An Examination of Capacity Markets In Electricity Market Design
Capacity Credit Markets

1. Defining Capacity
   1. Historical Context
   2. Competitive Market Context
2. Market Construct ➔ Market Power
3. To Subsidize Generation?
4. Efficacy of ICAP Subsidy
5. Fundamental Flaw in ICAP Concept
ICAP – Invented for Regulators

- Originally designed 30+ years ago to satisfy state regulators
  - Integrated Resource Plans
  - Economies of Scale in Generation
  - Avoiding Prudency Reviews
    - (Overbuilding)

Tight Power Pools
Wholesale Energy Transactions Before Restructuring

• Utilities would sell non-firm energy to neighboring utilities

• “Split-savings” transactions were based on relative costs

Utility A
$20/MWh

Utility B
$30/MWh

Non-Firm Energy
$25/MWh
Cost-Based Pricing
Before Restructuring

- Interrupting delivery to B to sell to C would harm A’s relationship with B for $1 more

Utility A: $20/MWh
Utility B: $30/MWh
Utility C: $32/MWh
Non-Firm Energy: $26/MWh
Cost-Based Pricing
Before Restructuring

- Adding a “capacity” payment prevented interruption of the transaction

Utility A
$20/MWh

Utility B
$30/MWh

Utility C
$40/MWh

Capacity
$3/MWh

Non-Firm Energy
$25/MWh
Market-Based Pricing
After Restructuring

- It is much more tempting to interrupt B if C is willing to pay $1,000/MWh
Market-Based Pricing
After Restructuring

Before Deregulation

Capacity

Non-Firm Energy

After Deregulation

Capacity

Non-Firm Energy
Capacity is really a “call” option

Firm Energy
- Call Option

Non-Firm Energy

If the buyer of Firm Energy gives the Seller a call option, the buyer has Non-Firm Energy.

The price for a daily Call Option approaches and even exceeds the price of Firm Energy. The major variables that determine the option price are: (1) strike price relative to underlying commodity, (2) volatility of commodity price, (3) time until strike deadline and (4) strike frequency.
Call Option is Most of the Value

Before Deregulation

Capacity

Non-Firm Energy

Firm Energy

Call Option Value

Non-Firm Energy
Call Option Cannot Be Separated from “Firm” Energy

It is impossible to eviscerate the call option from the price of Firm Energy because the call option is integral to Firm Energy.

Stripped of the embedded call option, Firm Energy would be worthless.

NOBODY BUYS NON-FIRM
Introducing Installed Capacity (ICAP) Credits

Before Deregulation

- Capacity
- Non-Firm Energy

After Deregulation

- Call Option
- Non-Firm Energy

Retailers

“Capacity” Credits (ICAP)
Introducing Installed Capacity (ICAP) Credits

Retailers are forced to buy capacity credits **even if** they have firm energy purchases adequate to serve their entire demand.

**Example**
Retailer’s Demand = 1,000 MW
Retailer’s Forward Purchases = 1,000 MW
⇒ Retailer must purchase 1,180 MW of ICAP credits (18% reserve)

**And:** ICAP must be local (deliverability requirement)
⇒ Market Power
Vertical Supply/Demand Curve

Short Run = 3-5 years
Market Power Allows Sellers to Manage Price of ICAP to Protect Monopoly Price

Capacity Credit Charges Absorb the Benefits of Competition

ICAP prices increase to eliminate the benefits brought by falling wholesale prices
Current Situation in Northeast

Retailer: I’ve bought Firm energy from you, but I need some generation credits.

Generator: What are they worth to you?
Retailer: Absolutely nothing. I’ll be fined if I don’t have them.
Generator: How much is the fine?
Retailer: $177/MW-Day
Generator: What do I have to do?
Retailer: Nothing that you aren’t doing already. Point to a generator that can deliver energy into PJM a few hours a year when called, if your unit is available to operate.

Generator: Can I still sell Firm Energy “short”?
Retailer: I’d rather you not, but there’s no way I can tell if you have.
Generator: I think I can save you a few dollars.
Long-Term Supply/Demand

- ICAP is irrelevant
  - Too small a revenue stream to matter
  - Too uncertain to rely on
    - Supply increasing past the reserve margin has no ICAP value
- Floors don’t work either
  - New York ICAP model
  - Why? Funds spread too thin
Existing Generators Get Most of the ICAP Payment

- **Megawatts**
  - New
  - Existing

- **Year 0**
- **Year 1**
- **Year 2**
- **Year 3**
- **Year 4**
- **Year 5**

- **4,600 MW to maintain 15% Reserve**
Over 5 years, only 7% of subsidy goes to new generators

If ICAP commands any price at all
The Results Aren’t Promising for ICAP
Reserves Increasing in Non-ICAP Markets

-generation Reserve Margins by NERC Region

-ECAR
-ERCOT
-FRCC
-PJM
-MAIN
-MAPP
-NPCC
-SERC
-SPP
-WSCC

100% under constr., 70% in adv. Dev., 30% in early dev.
Do Existing Generators Need ICAP?

- Can generators cover fixed and variable expenses through firm energy sales?
- Are subsidies necessary to keep generators from going away when spot energy prices are low?
- ICAP proponents warn of a “revenue gap”.
Do Generators Need a Subsidy?

Maximum Possible Contribution to Fixed Cost from Energy Market
(Example Unit w/ $40/MWH Variable Cost)

Hours Resource Not Operating
(Energy Market Price < Bid)

Hours Resource Operating
(Energy Market Price > Bid)

Revenue gap from energy market revenues? Not really.
Option value compensates more than enough.

Energy Bid
(Set Equal to Variable Cost)

Total Variable Cost

Maximum Total Possible Contribution Toward Fixed Cost

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Estimating Option Value

- Generators have an option, in real-time, to generate or not to generate
  - This flexibility is extremely valuable both in the forward markets and in the hourly markets

- The following two slides illustrate a very simple approach to extract this value
“Trading Around Assets”
Cinergy Sep ’99 Contract
Selling at The Peak Yields $8/MWh

Timing the market perfectly to extract this $8/MWh is nearly impossible

Variable Cost
Explaining Option Value: Cinergy Sep ’99 Contract
Selling around bandwidth yields $17

This approach is simple and yields much greater value.

Profits On Option
$17/MWh
Increase in Profits = $9/MWh
Generators Extracting Value

- This approach to extracting value to help pay the fixed costs of a generator is a simple method showing how generators can create value
  - Even in a low-volatility month like September
  - Using narrow, conservative trading ranges
  - No risk
- $17/MWh for one month translates to $70/kW-year from this tool alone
Examples We’ve Seen

- The next two slides show examples used by proponents of ICAP to explain why they need ICAP subsidies
  - Example 1: base-load, gas-fired plant
  - Example 2: peaking plant
Incomplete Example 1

Excludes Option Value

500 MW gas-fired combined cycle

- Fixed cost requirement (levelized) $95 - $140 per kw-yr
- Expected net revenues:
  - energy market $50 - $70 per kw-yr
  - uplift $1 - $1.5 per kw-yr
  - ancillary services $2 - $2.5 per kw-yr
  - total $53 - $74 kw-yr
  
  equals $21 - $87 kw-yr

However, our example showed September returning $17/MWh which translates to $5.78/kW-month. The same return over 12 months is $69.36, and that doesn’t even count off-peak hours and Saturdays! Obviously, this covers the “revenue gap”.

Incomplete Example 2

Excludes Option Value

125 MW gas-fired combustion turbine

- Fixed cost requirement (levelized) $60 - $90 per kw-yr
- Expected net revenues:
  - energy market less $25 - $40 per kw-yr
  - uplift $0.5 - $1 per kw-yr
  - ancillary services $2.5 - $3 per kw-yr
  - total $28 - $44 kw-yr

- revenue gap equals $16 - $62 kw-yr

Here, the burden is even smaller. Clearly, the $70 contribution of the option value covers the “revenue gap”.
Will All Generators Turn Profits Without ICAP?

- Maybe not
  - Some may not be sophisticated enough to employ simple portfolio management techniques
- Still, generating equipment will not disappear
  - Owners will learn how to manage better, or will sell to someone who can create more value
If Policy Makers Must Subsidize

- Limit subsidies to new generators
  - Just Like Economic Development
    - Only subsidize to attract new businesses

- Generator Objection: “But existing generators are providing the same service and reliability support as the new entrants”
  - And existing businesses are contributing to the economy, but that doesn’t mean you subsidize them to stay put when you know they aren’t going anywhere
Guarantee Payment Only to New Generators

- Pay new generators $50/kW per year for the first five years of operation.
- Fund through surcharge of $0.002/kWh to all customers through a $1.50/MWh charge to all suppliers that schedule through the ISO for delivery to retail customers.
- Apply only when reserves drop below 15%.
Price of New Generator Subsidy

Assuming paying subsidy off in 5 years, and:
- Maintaining Current Reserves at 17%
- Aggressive Load Growth of 2.5%
- No non-subsidized generation is built
1. Customers Benefit When Prices Fall
2. Revenue Continues When Prices Rise
STRATEGIC ENERGY

Generation Adequacy: A Simple Solution
Sellers Hedge Their Firm Energy Sales

Sell Most Generators Forward

Holding Some Generators in Reserve

Let’s Call These “Forward Reserves”
Holding Generators for Forward Reserves Shifts the Supply Curve Left

A generator with a portfolio of 5,000 MW will probably hold at least 500 MW for Forward Reserves.
The New Equilibrium Price Is $P + \Delta P$

Holding some supplies for Forward Reserves increases the price in the forward market.