# Comparison of Performance-Based Capacity Models in ISO-NE and PJM

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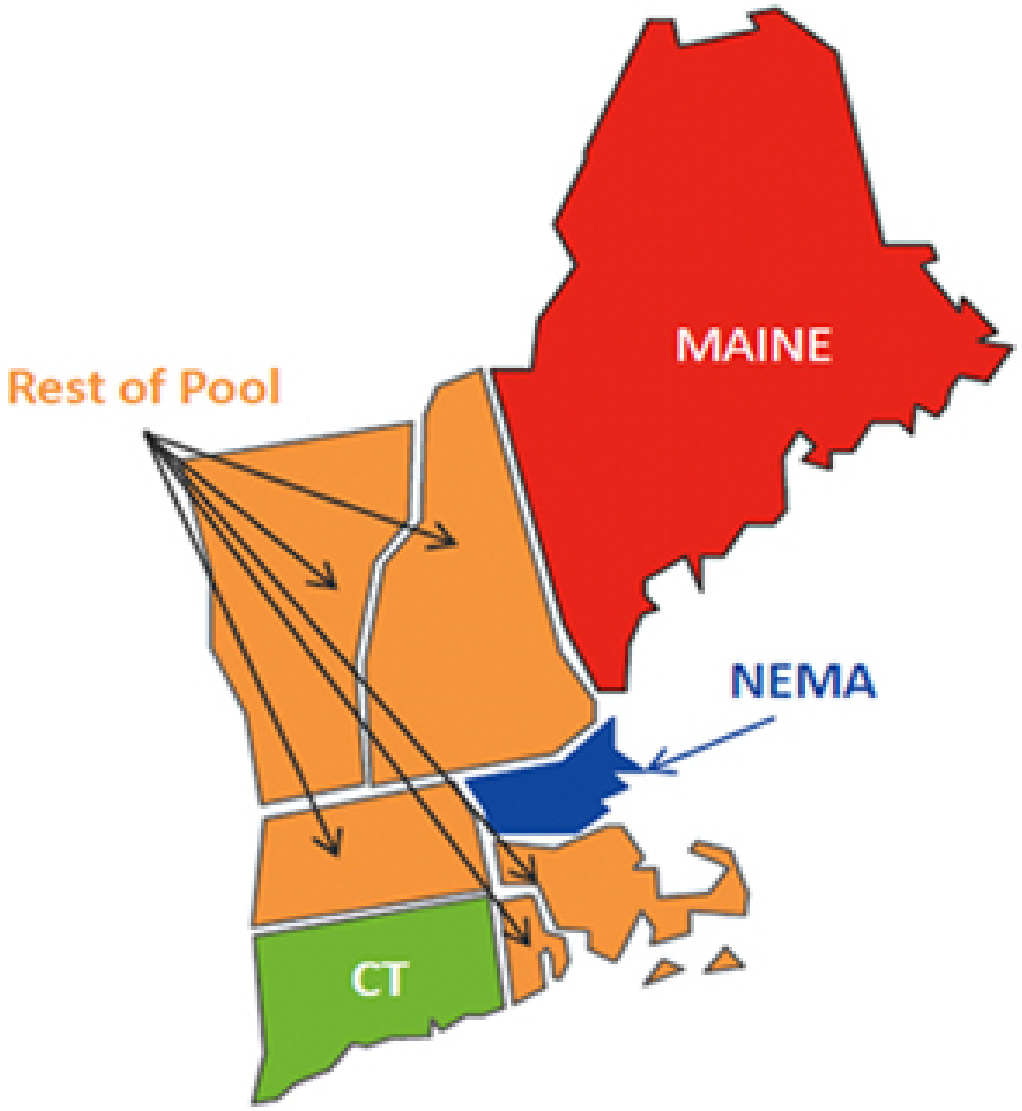
# Goals for discussion

- Provide a general overview of ISO-NE's Forward Capacity Market Design
- Compare and contrast Pay-for-Performance and Capacity Performance designs
- Attempt to quantify impact of design differences on market participants including value of risk and revenue drivers
- Begin dialogue about pros and cons of each design




# Forward Capacity Market Overview

- **Descending Clock Auction** design
- **Forward Capacity Auction** offer prices decrease during progressive rounds
- **Market Clearing Engine** produces a single clearing price for each **Capacity Zone**
- Existing resources take on a **Capacity Supply Obligation** for a one-year **Capacity Commitment Period**, three years in the future
- New resources offer either a one or seven year fixed price capacity commitment

# Forward Capacity Market: Qualifying Capacity

- ISO-NE does not use EFORd – ICAP only construct
- Supply resources offer and clear their **Qualified Capacity**
  - Existing Thermal: **Seasonal Claimed Capability** during five previous summer and winter periods for traditional existing generation resources
  - Intermittent: Average net output during peak hours for last five years
  - Demand Resources based on M&V plan
- Unlike PJM, forced outages do not automatically reduce forward capacity position
- A significant decrease in qualified capacity – i.e. more than 20% or 40 MWs – can be repaired through a **Restoration Plan**
- Smaller forced outages minimized though five year averaging

# Forward Capacity Market: De-list bids

- **Delist Bids** allow existing resources to “opt-out” for a single Capacity Commitment Period (or longer)
- **Dynamic Delist Bid:** Permits resources to opt out when prices fall below the **Dynamic Delist Bid Threshold** recommended by ISO-NE Market Monitor
  - Similar to PJM’s Net CONE Market Seller Offer Cap
  - Includes penalty risk premium calculated by Market Monitor
- **Static Delist Bid:** Based on IMM approved cost justification where if prices are below that level the unit will not be committed
  - Similar to PJM’s Avoidable Cost Rate (ACR) Offer Cap

# Performance capacity designs are a response to systemic performance failures in both markets

- ISO-NE
  - Gas interruptions caused substantial loss of generation
  - September 10, 2010 ISO violated NERC Reliability Standard due to loss of largest contingency
  - January 28, 2013 “near miss” where loss of 1-2 additional gas fired units could have caused severe reliability concerns
- PJM
  - Polar Vortex in January 2014 resulted in substantial reliability concerns
  - High uplift cost to load
  - Concern over lack of firm fuel and dual fuel for gas-fired generation

Figure 17: Outages by Primary Fuel – January 7, 7:00 p.m.

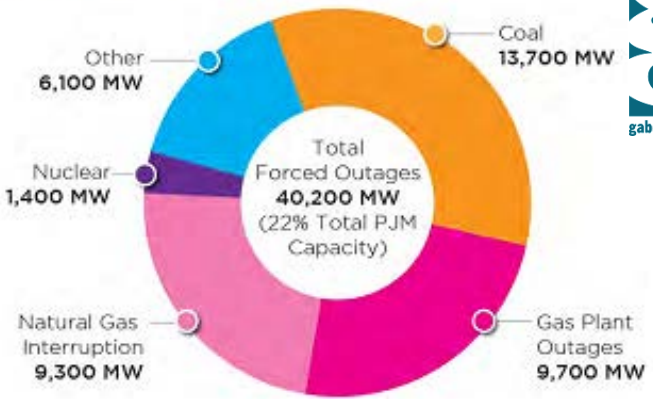
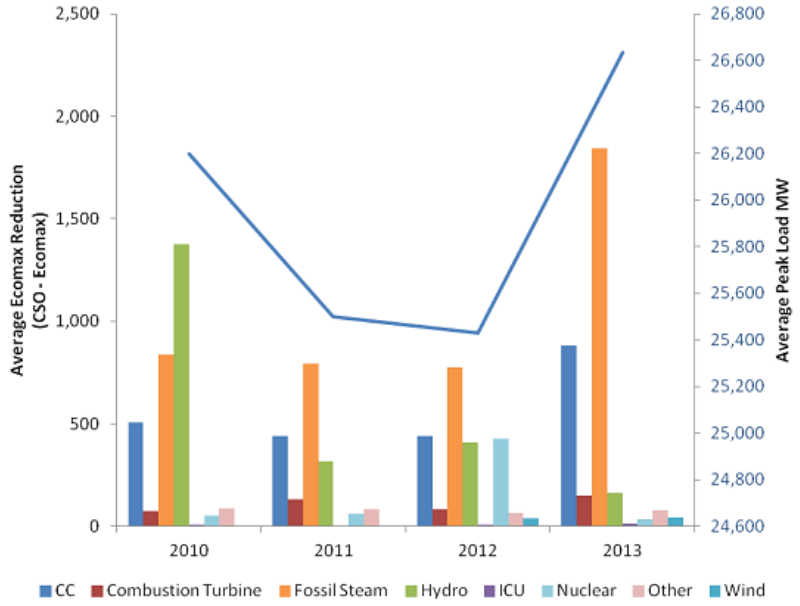



**Figure 5: MW of Reduction in Ecomax by Technology Type During Peaks**



# Five central concepts of Pay-for-Performance & Capacity Performance

- Universal concepts affirmed by Federal Energy Regulatory Commission ("FERC")
  - Substantial penalties for non-performance during a very small number of emergencies
  - Penalties can eliminate capacity revenues or become charge to supplier for significant under-performance
  - Few excuses for non-performance
  - Option for premium capacity payment based on risk + CAPEX
  - "Losers" pay "winners" – penalties allocated to over-performing resources
- Key differences between the two markets means that Capacity Performance is *not* "closely patterned" on Pay-for-Performance
- Novel design with a significantly different risk and reward profile

# Pay-for-Performance: Two settlement construct

- **Settlement 1:** Base Payment equals each resource's Capacity Supply Obligation * FCA clearing price
- **Settlement 2:** Performance Payment = actual performance during each five minute interval of reserve scarcity
- Monthly Capacity Payments equal the sum of the two settlements

- Penalty
  - Performance Payment Rate (PPR) * Balancing Ratio (BR) * Capacity Supply Obligation (CSO)
- Credit
  - PPR * Actual energy or reserves provided during each interval (A)
- Capacity Performance Score
  - A-(BR*CSO)
- Performance Payment
  - [A-(BR*CSO)]*PPR

# ISO-NE two settlement example 1: Neutral

| Pay-for-Performance Two Settlement Examples: Neutral | | | |
|---|---|---|---|
| **Market** | **Units** | **ISO-NE (ROP)** | |
| **Capacity Supply Obligation (CSO)** | MWs | | 1,000 |
| **DY 2019/2020 Auction Clearing Price (ACP)** | $/MW-day | $ | 231.13 |
| **Balancing Ratio (BR)** | $ | | 85% |
| **Actual Performance (A)** | MWh | | 850 |
| **Performance Payment Rate (PPR)** | $/MWh | $ | 2,000 |
| **Capacity Performance Score (A-(BR*CSO))** | Hour | | - |
| **Base Payment (CSO*ACP)** | $/Month | $ | 7,030,100 |
| **Performance Payment ([A-(BR*CSO)]*PPR)** | $/Month | $ | - |
| **Final Capacity Payment (Base Payment + Performance Payment)** | $/Month | $ | 7,030,100 |

# ISO-NE two settlement example 2: Short

| Pay-for-Performance Two Settlement Examples: Under-Performance | | |
|---|---|---|
| **Market** | **Units** | **ISO-NE (ROP)** |
| **Capacity Supply Obligation (CSO)** | MWs | 1,000 |
| **DY 2019/2020 Auction Clearing Price (ACP)** | $/MW-day | $ 231.13 |
| **Balancing Ratio (BR)** | $ | 85% |
| **Actual Performance (A)** | MWh | - |
| **Performance Payment Rate (PPR)** | $/MWh | $ 2,000 |
| **Capacity Performance Score (A-(BR*CSO))** | Hour | (850) |
| **Base Payment (CSO*ACP)** | $/Month | $ 7,030,100 |
| **Performance Payment ([A-(BR*CSO)]*PPR)** | $/Month | $ (1,700,000) |
| **Final Capacity Payment (Base Payment + Performance Payment)** | $/Month | $ 5,330,100 |

# ISO-NE two settlement example 3: Long

| Pay-for-Performance Two Settlement Examples: Over-Performance | | |
|---|---|---|
| **Market** | **Units** | **ISO-NE (ROP)** |
| **Capacity Supply Obligation (CSO)** | MWs | 1,000 |
| **DY 2019/2020 Auction Clearing Price (ACP)** | $/MW-day | $ 231.13 |
| **Balancing Ratio (BR)** | $ | 85% |
| **Actual Performance (A)** | MWh | 1,000 |
| **Performance Payment Rate (PPR)** | $/MWh | $ 2,000 |
| **Capacity Performance Score (A-(BR*CSO))** | Hour | 150 |
| **Base Payment (CSO*ACP)** | $/Month | $ 7,030,100 |
| **Performance Payment ([A-(BR*CSO)]*PPR)** | $/Month | $ 300,000 |
| **Final Capacity Payment (Base Payment + Performance Payment)** | $/Month | $ 7,330,100 |

# Capacity Performance: Three settlement construct

- **Settlement 1:** Capacity Payment for Cleared UCAP * Auction Clearing Price
- **Settlement 2:** Capacity Payment adjusted by total Non-Performance Charges and/or Bonus Payments
- **Settlement 3:** Shortfall in prompt forward Delivery Year from increased EFORd penalized by either Daily Deficiency Charge or Non-Performance Charge

- Non-Performance Penalty
  - Non-Performance Charge * Balancing Ratio (BR) * Cleared UCAP – excused non-performance
- Bonus Payment
  - Pro-rata share of pooled Non-Performance Charges
- Prompt forward settlement
  - UCAP shortfall * > 1.2 * Daily Capacity Revenues or Non-Performance Charges
- Results in penalty exposure for both performance *and* availability

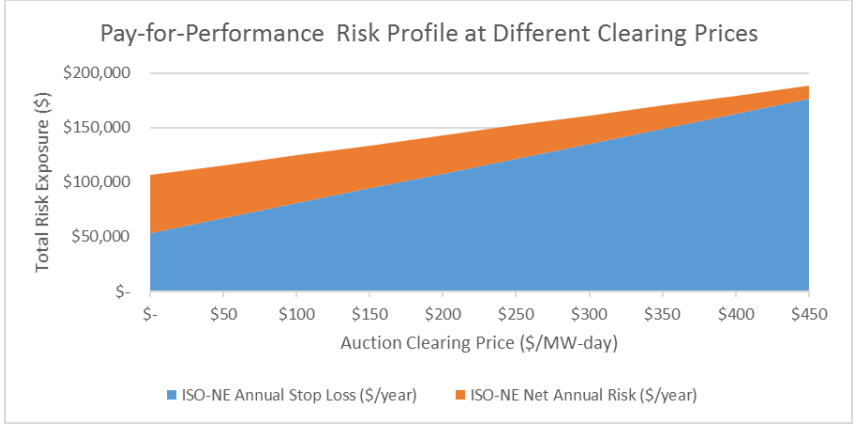
# Hourly penalty rate comparison

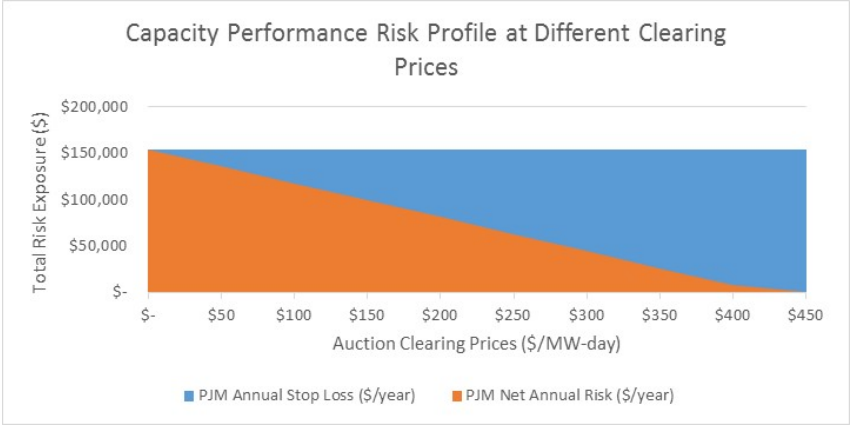
- Both markets penalize resources when delivered energy and reserves are below committed capacity * Balancing Ratio
- ISO-NE: Single pool-wide Performance Payment Rate:
  - 2018-2021: $2,000 per MWh
  - 2021-2024: $3,500 per MWh
  - 2024 onward: $5,455 per MWh
- PJM: Multiple Non-Performance Charge Rates:
  - Net CONE *modeled LDA* in ICAP Terms * (365 days/30 hours)

| Modeled LDA | Penalty Rate 2018/2019 | Penalty Rate 2019/2020 | YOY Change |
|---|---|---|---|
| DPL SOUTH | $ 2,943.34 | $ 2,980.31 | $ 36.97 |
| PS, PSEG NORTH | $ 3,395.38 | $ 3,446.56 | $ 51.18 |
| EMAAC | $ 3,245.22 | $ 3,223.07 | $ (22.14) |
| BGE | $ 2,684.34 | $ 2,450.29 | $ (234.05) |
| PEPCO | $ 2,857.00 | $ 2,775.37 | $ (81.64) |
| SWMAAC | $ 2,770.72 | $ 2,612.79 | $ (157.92) |
| PPL | $ 3,244.97 | $ 3,156.12 | $ (88.85) |
| MAAC | $ 3,095.44 | $ 2,977.55 | $ (117.90) |
| ATSI, ATSI CLEVELAND | $ 3,096.05 | $ 3,000.64 | $ (95.41) |
| COMED | $ 3,649.36 | $ 3,732.33 | $ 82.98 |
| RTO | $ 3,424.75 | $ 3,401.17 | $ (23.58) |

# Stop-loss limit comparison

- ISO-NE and PJM use stop loss provisions to cap penalty exposure
- ISO-NE: Monthly and Annual stop loss limits:
  - Monthly: Three months revenues using FCA starting price (> of Gross CONE or 1.6 * Net CONE)
  - Annual stop-loss: 100% of FCM revenues plus three months' revenue * difference between the FCA starting price and clearing price
- PJM: Annual stop-loss only
  - Net CONE *modeled LDA* in ICAP * 1.5 * 365 days
- Net Risk = Annual stop-loss minus capacity revenues
- Capacity Performance risk profile increases as prices fall



# Risk profile comparison

| Comparison of ISO-NE and PJM Capacity Markets 2018/2019 Auction Results | | |
|---|---|---|
| Market | ISO-NE (ROP) | PJM (RTO) |
| Net CONE ($/MW-Day) | $ 364.27 | $ 281.49 |
| Hourly Penalty Rate ($/MWh) | $ 2,000.00 | $ 3,424.75 |
| 2018/2019 Clearing Price ($/MW-Day) | $ 314.01 | $ 167.44 |
| Annual Capacity Revenues ($/MW-yr) | $ 114,612.00 | $ 61,115.60 |
| Annual Penalty Exposure ($/MW-yr) | $ 139,143.00 | $ 154,113.69 |
| Net Total Exposure (Revenue minus Annual Stop-Loss) ($/MW-yr) | $ (24,531.00) | $ (92,998.09) |

| | | |
|---|---|---|
| Hours to Loss of Total Capacity Revenues | 57.3 | 17.8 |
| Hours to Annual Stop Loss | 69.6 | 45.0 |

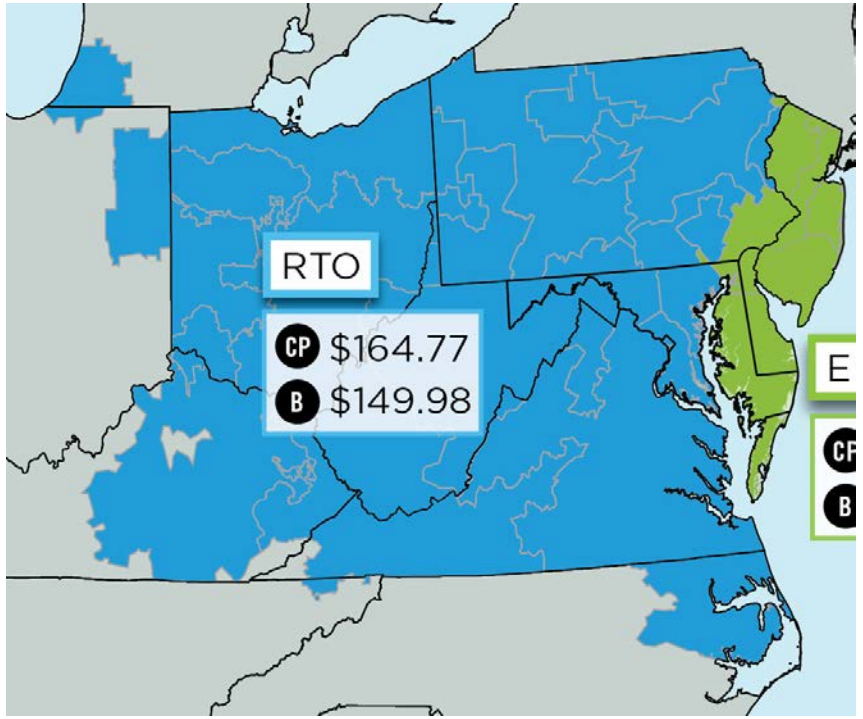
| Comparison of ISO-NE and PJM Capacity Markets 2019/2020 Auction Results | | |
|---|---|---|
| Market | ISO-NE (ROP) | PJM (RTO) |
| Net CONE ($/MW-Day) | $ 355.40 | $ 279.55 |
| Hourly Penalty Rate ($/MWh) | $ 2,000.00 | $ 3,401.19 |
| DY 2019/2020 Clearing Price ($/MW-Day) | $ 231.13 | $ 100.00 |
| Annual Capacity Revenues ($/MW-yr) | $ 84,361.20 | $ 36,500.00 |
| Annual Penalty Exposure ($/MW-yr) | $ 115,158.90 | $ 153,053.63 |
| Net Total Exposure (Revenue minus Annual Stop-Loss) ($/MW-yr) | $ (30,797.70) | $ (116,553.63) |

| | | |
|---|---|---|
| Hours to Loss of Total Capacity Revenues | 42.2 | 10.7 |
| Hours to Annual Stop Loss | 57.6 | 45.0 |

- We have attempted to develop an “apples to apples” comparison of risk profiles under both market designs
- Analysis uses clearing prices from the past two auctions results in ISO-NE and PJM
- Convert $/kW-Month (ISO-NE) to $/MW-day (PJM)
- Net total exposure attempts to show risk as a function of revenue
- *Net risk exposure is substantially higher under Capacity Performance*

# PJM's penalty and stop loss calculation produce significantly different risk profiles for resources within the same cleared LDA

| Modeled LDA | Annual Capacity Revenues | Penalty Rate | Annual Stop Loss | Net Penalty Exposure | Hours to loss of Capacity Revenues |
|---|---|---|---|---|---|
| BGE | $ 60,141.05 | $ 2,684.34 | $ 120,795.39 | $ (60,654.34) | 22.4 |
| PEPCO | $ 60,141.05 | $ 2,857.00 | $ 128,565.08 | $ (68,424.03) | 21.1 |
| SWMAAC | $ 60,141.05 | $ 2,770.72 | $ 124,682.18 | $ (64,541.13) | 21.7 |
| PPL | $ 60,141.05 | $ 3,244.97 | $ 146,023.58 | $ (85,882.53) | 18.5 |
| MAAC | $ 60,141.05 | $ 3,095.44 | $ 139,294.95 | $ (79,153.90) | 19.4 |
| ATSI, ATSI CLEVELAND | $ 60,141.05 | $ 3,096.05 | $ 139,322.18 | $ (79,181.13) | 19.4 |
| RTO | $ 60,141.05 | $ 3,424.75 | $ 154,113.69 | $ (93,972.64) | 17.6 |



# Comparison “Bonus Payment” structure between both market constructs

- Both ISO-NE and PJM allocate penalties collected from under-performing assets to over-performing assets
- Two purposes
  - Incent resources to improve their performance
  - Allow resources to recover from penalties through strong performance during future events
- Pay-for Performance includes a mechanism where any underfunding of bonus payments is “made-whole” through a charge to all capacity resources
  - PJM does not include such a mechanism
  - Any discount rate further increases capacity resources’ risk profiles because it takes “longer” to recover from a forced outage
- How do we estimate pay-out ratio in light of uncertainty surrounding excuses from performance?

# Comparison of excuses from performance obligation

## Pay-for-Performance

- ISO-NE directs the resource off-line or dispatches down for a binding transmission constraint
- De-rate that does not push Performance Score below Capacity Supply Obligation * Balancing Ratio
- Monthly/Annual stop-loss limits

## Capacity Performance

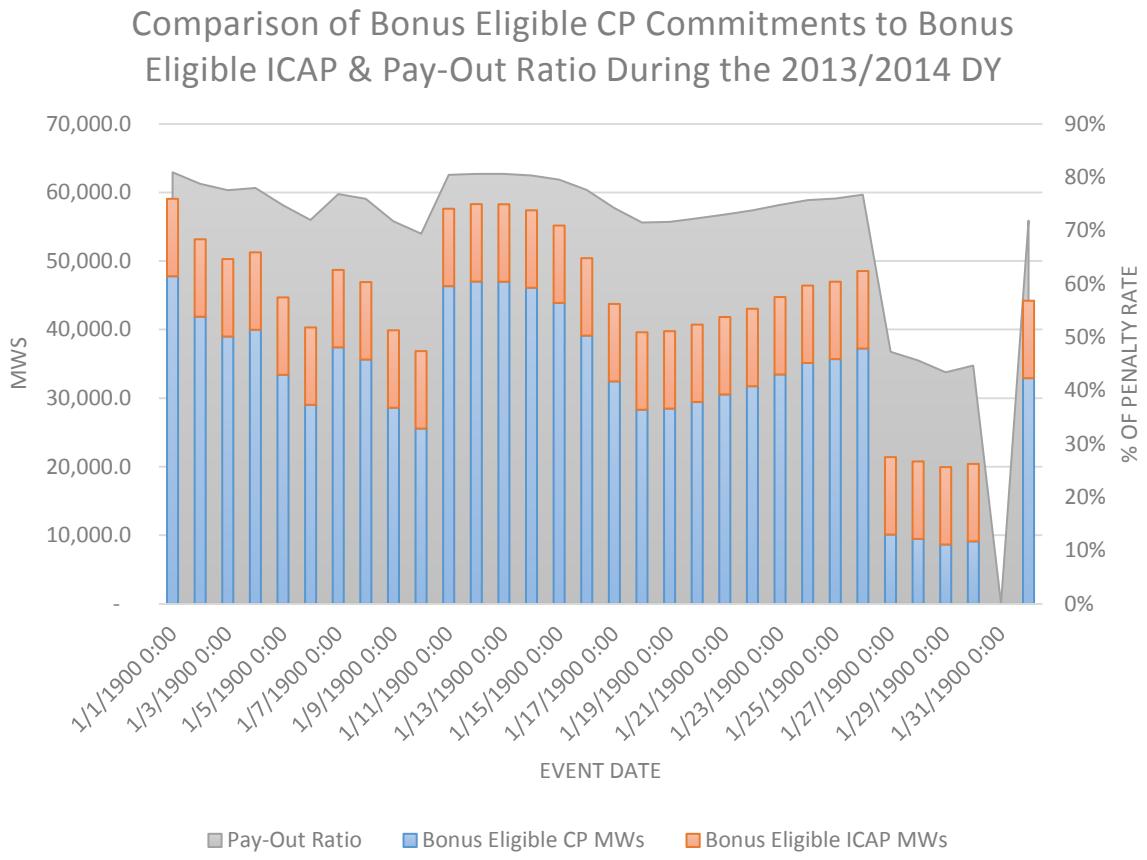
- UCAP v. ICAP
- Planned Outage
- Maintenance Outage
- Following dispatch below Expected Performance
- PJM determines that unit is not needed for reliability
- Annual stop-loss limit
- De-rate that does not push performance below Cleared UCAP * Balancing Ratio

# Estimating the effect of underfunding on a capacity resource's risk profile

- Excuses such as PJM dispatch strategy are difficult to quantify due to lack of publically available data
- Focus on UCAP to ICAP contribution to under funding as a "jumping off point"
- PJM publishes cleared UCAP by fuel type for each Delivery Year
- IMM's State of the Market report provides EFORd rates by fuel type and a fleet-wide average
- Gabel applied IMM's most recent EFORd values to PJM's cleared UCAP by fuel type for the 2018/2019 Delivery Year
- We then estimate the total quantity of bonus eligible MWs during all RTO-wide emergencies during the 2013/2014 Delivery Year using the Balancing Ratio values filed with FERC during Capacity Performance litigation process
- We assume that all capacity resources are producing their ICAP value during each event
- The sum of the ICAP/UCAP delta and bonus eligible MWs approximates the pool of resources that will receive a pro rata share of the corresponding penalties

# This analysis suggests that the average pay-out-ratio for all 2013/2014 RTO-wide events is 72%

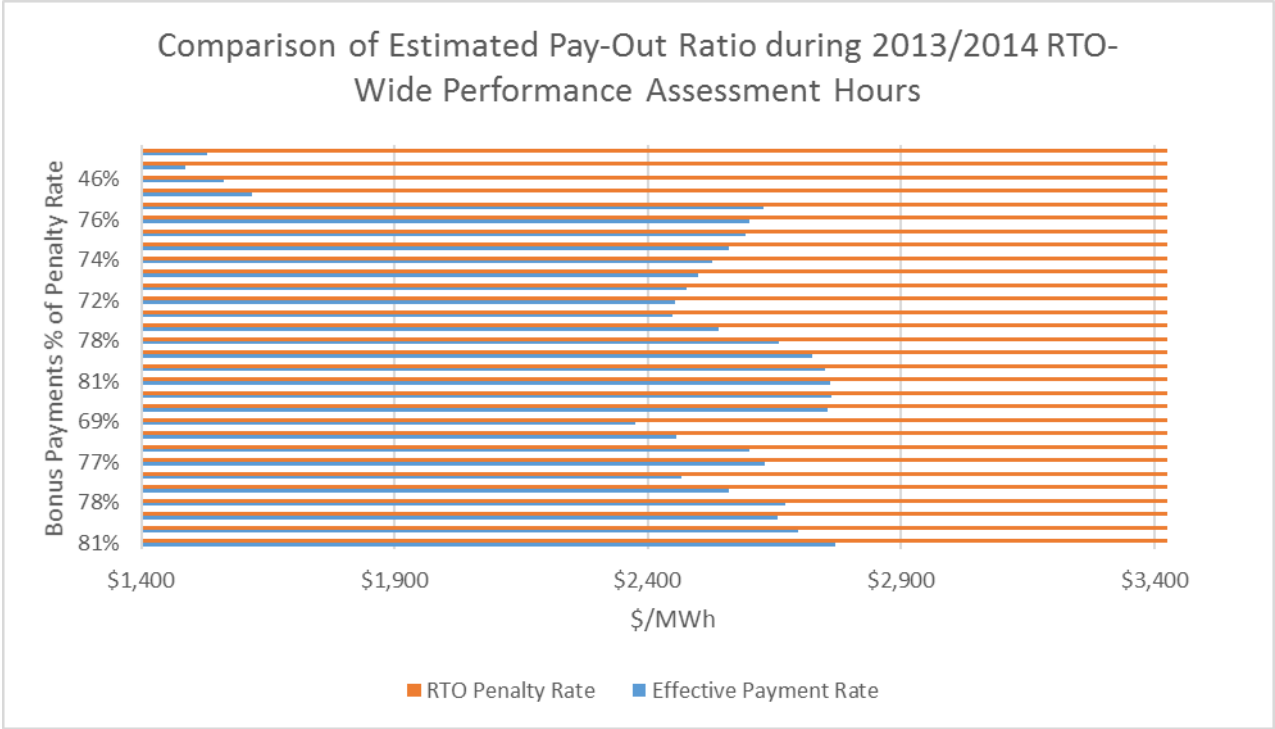
| *2018/19 ICAP Estimate of Cleared UCAP MWs by Fuel Type* | | | |
|---|---|---|---|
| **Fuel Type** | **MWs UCAP** | **EFORd** | **ICAP** |
| Coal | 44,560 | 10% | 49,015.5 |
| Distillate Oil (No.2) | 2,811 | 9% | 3,064.2 |
| Gas | 64,979 | *6.9%* | 69,462.3 |
| Kerosene | 235 | *6.9%* | 251.0 |
| Nuclear | 27,432 | 1.4% | 27,815.8 |
| Other - Gas | 301 | *6.9%* | 321.8 |
| Other - Liquid | 40 | *6.9%* | 43.2 |
| Oil | 5,025 | 9.0% | 5,477.4 |
| Other - Solid | 511 | *6.9%* | 546.3 |
| Solar | 184 | 38% | 297.6 |
| Water | 7,273 | 4.7% | 7,614.7 |
| Wood | 263 | *6.9%* | 280.6 |
| Wind | 857 | 13% | 1,603.0 |
| Demand Response | 11,084 | 0.0% | 11,084.4 |
| Energy Efficiency | 1,247 | 0.0% | 1,246.5 |
| **Grand Total** | **166,837** | | **178,124.3** |
| **Net Total** | | | **11,287.4** |



# Value of over-performance

- We see a meaningfully spread disparity in estimated pay-out ratios:
  - Highest: 81%
  - Lowest: 43%
- Additional excuses from performance likely further erode pay-out ratios
- Not the case for ISO-NE where full funding of Bonus Performance is mandated though uplift payments
  - Likely cost prohibitive in PJM
- Unlike, ISO-NE, over-performance MWs are not fungible in PJM
- PJM has no market-mechanism to manage under-funding
- Bonus value “trapped” by under-funding

| *1,000 MW UCAP Capacity Resource in PJM* | | | | |
|---|---|---|---|---|
| **Penaly Rate** | **Effective Bonus Payment Rate** | **Annual Revenues** | **Hours to loss of Revenue** | **Hours to Earn Back Capacity Revenues** |
| $ 2,756,356 | $ 1,980,399 | $ 36,500,000 | 13.2 | 18.4 |



# ISO-NE Capacity Performance Bilateral v. PJM's Replacement Transaction

- ISO-NE allows capacity resources with a positive Capacity Performance Score to transfer some or all of its Capacity Performance Score to a third party
- Not limited to "un-cleared capacity"
- Fungible between market participants provide that both resources were included in the same scarcity event

- Replacement Resource Transactions limited to Available Capacity (i.e. un-cleared MWs) located in the owner's account before the emergency
- Parties must "predict" their performance and the probability of an emergency occurring shortfall in order to transact for a suitable Replacement Resource
- Over-Performance from cleared a Capacity Resource cannot be used as a Replacement Resource and is not fungible

# Revisiting ISO-NE two settlement example 3: Long

| Pay-for-Performance Two Settlement Examples: Over-Performance | | |
|---|---|---|
| **Market** | **Units** | **ISO-NE (ROP)** |
| **Capacity Supply Obligation (CSO)** | MWs | 1,000 |
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*Excess Capacity Performance Score value of Bonus Performance Payments or the price of a Capacity Performance Bilateral established by parties to the transaction*

# Questions

June 2, 2016

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