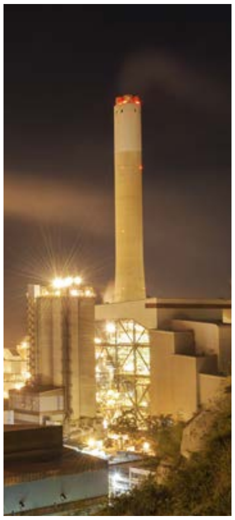
WHITEPAPER

How ISO-NE's Pay-for-Performance Initiative Will Shake Up New England



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Executive Summary

Regional power markets have shifted in recent years in response to fast-changing supply and demand parameters. Regional transmission organizations have identified issues in their capacity market designs that have led to inadequate peak generation capacity or failed to provide appropriate incentives for investment in flexible capacity. In the Independent System Operator-New England (ISO-NE) region, these problems have resulted in high-profile "narrowly missed catastrophic events"[1] that have spurred recent proposals for substantial market design changes.

The most significant of these proposals has been the new Pay-for-Performance Initiative (PI) that alters how a generation resource's capacity payments are calculated. Approved in May 2014, the PPI will influence bidding behavior in the upcoming February 2015 auction and performance payments in the market beginning in 2018. Capacity payments in ISO-NE will be subject to a two-settlement process, including a capacity base payment and an additional capacity performance payment that redistributes penalty payments from underperforming resources to overperforming resources. These capacity performance payments will be allowed to be negative, creating a substantial financial penalty for underperformance in scarcity conditions.

This new program will have major consequences for suppliers and investors. It introduces uncertainty to previously reliable expected capacity payments: Settled capacity payments to generators will be unknown even for the upcoming month and will depend on an expanded set of factors. The program also changes the bid behavior of generators: Capacity market bids will depend on each supplier's views of expected scarcity hours and the historical and expected performance of its units. A premium will be placed on accurate projections of the market and the reliability of each asset. The PI program also will likely result in more retirements of oil/gas steam capacity and the construction of new, efficient units—further accelerating ongoing changes in the generation fleet.

Recent court decisions underscore uncertainties with PI, including a decision on September 17, 2014, that may make demand response (DR) participation in Federal Energy Regulatory Commission (FERC) markets illegal. New environmental regulations such as the proposed Clean Power Plan, which sets Northeastern U.S. existing power plant emission rates for CO2 well below those of any current fossil power plant, also will interact with this new capacity regime and add uncertainty for generators.

In the context of the PI program and other forward capacity market changes, ICF International has developed a methodology for estimating performance payments and overall capacity revenues. We make accurate projections for individual units and help clients in ISO-NE to optimize their strategies, maximize revenues, and mitigate risks. We are well positioned to provide this assessment because of our staff expertise, our analytic tools, and our extensive and recent experience in ISO-NE markets.

FCM Performance Problem

The rapid evolution of the power sector in New England—driven by the trends that have reshaped supply and demand dynamics across the country—has revealed shortcomings in the design of the ISO-NE forward capacity market (FCM) and the market incentives intended to create for reliable generation

1. Testimony of Peter Brandien on Behalf of ISO-NE, in FERC Docket No. ER14-1050, et al., Attachment I-1b (Jan. 17, 2014).

capacity. As a consequence, during the past two years, ISO-NE has grown increasingly concerned with the underperformance of its generating resources under scarcity conditions.

Three factors have generally driven these performance issues:

- Greater dependence on natural gas and a constrained gas pipeline network that have led to interruption of gas supply during peak cold weather events.
- Inflexible oil/gas steam and coal units that cannot provide reliable backup because of increased outages and operational difficulties.
- A loss of generation capacity due to a variety of concerns, including inadequate staffing, mothballing of dual-fired capability, and failure to maintain adequate oil supplies.

These factors have been implicated in several high-profile instances when underperformance of generation units resulted in serious operating issues and "narrowly missed catastrophic events." Perhaps the most notable of these events stemmed from a five-day cold stretch beginning on January 21, 2013. This stretch led to a gas shortage and razor-thin reserve margins. These conditions were due in part to pipelines that were restricted from the west and south and to reserves for backup oil-fired generators that had not been fully maintained. As a result, reserves became depleted and were not available for dispatch.

By January 28, 2013, these fuel-supply constraints led ISO-NE to recognize a capacity deficiency and implement operating procedure 4 actions. This process included dispatching gas-fired generating resources overnight to offset the loss of other fuel-constrained resources, which in turn led to a spiraling effect of further reducing available gas supplies and making facilities unavailable for further dispatch. Load ramped up the next day and required ISO to call on demand resources to maintain operating reserves.

In short, although the 2013 cold snap was not as severe as one that hit the region in 2004, the changing generation mix—including New England's increasing dependence on natural gas and declining use of oil—has resulted in lower oil inventories and increasing vulnerability to gas supply constraints. So, even a relatively milder weather event can have potentially serious consequences in the absence of reliable, firm capacity.

The ISO-NE's 2013/2014 winter reliability program improved reliability in the winter of 2014 by creating incentives for dual-fuel resource capability and participation. ISO-NE described the program as a short-term solution to reliability problems arising from shortages in gas supplies. By implementing the program before the PI takes effect, the ISO compensated dual-fired generators for the carrying costs of unused fuel oil.

Generation underperformance is not only associated with gas capacity shortages. For example, on July 19, 2013, during a heat wave, 15 percent of generating capacity was unavailable. This condition was due to the significant amount of oil/gas steam units in the supply mix. These units have trouble starting at their claimed start time and often are offline for months at a time (see Exhibit 1 on the next page). Thus, planned capacity is not able to perform when called.

The FCM design has failed to provide the appropriate incentives for suppliers to make investments to address availability concerns and to ensure that capacity is reliable. According to ISO-NE's FERC filing (ER14-1050), "capacity resources rarely face financial consequences for failing to perform, and therefore have little incentive to make investments to ensure that they can reliably provide what the region needs: energy and reserves when supply is scarce."[2]

2. Order on *Tariff Filing and Instituting Section 206 Proceeding*, 147 FERC ¶ 61,172, at p. 3, (May 30, 2014).

Exhibit 1a: Historical Declining Performance of ISO-NE Operating Units

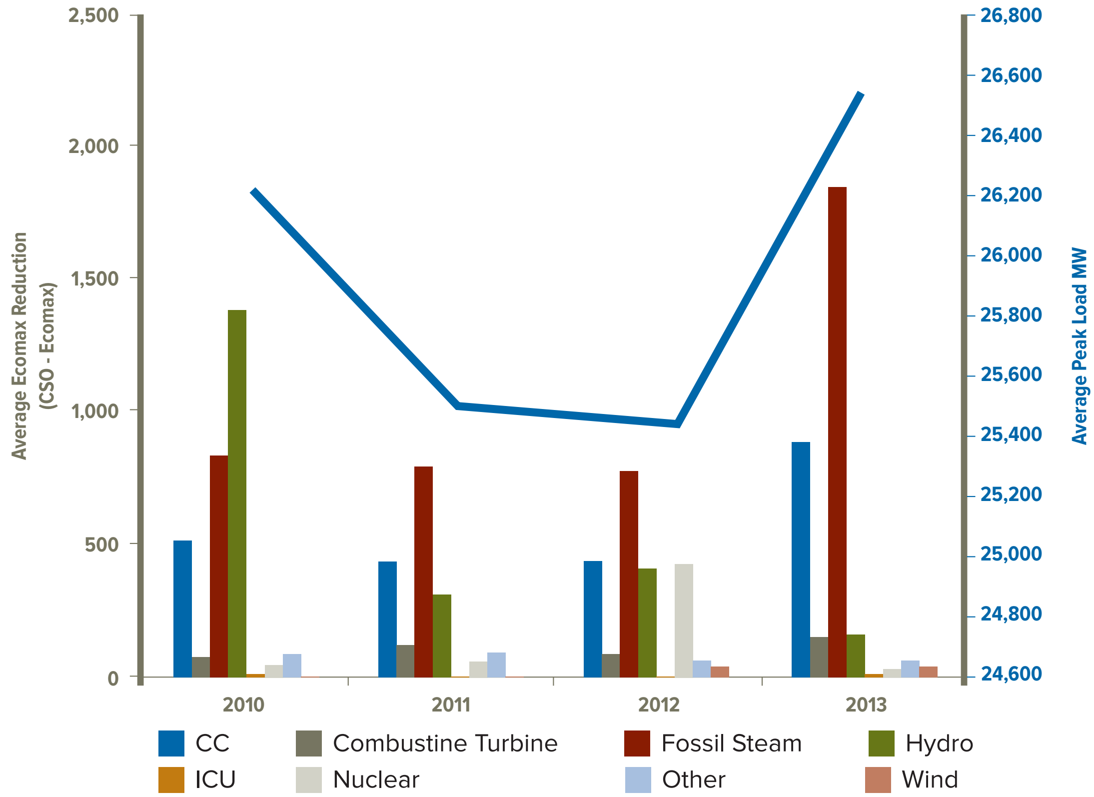
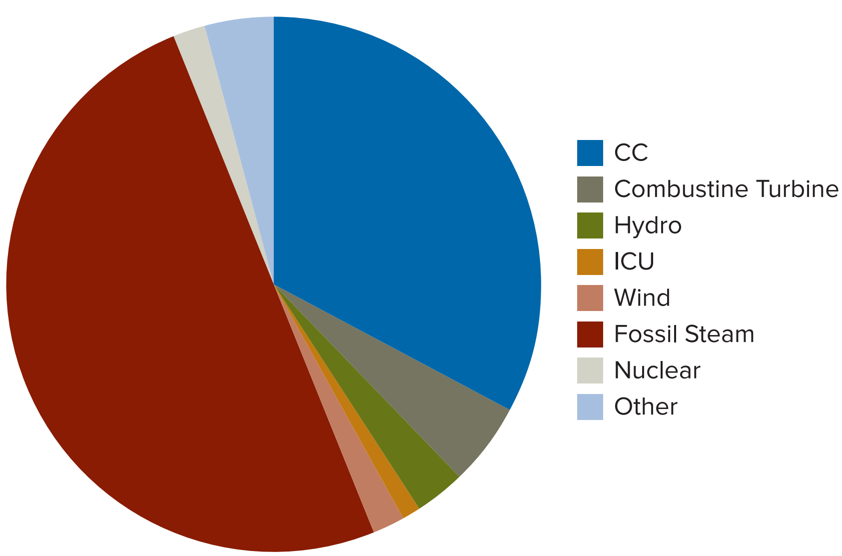


Exhibit 1b: July 19, 2013 Heat Wave Underperformance –
4,611 MW (15% of Capacity Supply Obligation)



Source: ISO-NE

Part of the problem relates to the concept of what is meant by a generation resource's availability. From the inception of the market, FCM has measured resource performance during certain types of scarcity conditions called "shortage events."[3] Performance is assessed based on a resource's availability during shortage events: The resource is assessed as being fully available if it were producing energy at the time or if it self-reported that it was ready to commence startup procedures. But this assessment does not mean that a resource was performing as needed to meet the market's needs. In fact, a resource was treated as fully available even if it could not start up for a number of reasons.[4]

Another issue is that resources not available during a shortage event received reduced capacity payments—approximately 5 percent of annual capacity revenues per shortage event lasting fewer than 5 hours. Although a financial disincentive for underperformance has existed, it has been relatively mild. Because capacity payments could not be negative regardless of the number of shortage events, the lowest performing resources still could garner positive payments. Moreover, ISO-NE has recognized that its availability measure did not differentiate for unit flexibility and provided equal payment to flexible and inflexible units, creating a distorted market signal for investment in flexible generation.

ISO-NE Response

In the past year, ISO-NE has proposed a number of changes meant to reward performance, penalize underperformance, and create incentives to invest in capacity.

- ISO-NE proposed, and on November 1, 2013, FERC approved, a modification in the Transmission, Markets and Services Tariff which increased ISO's ability to penalize underperformance. The change essentially induces shortage events more frequently by redefining the trigger to include instances when a shortage of 30-minute operating reserves occurs—not just in the previous 10-minute spinning reserve for 30 contiguous minutes. This change became effective November 3, 2013.
- ISO-NE also has moved to increase energy prices during shortage hours to incentivize generators to be available and benefit from higher energy margins.[5] ISO-NE instituted 2013/2014 and 2014/2015 winter reliability programs to guarantee availability of oil reserves in units with dual-fired capability. The program rewards oil-fired and dual-fuel generators that can establish a specified amount of on-site oil inventory and switch fuels in a timely manner if necessary. It also adds a special winter DR program.

Pay for Performance Initiative

The most consequential change is in FCM itself through ISO-NE's new PI approved by FERC on May 30, 2014, (R14-1050-000; EL14-52-000). Several elements of ISO-NE's initiative are proposed to be implemented in the PJM ISO which faced problems similar to those of ISO-NE.[6]

PI creates a two-settlement process where the capacity revenue of a resource now is comprised of a capacity base payment (from the forward capacity auction) and an additional capacity performance payment that redistributes penalty payments from underperforming resources to overperforming resources.

3. Shortage events are scarcity conditions in which the supply of energy and reserves is insufficient to meet the demand for energy and ISO's real-time reserve requirements for a duration of 30 minutes or more.
4. During shortage conditions a resource that was offline but had 10-hour startup time was considered available. Similarly, resources that were not committed due to an outage or derate of transmission equipment were considered available.
5. The reserve constrained penalty factor in 30-minute reserves was increased from $100/MWh to $500/MWh.
6. PJM ISO is proposing the adoption of a new capacity performance product with higher performance requirements and penalties for underperformance.

The capacity performance payment is determined by a resource's performance whenever scarcity conditions occur during the capacity commitment period. This payment may be a positive or negative adjustment to the base payment, reflecting superior or inferior performance during scarcity conditions.

The performance payment is determined by a resource's performance score, which is calculated during each 5-minute interval under scarcity conditions. The performance score is the difference between the resource's actual performance and a share of its capacity supply obligation (CSO).

How Performance Scores Are Calculated

For each scarcity hour, the capacity penalty (or reward) for each resource i with CSO_i dispatching at MW_i is calculated based on the following formula:

$$\text{Capacity Penalty}_i = PPR * (MW_i - CSO_i * BR)$$

BR = (Load + Reserve Requirement) / Total CSO of all units in the system

Or

$$\text{Capacity Penalty}_i = PPR * (MW_i - CSO_i * BR)$$

BR = (Load + Reserve Requirement) / Total CSO

BR—Balancing Ratio

PPR—Performance Payment Rate

The PI program will phase in increasing PPRs as shown in the table below.

Period	Performance Payment Rate ($/MWh)
2018/2019 – 2020/2021	2,000
2021/2022 – 2023/2024	3,500
2024/2025 +	5,455

From a settlements perspective, capacity payments will be made monthly, and each resource's monthly capacity payment will be the sum of the resource's capacity base payment for the month plus the sum of the resource's capacity performance payments for all five-minute intervals in the month, which can be positive or negative subject to monthly and annual stop-loss provisions. These calculations are performed for all resources, including both those with and without capacity supply obligations. For resources without a CSO for which their share of system requirements is zero, any energy or reserves delivered during scarcity hours are credited at the capacity performance payment rates. Therefore, in a month with H hours of scarcity, a 1 MW resource without a CSO is expected to receive capacity credits of PPR * BR * H.

The stop-loss provisions ensure that although a supplier's net FCM revenue can be negative, its total downside exposure is limited.

There are both monthly and annual provisions. The monthly stop-loss provisions limit the losses from underperformance to an amount equal to the product of the starting price of the corresponding FCM auction max {1.6 * Net CONE, CONE} times the capacity supply obligation. The annual stop-loss

provisions limit the annual amount of losses for a capacity resource to three times its maximum monthly potential loss.[7]

Recognizing that the risk factors for capacity resources are very different from the previous market, ISO-NE also modified its mitigation procedures. These procedures are used to protect the market from sell-side manipulation. The new measures are generally more relaxed and incorporate the following:

- They are now applicable only for pivotal suppliers. A market participant is considered pivotal if any of its resources is required to meet system wide capacity requirements (i.e., the installed capacity requirements [ICRs]) or the capacity requirements of any import-constrained region.
- The dynamic delist bids[8] —the threshold below which resources may leave the capacity market without cost review by the independent market monitor (IMM)—were increased from $1/kW-month to $3.94/kW-month.

Other delist bids (Static, Permanent and Export delists) are provided by components including net going forward costs, risk premium and expected capacity performance payments. IMM evaluates its component separately.

Implications of the PI Program

Uncertainty

Previously, capacity resources in ISO-NE could be certain of their expected capacity payments for the next three years, especially with infrequent shortage events. However, under PI, settled capacity payments to generators are unknown even for the upcoming month. Payments will depend on a large number of factors, including the performance of the resource and other resources in the system and scarcity hours. In 2018/2019, for example, if FCM prices clear at equilibrium levels of $11.08/kW-month and about seven[9] scarcity hours occur in a specific month during which a power plant is not available, FCM revenue will be lost. The scarcity hours in which the power plant is unavailable will result in losses.

Modification of the Supply Curve in FCM Auctions

The implementation of PI is expected to have an impact on market participants' bids in FCM auctions. Generation owners will be required to develop the most accurate estimates of scarcity hours and asset performance, as explained below.

In formal terms, the expected bid (B_i) of the resource i in FCM before PI can be expressed as $B_i = \max\{0, GFC_i\}$; whereas with PI, the expected bid (B_i) of the resource i in FCM can be expressed as the more complex formula:

$B_i = PPR * BR * H + \max\{0, GFC_i - PPR * A_i * H\}$[10] *where:*

- PPR: is the capacity performance payment rate;
- BR: is the expected capacity balancing ratio;
- H: is the expected number of hours with scarcity conditions;

7. For new resources with multiple-year commitments, the monthly stop-loss limit is based on their applicable FCM price rather than the auction starting price for the duration of their multiple-year commitment. Therefore, the maximum potential net loss for these resources is limited to zero.
8. ISO-NE FCM features a descending clock auction, so supply resources could leave the auction through presubmitted delist bids. Static, dynamic, and permeant delist bids are defined based on submission time (before/during auction) and threshold levels.
9. 7=11,080$/MW/(2,000 $/MWh* BR) where BR is assumed at 0.7
10. Joint Testimony of David LaPlante and Seyed Parviz Gheblealiv and on behalf of the ISO, in FERC Docket No. ER14-1050, et al., (Jan. 17, 2014), Attachment I-1e.-

- GFC_i: is the resource going-forward cost net of energy and ancillary service revenue, and
- A_i: is the expected average performance of the resource during scarcity hours.

The term PPR * BR * H reflects the opportunity cost of the resource for undertaking CSO. As explained before, even without CSO, a resource is expected to earn capacity payments at a rate of PPR * BR * H. Therefore, the resource will require a capacity price of at least at PPR * BR * H to undertake the added CSO burden. The second term reflects the generator's views of its going-forward costs that are not covered by the expected capacity performance payments.

What does the change mean in basic terms? If a generator for which the net going-forward costs are zero for both regimes (PI and not PI), under PI, the FCM bid of this generator will be higher by PPR * BR * H. Therefore, the FCM bids of generators with positive going-forward costs will depend on their views on expected scarcity hours and the historical and expected performance of the unit.

In other words, in order to make the most rational economic decisions, mitigate risks, maximize revenue, and minimize costs, generators will have to estimate as accurately as possible how many scarcity hours will occur and how their assets will perform.

Firm Fuel Supply Deliberation

With the potential for capacity payment penalties and lost opportunities in the energy market (with price spikes during scarcity periods), an additional incentive exists for generators to have firm fuel supply. When possible, gas-fired generators will consider activating dual-fired capabilities (and maintaining distillate oil reserves) or firm gas supply contracts. But generators also must consider the tradeoffs of the additional costs of firm fuel supply relative to decreased revenue potential.

Modernization of the Fleet

In the long term, PI will result in a more efficient, flexible fleet with lower energy prices. Under the new regime, new, efficient units can arbitrage their flexibility and low forced outage rates at the expense of less reliable and more inflexible oil/gas steam-fired units. This relative advantage will likely result in accelerating retirements of oil/gas steam capacity and incentivizing the construction of new, efficient units. In the long run, this dynamic should result in lower energy prices in ISO-NE, as more efficient units displace less economic generation. In the near- to medium-term though, the dynamic could result in periods of capacity shortfall and price spikes if the transition is not orderly.

ICF Methodology for Determining Performance Payments under PI

One of the key components in estimating the performance payment is determining the number of scarcity hours in a given year under different scenarios on weather and load. ICF uses an in-house Monte Carlo simulation tool—the Stochastic Resource Adequacy Model (SRAM [11]). We benchmark its results to the information provided by ISO-NE. ISO-NE's loss of load expectation (LOLE) model[12] used to establish ICR for FCMs also can be used to estimate the expected number of hours per year when insufficient capacity exists to meet the system's operating reserve requirements, i.e., scarcity hours. The table below summarizes ISO-NE's estimated hours of system operating reserve deficiencies at different capacity levels assuming normal weather.

11. SRAM is an hourly chronological loss-of-load simulation tool specifically designed to capture treatment of scarcity. ICF's SRAM has been developed to analyze the impact of supply and load uncertainty on the reliability of power systems and wholesale power prices. SRAM forecasts loss of load-related metrics, including scarcity events.
12. ISO-NE is using GE's MARS model. The GE MARS program is a multi-area model generally meant to compute the reliability of a system comprising a number of interconnected sub-areas containing generation and load. GE MARS uses a Monte Carlo process chronologically progressing from hour to hour to evaluate random generation outage combinations. This process simulates the year repeatedly (multiple replications) to evaluate the impact of the random generation outage combinations.

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About ICF International

ICF International (NASDAQ:ICFI) provides professional services and technology solutions that deliver beneficial impact in areas critical to the world's future. ICF is fluent in the language of change, whether driven by markets, technology, or policy. Since 1969, we have combined a passion for our work with deep industry expertise to tackle our clients' most important challenges. We partner with clients around the globe—advising, executing, innovating—to help them define and achieve success. Our more than 5,000 employees serve government and commercial clients from more than 70 offices worldwide. ICF's website is www.icfi.com.

Exhibit 2: Estimated Hours of System Operating Reserve Deficiencies Annually

Capacity Level	Expected	5/95	50/50	95/5
ICR plus 2,500 MW	**2.9**	1.4	2.5	5.8
ICR plus 2,000 MW	**4.4**	2.1	3.8	8.9
ICR plus 1,500 MW	**6.7**	3.1	6.0	13.0
ICR plus 1,000 MW	**10.0**	4.9	8.9	18.7
ICR plus 500 MW	**14.7**	7.6	13.6	26.7
ICR	**21.2**	11.4	19.8	36.2

Notes: Estimated system-level operating reserve deficiency hours 'at criteria' plus specified additional installed capacity, using the ICR and capacity planning model assumptions for the 7th Annual Forward Capacity Auction (see text)

Source: ISO-NE, Operating Reserve Deficiency Information – At Criteria and Extended Results

ICF incorporates its estimate of gas supply shortages and the corresponding impact on power plant supply and forecasts the number of scarcity hours by month as well as the average balancing ratio during scarcity hours for each month.

With these parameters available, ICF models the bidding behavior of each power plant in FCM based on the plant's historical operating performance and assuming risk averse behavior from market participants. This approach allows ICF to provide an accurate FCM price forecast and to estimate FCM market entry (new power plant construction) and exit (retirements or resources that decide to remain in the system without CSO) and their impact on power prices in the future.

With this methodology, ICF advises clients on strategy optimization, including support on decisions for firm compared with interruptible gas supply, optimal portfolio commitment to maximize revenue from the FCM and PI, and the valuation of resources.

Conclusions and Next Steps

The changes in FCM design and the advent of the PI program will create risks and opportunities for suppliers. Generating assets must reevaluate their FCM bidding behavior in the next auction (February 2015) and beyond in light of the reliability of their assets and the likelihood of scarcity conditions. They will need to consider the potential uncertainties of the new capacity payment system and the possible acceleration of retirements and fuel switching. Those with more reliable assets may experience a significant competitive edge, while others may find themselves managing increased risk or considering hedging with more firm fuel supply. ICF is advising clients on how to best adapt and position themselves to optimize revenues, minimize costs, and mitigate risks.

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