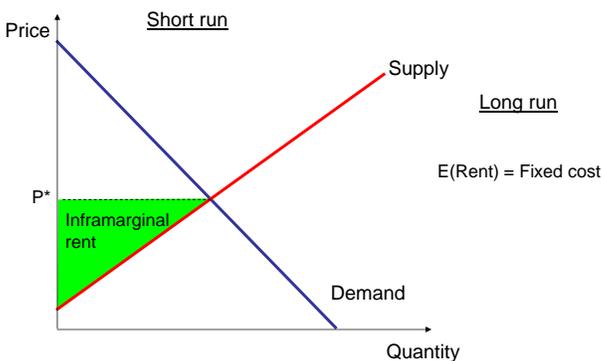
A tale on how (not) to design markets

"If all else fails,
then do the right thing."
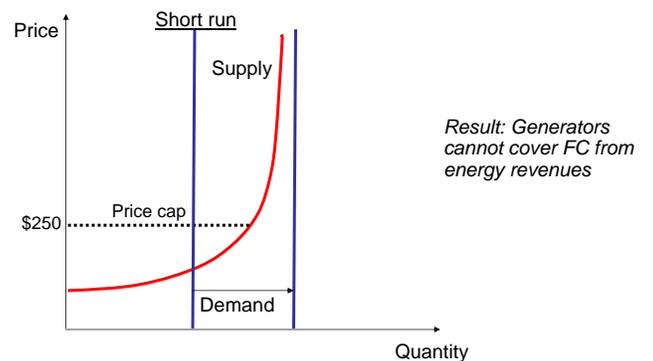-- Evan Kwerel, FCC

- 1998: Traditional spot capacity market
- 2004: Modern spot capacity market
  - Addresses market power
  - Addresses performance incentives
- 2006: Forward capacity market

Why a capacity market at all?

Other industries don't have one

Price

Short run

Supply

Long run

E(Rent) = Fixed cost

P*

Inframarginal rent

Demand

Quantity

Electricity demand is inelastic

Price

Short run

Supply

Result: Generators cannot cover FC from energy revenues

$250

Price cap

Demand

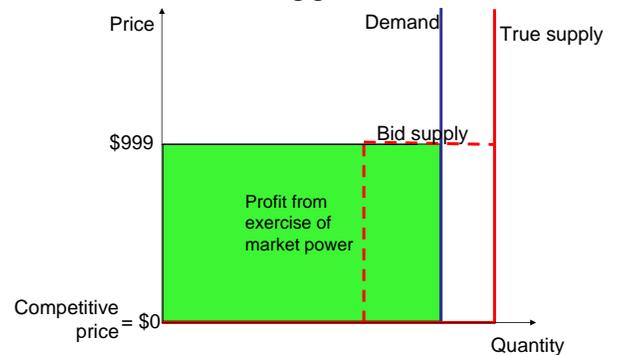Quantity

Purpose of market

- Induce just enough investment to maintain adequate resources
- Induce efficient mix and operation of resources
- Reduce market risk
- Avoid market power in capacity market
- Reduce market power in energy market

"Everything should be made
as simple as possible
... but not simpler." -- Einstein

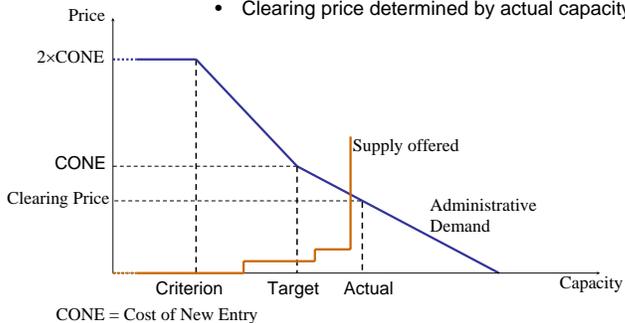## Round 1
Traditional Spot Capacity Market

Price — Demand — True supply

Competitive price = $0

Quantity

Traditional Spot Capacity Market
"Pick the Biggest Number"

Price — Demand — True supply

$999 — Bid supply

Profit from exercise of market power

Competitive price = $0

Quantity

Round 2
Modern Spot Capacity Mechanism (LICAP)

LICAP market clearing
- Suppliers bid as they wish
- Clearing price determined by actual capacity

Price

2×CONE

CONE

Clearing Price

Supply offered

Administrative Demand

Criterion   Target   Actual   Capacity

CONE = Cost of New Entry

Round 3
Forward Capacity Market

- Why forward capacity market?
- Auction mechanics
- Price formation
- Performance incentives
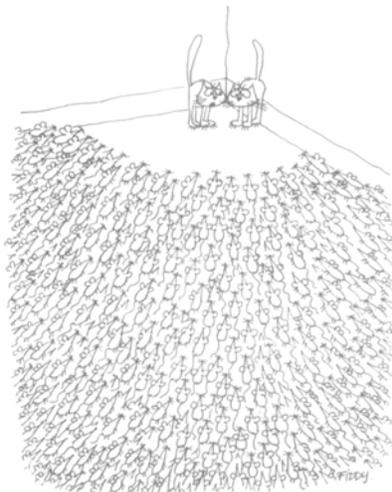
"Well don't just stand there - negotiate!"

Why forward procurement?

- New projects compete in advance of entry
  - Coordinated entry
    - Less uncertainty in achieving target (buy less)
  - New capacity sets price directly
    - Less reliance on demand curve for price setting
- Long-term commitment for new capacity
  - Reduced investor risk
  - Better price signal for new investment

Planning period

- Annual auction occurs three years before commitment begins
- Allows new projects to compete

Commitment period

- Existing capacity: one year
  - Already invested. No need for long commitment
  - Shorter commitment reduces risk
  - No need to arbitrage across years
- New capacity: five years (at most)
  - Longer commitment reduces investment risk
  - Price better reflects cost of new entry
  - New capacity can select shorter commitment in qualification
- New and existing capacity paid the same price in first year of commitment
- New capacity price is indexed after first year

Descending clock auction

- Auctioneer announces high starting price
- Suppliers name quantities
- Excess supply is determined
- Auctioneer announces a lower price
- Process continues until supply equals demand

Capacity requirements

- Before auction, ISO determines for first year of commitment period
  - Minimum capacity in each zone and system
  - Transfer limits between zones
- System requirement is set at Installed Capability Requirement (ICR)
  - Safety margin beyond ICR not needed
    - Entry is coordinated
    - Adjustments are possible

Starting price

- Starting price must be set sufficiently high to create significant excess supply
- Setting too high a starting price causes little harm
  - Competition among potential projects determines clearing price; high start quickly bid down
- Setting too low a starting price destroys auction
  - Inadequate supply or insufficient competition
- Price of $16/kW-month is recommended
- Note clearing price will exceed cost of new entry in some years to the extent it is below cost of new entry in other years (of surplus)

Zone selection criterion

- Zones determined before auction based on transfer limits that may bind in auction
- Potential import constrained zone
  - Not a separate zone if installed capacity exceeds local sourcing requirement
- Potential export constrained zone
  - Modeled in auction

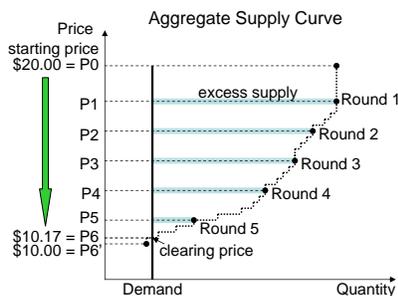## Mechanics: Single zone

- Clock auction done in discrete rounds
- In each round,
  - Auctioneer announces
    - Excess supply at end of prior round
    - Start of round price
    - End of round price
  - Each bidder then names
    - Supply at all prices between start of round price and end of round price
  - Auctioneer determines excess supply at end of round price
    - If excess supply, auction continues
    - If no excess supply, clearing price determined

Individual Supply Bid, Round 6
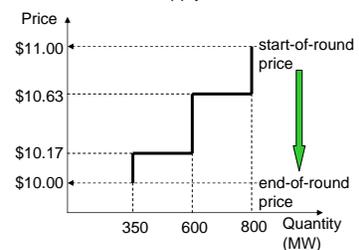
- Bidders can only maintain or reduce quantity as price falls
- "Intraround bids"
  - Better expression of bidder preferences
  - Better control of pace of auction
  - Larger bid decrements do not reduce efficiency
  - Ties are reduced

Descending clock auction

Mechanics: Multiple zones

- Auction begins just as with a single zone: a single price for all capacity
- Price separation only occurs if and when transfer limits bind

Three zone example

1. Connecticut potentially import constrained
2. Maine potentially export constrained
3. Rest of pool
- Auction finds prices and supply levels such that
  - System requirement is met
  - Connecticut requirement is met with local capacity and imports
  - Maine does not supply more than its local need plus export limit

Prices depend on binding constraints

- Neither Connecticut nor Maine bind
  - Prices decline until system requirement met
  - Prices: Connecticut = Rest of Pool = Maine
- Only Connecticut constraint binds
  - Prices decline until Connecticut binds, remaining prices decline until system met
  - Prices: Connecticut > Rest of Pool = Maine
- Only Maine constraint binds
  - Prices decline until system requirement met, Maine price declines until Maine constraint met
  - Prices: Connecticut = Rest of Pool > Maine
- Both Connecticut and Maine constraints bind
  - Prices decline until Connecticut binds, remaining prices decline until system met, then Maine declines until Maine constraint met
  - Price: Connecticut > Rest of Pool > Maine

Information policy

- Demand curve and starting price announced before auction
- After every round, auctioneer reports
  - System excess supply at end of round price
    - System excess supply calculation respects export limits for export constrained zones
  - Oversupply in export constrained zones
  - *Zone-specific excess supply in import constrained zones is not reported*

No rationing, except imports/exports and existing capacity

- What happens if a bidder drops from 800 MW to 600 MW at the clearing price? Either 800 MW or 600 MW is accepted
- No rationing respects lumpy investments
- If multiple bidders drop at the clearing price, the bids are accepted to minimize excess supply
- Import/export bids may be rationed
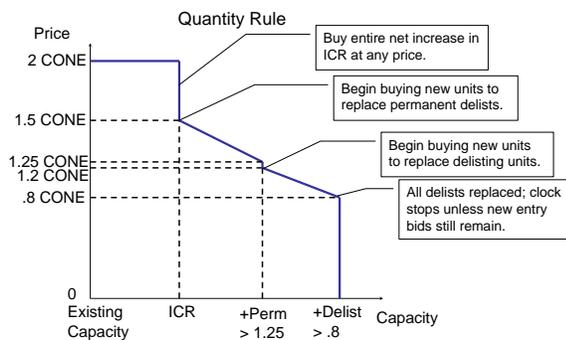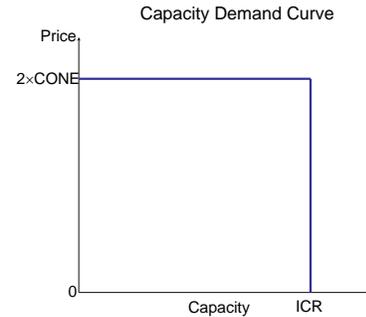- Existing capacity may be rationed

Market power

- Addressing market power in capacity market is essential
- Strong incentive to exercise market power
  - Existing capacity has substantial sunk costs
  - New capacity is only a tiny fraction of total
  - Market is concentrated, especially in zones
    - Any of top-4 suppliers could unilaterally set price
- Long-term price signals are more stable and efficient if determined from competitive forces, rather than market power

Market power solution

- New capacity
  - New capacity bids are not mitigated in any way (except starting price)
  - Assumes competition for new capacity
- Existing capacity
  - For purposes of price setting, all existing capacity, except for retirements and imports/exports, is considered bid in at a price of zero
  - Capacity can opt out of capacity market with exit bid above the clearing price
  - Retirement bids submitted at start of auction
    - Accepted retirements excluded from any future capacity auction
    - Retirements may be rejected for reliability reasons, but only if the reliability problem cannot be resolved during the planning period with alternative actions, such as transmission upgrades or new capacity
  - Import/Export bids submitted at start of auction
    - Accepted imports/exports must respect import/export limits
    - Exports in constrained zones limited to quantity that cannot be supplied by unconstrained zones
    - Import/exports must be backed up by contract

Market power solution

- Price typically is set by new capacity, since new capacity does not have sunk costs
- Sometimes price is set by outside opportunities
  - Retirement (but once and for all)
  - Imports/Exports (but limited to import/export limit)
- Price is never set by existing capacity other than retirements and imports/exports
- Demand curve needed to determine price in event of surplus of existing capacity without retirements or imports/exports

Capacity Demand Curve

Price

$2 \times$CONE

0

Capacity   ICR

Quantity Rule

Price

2 CONE

1.5 CONE

1.25 CONE
1.2 CONE
.8 CONE

0

Existing   ICR   +Perm   +Delist   Capacity
Capacity   > 1.25   > .8

- Buy entire net increase in ICR at any price.
- Begin buying new units to replace permanent delists.
- Begin buying new units to replace delisting units.
- All delists replaced; clock stops unless new entry bids still remain.

Monopsony market power

- Any capacity built by load through RFP or other process must be offered at cost in the first year it participates in the capacity market
- Capacity built by load in an RFP at a capacity cost of \$8/kWm, net of inframarginal rents, must bid in the capacity market at \$8/kWm for one year

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Protections if auction fails:
Inadequate supply

- At the starting price, a zone has insufficient supply to satisfy its local sourcing requirement
  - New capacity in zone is paid starting price
  - Existing capacity in zone is paid 1.1×EBCC
  - Auction is conducted for zones with adequate supply
- At the starting price, system requirement cannot be satisfied
  - Auction is conducted for export constrained zones
  - In all other zones,
    - New capacity is paid starting price
    - Existing capacity is paid 1.1×EBCC
- *Note: Rule does not discourage new projects*

Protections if auction fails:
Insufficient competition

- Existing capacity, less retirements and net exports, is less than the requirement, and
- At the starting price, the capacity bid is more than the requirement but less than 4% excess, or a supplier's new capacity is pivotal
  - Auction is conducted
  - New capacity is paid the clearing price
  - Existing capacity is paid the smaller of the clearing price and 1.1×EBCC
- Applied for system and in each zone
- *Note: Rule does not discourage new projects*

Imports and exports

- Imports and exports are treated the same
  – Bids submitted at qualification
  – Bids may be rationed
- Net exports must be consistent with transfer limits
- Exports from constrained zone not allowed if could be done from unconstrained zone
- Imports/exports must be based on contracts

## Reconfiguration auction

- Takes place at same time as primary auction
  – Primary: 3 years ahead (40 months ahead)
  – Reconfiguration: 2, 1, 0 years ahead
                                 (28, 16, 4 months ahead)
- Reconfiguration includes
  – Adjustment of ICR for current forecast
  – Supplier's buy/sell to balance position (including demand response)
  – Possible carve out for demand response or other resources that might be unable to offer 3 years ahead

Reconfiguration auction

- Sealed-bid uniform price double-auction
- Same demand curve as in primary auction, netting out capacity already purchased
- No bid mitigation other than floor of zero and cap at deficiency charge

Monthly spot exchange

- Monthly simultaneous clearing
  – Sealed-bid uniform price double auction
  – Suppliers buy/sell to balance positions
  – Demand curve same as in primary auction
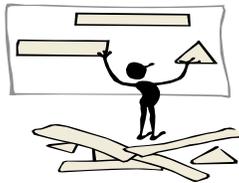
Part 2
Putting All the Good Ideas on
Resource Adequacy Together

❑ **Positive ideas (All right, all fit together)**
  – High spot energy prices send efficient signals
  – Long-term contracts fight market power
  – Options reduce risk
  – ICAP solves the reliability problem
  – Demand elasticity is wonderful

❑ **Exaggerations & ideas attacking good ideas**
  1. **ICAP is anti-market (energy only)**
  2. **Selling options restores the missing money**
  – Requiring long-term contracts is too centralized
  – High prices mean too much risk / market power
  – Options are too complex
  – *It's all too complex!* Wait for demand elasticity

Fallacy #1: Energy-only avoids
administrative intervention

The principal reason for an energy-only market
would be prices determined without either
administrative price caps or other interventions.
– MISO, 2005

- Only in markets with responsive demand
- Current markets cannot price reliability

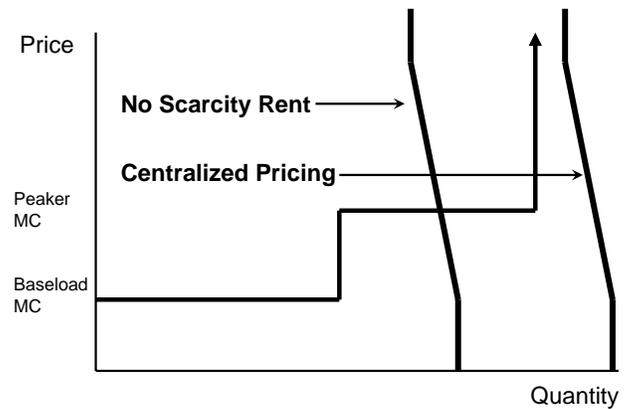**Energy-Only Market "without Administrative Interventions"**
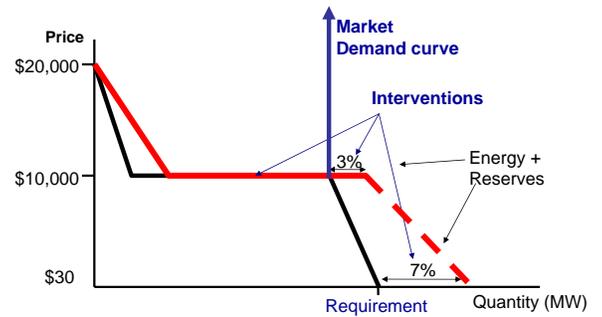
**Proposed modifications of the market's energy demand
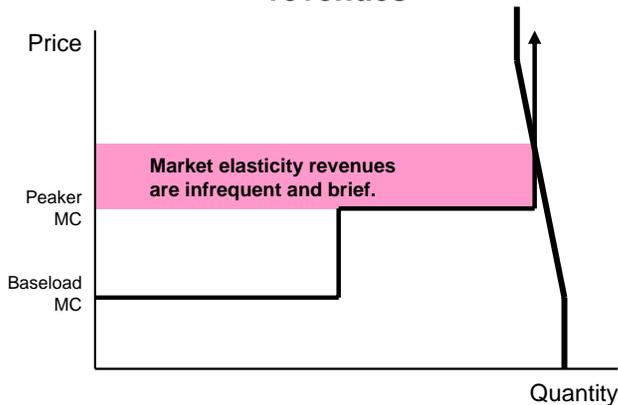curve for an energy-only market.**

Someday, when the market works

High (scarcity) Prices
$80,000/MWh x 50,000 MW
= $4 billion / year

Non-Centralized Elastic Demand
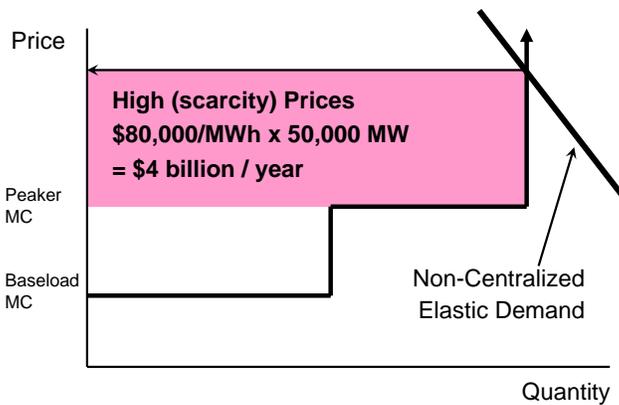
Reality: No market scarcity revenue here

No Scarcity Rent

Centralized Pricing

Market-driven scarcity (elasticity) revenues

Market elasticity revenues are infrequent and brief.

To test if market works with energy-only:

- Calculate expected rents from high spot prices
- when installed capacity is adequate

Show:
market elasticity revenues > missing money
(~ $ 4 billion)

"I don't know what the big deal is.
I've been having rolling blackouts for years."

What about a market for reliability?
(instead of Energy-Only)

- It would black out low-value demanders first
- Right now we can't do this
- Later, with fancy circuit breakers, we could

How are we doing?

1. Standard energy-only ➔ very administrative
2. Elastic energy-only ➔ not here yet
3. Energy-only + reliability market ➔ not here

❑ Three strikes:
   If Energy-Only is best, then it must be
   E-Only is   Good Administrative
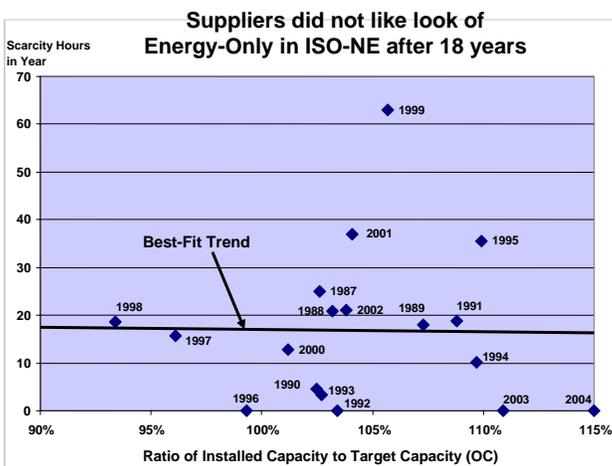   ICAP is   Bad Administrative

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Compare Energy-Only vs. All Good Ideas

- **Energy-Only**
  - Perfect performance incentives
  - "Easy" transition to non-administrative (for regulator)
  - Unclear (right on average) investment signals
  - Poor consumer protection from $10,000 prices

- **ICAP + Same High Energy Prices + Options**
  - Perfect performance incentives
  - "Easy" transition to non-administrative (for players)
  - Clear investment signals
  - Good consumer protection

**Suppliers did not like look of
Energy-Only in ISO-NE after 18 years**

Scarcity Hours in Year vs. Ratio of Installed Capacity to Target Capacity (OC)
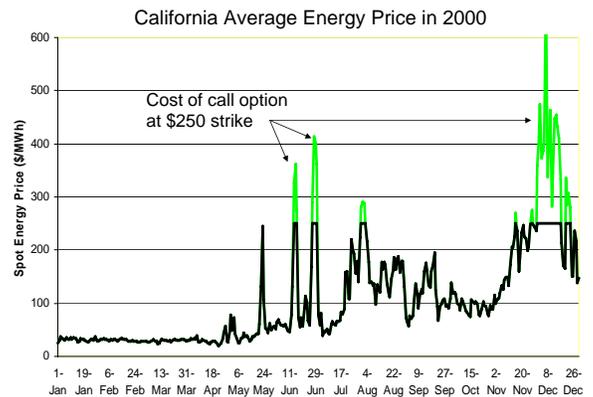

Is Energy-Only really so messy?

- Electricity's getting expensive again
  - **+** Energy-Only volatility
  - **+** Energy-Only risk premiums
  - **+** Energy-Only market power

➔ Better to use all good ideas not Energy-Only

"Is it dark in here or is it just California?"

Fallacy #2
Call option restores missing money

California Average Energy Price in 2000

Cost of call option at $250 strike

Call option doesn't restore missing money

- Competitive price just reflects cost
- Lower strike price increases cost
- Greater scarcity increases risk and cost
- Missing money only comes from higher prices
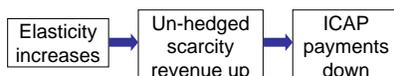
Summary of Convergence

- Full strength scarcity pricing
- Mandatory load hedges with options
- Reliability controlled by ICAP market
- Long-term contracts
- Increased demand elasticity

Virtuous Dynamics

Introduced with ICAP:

Mandatory hedges → Price cap raised → Energy price increases → Missing money restored

Over time:

Elasticity increases → Un-hedged scarcity revenue up → ICAP payments down

"We're at the home of Jim and Mindy Marks, who are about to discover that their utility bill has gone sky-high. Let's watch."