# NYISO Meter Data Study: Initial Findings

Paul M. Sotkiewicz, Ph.D
President
E-Cubed Policy Associates, LLC
October 30, 2017

# Disclaimer

The thoughts, analysis, and opinions expressed are my own, and not necessarily those of the NYISO, or any other ISO/RTO market referenced herein.

# Presentation Outline

1. Current state of Demand Response (DR) and Distributed Energy Resources (DER) or Behind the Meter (BTM) net generation(NG) in the NYISO Context
2. Meter Service Provider (MSP)/Meter Data Service Provider (MDSP) Practices and Options
3. Intersection of NYPSC Value of Distributed Energy Resources (VDER) tariff and NYISO Markets
4. Customer Baseline Load (CBL) considerations in energy and capacity and ancillary services
5. Statistical sampling considerations and applications for non-interval metered loads
6. Next steps

# Current NYISO Market Context for DR

- Energy Market Participation for DR
  - Day-Ahead Demand Response Programs (DADRP)
  - Emergency Demand Response Program (EDRP)
  - No real-time options as yet
  - Can also have “local generation” to help in reduction, but this is still a net load
  - “Typical” CBL methodology is in place
- Capacity Market Participation for DR
  - Special Case Resources (SCR)
  - Average Coincident Load (ACL) baseline with declared load reduction value implying a maximum or firm service level
- Ancillary Service Market Participation
  - Demand Side Ancillary Service Product (DSASP)
  - Regulation
  - Reserves
- Interval metering required
- Non-interval metering participation for small customer aggregation for EDRP and SCR

# Current NYISO Market Context for BTM NG

- BTM NG is the closest thing to what looks like a net injection DER in the NYISO context
- BTM NG are injection only resources and cannot be used for DR
- Energy Market Participation
  - Can participate similar to other generators in the energy market
- Capacity Market Participation for BTM
  - Min rating of 2 MW, min injection of 1 MW
  - Cannot be an intermittent resource
  - Adjusted host coincident load used as part of the “baseline”
- Ancillary Service Market Participation
  - Can provide spinning and non-spinning reserves depending on facility configuration
  - Could provide regulation or spinning reserve if only a single generator…multiple generators not permitted
- Interval metering and 6 second telemetry required with ability to accept 6 second basepoint

# Metering Institutions

# Metering Institutions: Current NYISO Context

- New York PSC has some of the best defined metering standards and rules regarding Meter Service Providers (MSPs) and Meter Data Service Providers (MDSP)
  - MSP: An entity that provides meter services, consisting of the installation, maintenance, testing, and removal of meters and related equipment.
  - MDSP: An entity providing meter data services, consisting of meter reading, meter data translation and customer association, validation, editing, and estimation.
  - Can be a utility or a third party provider of these services
  - ***New York Practices and Procedures for the Provision of Electric Metering in a Competitive Environment***
- Technical metering standards across other ISO/RTO markets have similar if not identical technical standards as enumerated by the NYPSC in 16 NYCRR Part 92
  - ANSI, NAESB, NIST standards are invoked here as they are in other markets
- NYPSC still has regulatory authority, but has not supported the third party provider aspects of the regulation in many years

# Metering Institutions: PJM Experience

- PJM follows the same technical standards that are used in NY state
  - In fact they followed these standards by all accounts
- Most metering for DR is done by incumbent utility providers
- But there are individual aggregators and third parties providing metering and reporting
  - Many aggregators like to telemeter their own data back to their operations centers to ensure their sites are complying
  - Also some anecdotal evidence of incumbent utilities delaying metering rollouts
- Incumbent utilities still have chance to view the meter data and dispute it
  - Often PJM staff will use utility meter on same site as the DR interval meter (whether installed by the utility or the aggregator) as a check on whether the interval meter is calibrated correctly, and will investigate if there are discrepancies…makes monitoring a spot check method
  - No approval of third parties *per se* but PJM verifies upfront that meter standards are met and rely on the idea that standards must continue to be met.
  - With every event settlement submitted, utilities can check and dispute metering or the settlement within 10 days

# Metering Institutions: CAISO Experience

- DR providers either must serve as a Scheduling Coordinator, or contract with one to act as the supplier of meter data to the CAISO for the DR provider.
- Third parties can provide all the required metering services
  - Audits and inspections must be done by CAISO authorized companies and inspectors
  - Companies and inspectors can become authorized through application to the CAISO and passing the CAISO administered exam
- Infrastructure is in place at the CAISO to facilitate interactions between third parties and CAISO with regard to metering functions
  - Separate metering department administers the authorizations, exams
  - Done through the Energy Data Acquisition Specialists Team

# Metering Institutions: ISO-NE Experience

- Must be able to receive dispatch instructions through demand designated entities (DDE) and transmit 5 minute interval data through the DDE to the ISO.
- Independent 3rd party metering and M&V validation on an annual basis
- ISO audits of DR are possible and spelled out on great detail
- The MSP/MDSP equivalent function in ISO-NE can be moved out to third parties who are listed in the M&V plan and take on responsibilities for telemetry, dispatch, meter reading, etc.

# Metering Institutions: Potential Options Forward-1

- Option 1: Permit incumbent distribution/transmission provider and third parties to be the MSP and MDSP
  - Provides options for aggregators who may want to have control over meter installation and testing while also having control over their own resources as MDSP
  - Requires some further procedures and infrastructure to monitor metering accuracy and possibly pre-approve third party providers
  - Avoids a single gatekeeper and can admit entry into the wholesale markets with greater ease
  - Competition can drive costs down
  - Independent party still required for auditing the meter for third parties. But is this true for the incumbent utility if they provide the services?
  - Supported by existing NYPSC framework
  - This option provides multiple ways in which metering can be provided and would be consistent with other ISO/RTO institutions in this area.

# Metering Institutions: Potential Options Forward-2

- Option 2: Only permit the incumbent distribution/transmission utility to provide both MSP and MDSP services
  - Runs contrary to existing state policy
  - Easy one stop shopping for DR and DER
  - Minimal infrastructure for the NYISO to implement and oversee
  - But places the incumbent utility in a place to be a *de facto* gatekeeper to the wholesale market for DR and DER
  - Could it be done cheaper by a third party?
  - Would a third party be required for auditing the meter? After all, even utility meters can fail or require re-calibration
  - NYPSC still has regulatory authority over these entities to ensure accuracy of the meter and timely roll out of requested infrastructure.
  - This option leverages infrastructure that is already in place and and would require minimal changes overall and possibly leverages knowledge and expertise possessed by incumbent utilities

# NYPSC VDER Tariff and NYISO Markets

- VDER Tariff is a NYPSC-approved retail service tariff that applies to DER that are net generators
  - Wind and solar are intermittent and while qualifying for VDER do not qualify as BTM NG in NYISO
- VDER Compensation
  - LBMP for energy plus losses on the distribution system
  - Capacity paid for at the NYISO capacity price
  - Environmental value (price of Tier 1 RECs), but other values such as $CO_2$, $SO_2$, and $NO_x$ should be embedded in LBMP and fixed costs such as retrofits may appear in Capacity prices
  - Distribution infrastructure value in that DER can offset or defer new distribution infrastructure

# NYPSC VDER Tariff and NYISO Markets

- VDER Tariff requires at least hourly interval metering at some level to implement
- Seems that there is no reason for DER that qualify under the VDER tariff to participate in the NYISO markets directly for energy and capacity
  - Such participation would be redundant and result in double compensation for the same MW or MWh
- This currently does not affect DR in the NYISO markets
  - **In what follows in this presentation**, the concentration will be on DR related issues in the NYISO
  - How DR is handled provides insights to how DER may be treated going forward in the NYISO markets

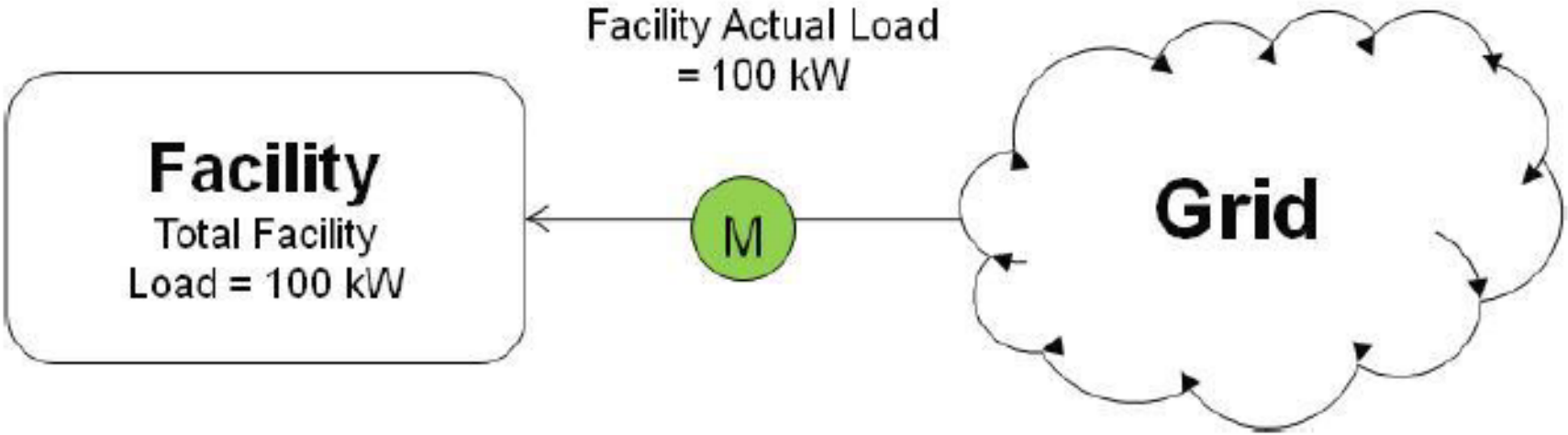
# Energy Market Baselines

# Energy Market Customer Baseline Load (CBL) Overview
# No DER or DG or BTM NG

- The purpose of a CBL is to have a measure of the counter-factual consumption of a customer if it did not engage in a load reduction activity for demand response in the energy market.
- There is no "theory" of how to do baselines, it has been as much intuitive and empirical as anything else
- The big issue is to ensure the CBL matches the actual load as closely as possible

- Current NYISO Energy Market CBL:
  - Highest 5 of last 10 non-event days for weekdays
  - Highest 2 of last 3 non-event days for weekends and holidays
  - Weather adjustments (2 hour window starting 4 hours prior to the event) +/- 20%

# Energy Market Customer Baseline Load (CBL)
# No DER or DG or BTM NG: Implied Meter Configuration




*Source:* ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources Manual M-MVDR, Revision: 6 Effective Date: June 1, 2014

# Energy Market Customer Baseline Load (CBL): PJM

- Baseline chosen must have a relative root mean square error of less than 20% to ensure the accuracy of the CBL with actual loads
- Standard tariff defined CBL
  - Average of 5 non-event days in the past 45 days for weekdays
  - Average of 3 non-event days out of 45 for weekends and holidays
  - Adjustments starting 4 hours prior to the event up to 1 hour prior to the event
  - 8 other possible choices, though rarely used
  - Regression defined weather sensitive adjustments are also possible for use with some methods

# Energy Market Customer Baseline Load (CBL): ISO-NE

- ISO-NE is in the process of changing their CBL methodology with a switchover date of June 2018 for demand response
- Before June 1, 2018
  - 5 minute interval data for last 10 non-event days out of the previous 30 days taking the simple average of those 10 days. Leaves open the possibility for using an event day if cannot get to 10 days.
  - Weather adjustment is 2 hour period 2.5 hours before the event
- After June 1, 2018
  - Adds Saturdays and Sunday/Holiday as additional day-types not available previously
  - Weekends, 5 most recent non-event days simple average
  - Adjustment is 25 minutes prior to start of the event up to 10 minutes prior to the start of the event

# Energy Market Customer Baseline Load (CBL): CAISO

- Current CAISO Energy Market CBL:
  - Simple average of the 10 most non-event days for weekdays out of the past 45 days…can go with a minimum of 5 days
  - For weekends and holidays the last 4 non-event weekend holiday days
  - Weather adjustments (3 hour window starting 4 hours prior to the event) +/- 20%
  - If there is 5 minute interval metering, roll up to hourly data for an hourly baseline.

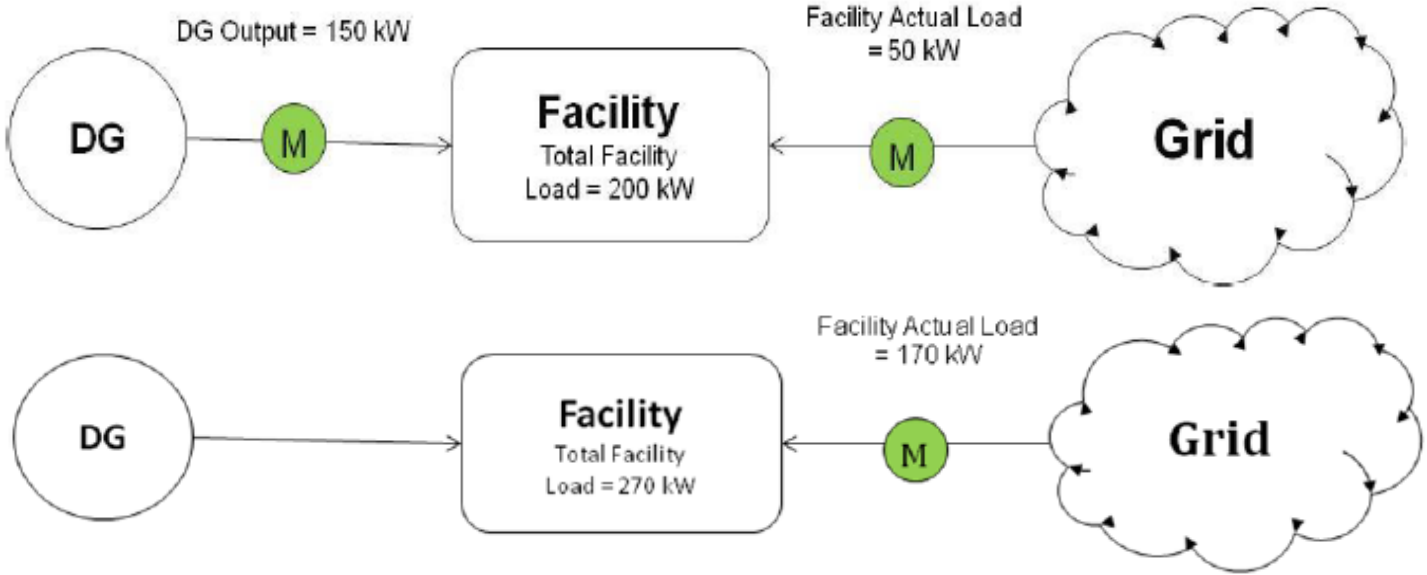
- Nexant Report to Baseline Accuracy Working Group
  - Current CBL in CAISO works well for medium to large C&I customers, but not smaller loads
  - Use control groups over baselines as a possibility? Like ERCOT?
  - Frequent dispatch with BTM storage that is used often?

# Energy Market Customer Baseline Load (CBL): CAISO  Nexant Study

- Residential Recommendations:
  - Control groups
  - 4 day weather matching the high temperatures
  - Highest 5 of 10 days
  - Weather adjustments (2 hour window starting 4 hours prior to the event) +/- 40%

- Non-residential Recommendations
  - Control groups
  - 4 day weather matching the high temperatures
  - Average 10 of 10 days
  - Weather adjustments (2 hour window starting 4 hours prior to the event) +/- 40% (except 10 of 10 which is +/-20%)

# Energy Market Customer Baseline Load (CBL)
# DER or DG or BTM NG: Meter Configuration Options

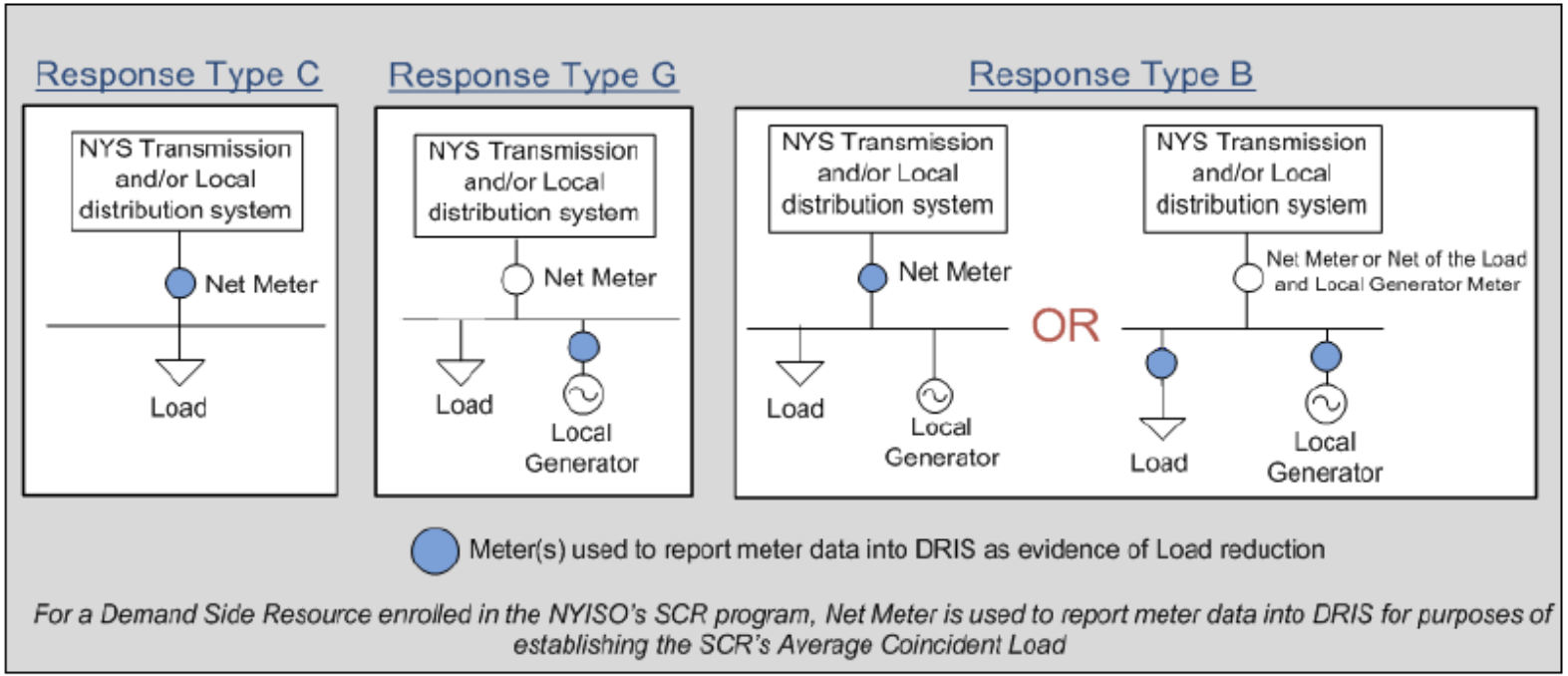



*Source:* ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources Manual M-MVDR, Revision: 6 Effective Date: June 1, 2014

# Energy Market Customer Baseline Load (CBL) M&V Implications DER or DG or BTM NG

- ISO-NE:
  - Explicitly considers different configurations/possibilities for settlement (5 combinations)
  - It is easiest when the DER/DG/BTM NG is at least sub-metered if not directly on its own meter for monitoring and settlement purposes
- PJM:
  - Explicitly considers the idea of metering or sub-metering generation on-site for monitoring and settlement
  - But like ISO-NE also considers generation only used to reduce load
  - Explicitly considers whether generation is used for other purposes on the event day or is used in the normal course of operations
  - What is the “baseline” generation for normal operations? This is not well defined.
- CAISO:
  - Explicitly requires generation behind the meter be separately metered/sub-metered for monitoring and settlement
  - Explicitly requires a generation output baseline to discerns between normal operation and running generation for an event
  - Uses the current 10-in-10 method during non-event days to establish the baseline

# Energy Market Customer Baseline Load (CBL)
# Current NYISO DR Meter Configuration Options




*Source:* New York Independent System Operator Manual 7 Emergency Demand Response Program Manual June 2016

# Energy Market Customer Baseline Load (CBL): Options and Takeaways

- Many similarities, also many differences
- What fits best?? Are there multiple CBLs that can be used?
- What about variable loads??
  - CBLs do not work well for these by definition…but what if a variable load purchased a position and could “buy out” as in any other commodity market?
- Seems the best baseline is one that best fits empirically...but may require trying many different baselines
- With DER/DG/BTM NG it would seem metering/sub-metering that generation makes the most sense going forward
  - Also formally establishing a DER/DG/BTM NG baseline seems to also be advised much like CAISO, and alluded to by PJM in its documentation
  - ***NYISO already accounts for generation at the site that is metered closely follows what is also in CAISO today for establishing the generation baseline...though it is not identical***

# Capacity Market Baselines

# Capacity Market Customer Baseline: Maximum Supply and Performance Overview

- Maximum supply could be based on the contribution to peak load OR a CBL similar to the one calculated for the energy market, but based upon peak hours for the year or season
- Performance baseline has become important in PJM and ISO-NE with capacity market reforms
- Overall, there are differences across the ISOs/RTOs with centralized capacity markets

- Current NYISO Capacity Market:
  - ACL is the maximum that can be sold. Nominated quantity reduction is at or below ACL
  - Performance is based on ICAP equivalent and ACL is the baseline load
  - 2014 DNV-GL Recommendation was to switch to use of an energy market type CBL for performance measurement

# Capacity Market Customer Baseline: Maximum Supply and Performance in PJM

- Maximum supply is based upon the Peak Load Contribution (PLC) which is the analog to ACL in NYISO
- Nominated reduction values can be evaluated in two ways:
  - Firm Service Level (FSL) which is maximum metered demand permitted during an event without a penalty
  - Guaranteed Load Drop (GLD) which requires the specific load drop during the event
- Performance baseline:
  - FSL Option: PLC – metered load $\leq$ nominated value or metered load $\leq$ FSL
  - GLD Option: min{PLC, CBL} – metered load $\geq$ nominated value
- Under GLD, if the CBL is above the PLC, and the actual load drop occurs, the DR (or mixed DR and BTM generation) is not performing as expected.
  - If CBL alone is used, without a check against PLC, loads have an incentive to ramp up consumption prior to an event, then drop load to a level much higher than was expected and considered to be in compliance…this is not the right reliability incentive.

# Capacity Market Customer Baseline: Maximum Supply and Performance in ISO-NE

- Caveat: As understood by the strict language of Market Rule 1
- Maximum supply is based upon the same energy market CBL calculation as discussed above based on historical summer/winter conditions
- Nominated values are reductions from the CBL
- Performance:
  - Treated like a generator and must follow dispatch instructions
  - Penalties/bonuses for under/over performing the dispatch
- Essentially using the same paradigm as the energy market baseline

# Capacity Market Customer Baseline Takeaways

- From a commodity market perspective, one cannot sell back more than is purchased
  - The NYISO and PJM maximums make sense in this context
- Getting down to a committed maximum demand is akin to to participating on the demand-side of the market and telling the ISO to “not buy more than the committed maximum for my load”
  - Again, the NYISO and PJM models work well in this context
- Performance incentives before and during an event should be consistent with reliability needs
  - Allowing only the CBL to be used, without accounting for the maximum supply level, for determining compliance can lead to loads ramp up consumption ahead of the event, triggering the event sooner and then getting credit for reducing load but not down to what was expected.
- Using a CBL-only method can harmonize the energy settlement and performance with capacity obligations
  - But what are the reliability incentives?

# Sampling for Non-Interval Metered Sites

# Statistical Sampling Overview for CBL and Settlements

- Statistical sampling allows DR providers to install interval meters on only a small subset of customers with like profiles and characteristics to derive a CBL and M&V for performance without installing interval meters on all DR customers
  - Such techniques are used for residential and small commercial mass market customers
  - Often used for programs such as direct load control (DLC) related to controlling devices such as HVAC units, hot water heaters, and pool pumps
  - With fewer interval meters installed, sampling can reduce the cost of DR participation.
  - In ISO-NE and PJM where energy efficiency can be used to supply capacity, it can also be used as part of the M&V plan.
  - Sampling is done with the use of interval metering on the subset of all sites being aggregated
  - In NYISO small customer aggregation is permitted through the proposal of a sampling and measurement methodology in the Emergency Demand Response Product Manual, though there are not explicit methods in the NYISO manuals

# Statistical Sampling Overview: Energy Efficiency in PJM and ISO-NE and ISO NE Demand Response

- PJM has followed ISO-NE in the area (regarding efficiency) and the same formulas are used based on a 10% error and 80% confidence interval (90% one-tail as PJM calls it)
  - n': number of samples in an infinite population
  - r.p.: relative precision (10%)
  - c.v.: coefficient of variation

$$n' = \left\{ \frac{1.282 \times c.v.}{r.p.} \right\}^2$$

- If the c.v.=1 (default in PJM EE application for heterogeneous samples), this means the number of samples to achieve this relative precision is 164.
  - c.v. studies can be done to show this is a lower value
- For small samples, N < 200, the relative number of samples increases
  - Using same example, N=150, n = 78.

$$n = \frac{n'}{1 + \frac{n'}{N}}$$

*Source:* PJM Manual 18B:Energy Efficiency Measurement &Verification Revision: 03 Effective Date: November 17, 2016

# Statistical Sampling: PJM and CAISO Energy Market DR

- PJM and CAISO use a similar methodology as with energy efficiency but it is more stringent and requires a two tail precision of 90% (or 95% one tail).
  - In the variance study, n ≥ 75 for an initial sample

$$Mean(X_t) = \bar{X}_t = \frac{1}{n}\sum_{i=1}^{n} X_{i,t}$$

$$Var(X_t) = s^2_{X_t} = \frac{1}{n}\sum_{i=1}^{n} (X_{i,t} - \bar{X}_t)^2$$

$$M_t = \left(\frac{Z_{\alpha/2}}{e}\right)^2 \frac{s_t^2}{\bar{X}_t^2}$$

$$Z_{\alpha/2} = 1.645 = critical\ value\ at\ 90\%\ confidence\ (\alpha = 0.1)$$

$$e = 0.1 = error$$

*Source:* PJM Manual 19:Load Forecasting and Analysis, Revision: 31Effective Date: June 1, 2016

- Sampling can support participation in energy, capacity and synchronized reserve in PJM, but only energy in California
  - PJM: 4 consecutive weeks of hour intervals for energy and capacity (672 intervals) or 2 consecutive weeks 1 minute intervals for SR (20,160 intervals).
  - CAISO: Sampling can be used for reserves but, but only to settle aggregations that have interval metering, but not down to 5 or 15 minute levels

# Statistical Sampling Takeaways and Options

- Good uniformity of statistical sampling methods across the ISOs/RTOs with large DR participation
- All follow known statistical methods for confidence and relative precision
- Questions around sampling will be how homogeneous or heterogeneous will be the samples and how to stratify the samples
- Demand Response sampling seems to require more rigor and greater sample sizes
  - With same c.v.=1, PJM and CAISO would require a sample of 271 for an infinite population of DR sites as opposed to 164 for EE sites.
- While NYISO does not have explicit sampling protocols today, following standard practice in other markets makes sense.
- Sampling is not appropriate for
  - Small populations…essentially all sites would need to be interval metered in any case
  - Heterogeniety across the potential population sites
  - Where interval metering is feasible and relatively a small costs relative to compensation from actions taken

# Next Steps

- Stakeholder feedback from presentation on thoughts and ideas
- Concentrated outreach to ISOs/RTOs on some of the unwritten rationales for their rules and procedures
- Work with NYISO staff on their questions and concerns
- Incorporate feedback, NYISO input, ISO/RTO outreach into the initial findings to develop recommendations
- Target a final report by the end of November

# Questions?

Paul M. Sotkiewicz, Ph.D

drpaulg8r@gmail.com

610-955-2411

352-244-8800