

Measurement & Verification in New England's Forward Capacity Market

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Overview

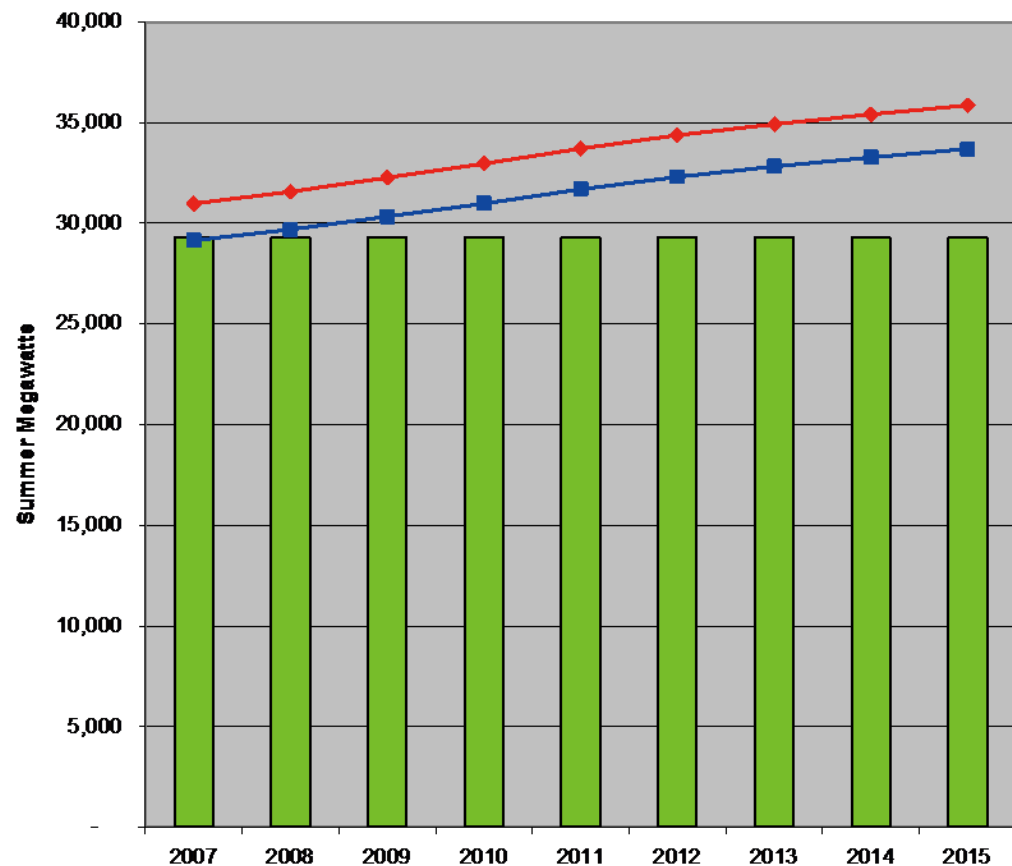
- Wholesale Market Products
- Forward Capacity Market
- Demand Resource Types
- Qualification Process
- Measurement & Verification
- Show of Interest for the 1st Forward Capacity Auction

Wholesale Electricity Products

- **Energy Markets**
 - Schedule and dispatch resources economically to meet customers' demand 24 hours per day, 365 days per year.
- **Ancillary Services Market (Reserves)**
 - Keep sufficient resources on reserve just in case of a sudden problem (contingencies).
- **Capacity Market**
 - Procure enough resources to meet the region's future peak demand and reserve requirements.

New England Capacity Outlook 2007-2015

Based on the ISO's Expected Load Forecast, New England will need approximately **200 MW** of new resources by 2009 and approximately **4,300 MW** of new resources by 2015.



Forward Capacity Market - Objectives

- Procure enough capacity to meet New England's forecasted demand and reserve requirements three years in the future.
- Provide a long-term (up to 5 year) commitment to Supply and Demand Resources to encourage investment.
- Select a portfolio of Supply and Demand Resources through a competitive **Forward Capacity Auction (FCA)** process.
- The selected Supply and Demand Resources are paid the market-clearing price.
- The 1st FCA will be held in February 2008 for capacity delivery in 2010.

Eligible Resources

- **Supply Resources**
 - Traditional Generation (Oil, Coal, Natural Gas, etc)
 - Intermittent Generation (Wind, Solar, etc.)
 - Renewable Generation
- **Demand Resources**
 - Energy Efficiency
 - Load Management
 - Distributed Generation
 - Demand Response



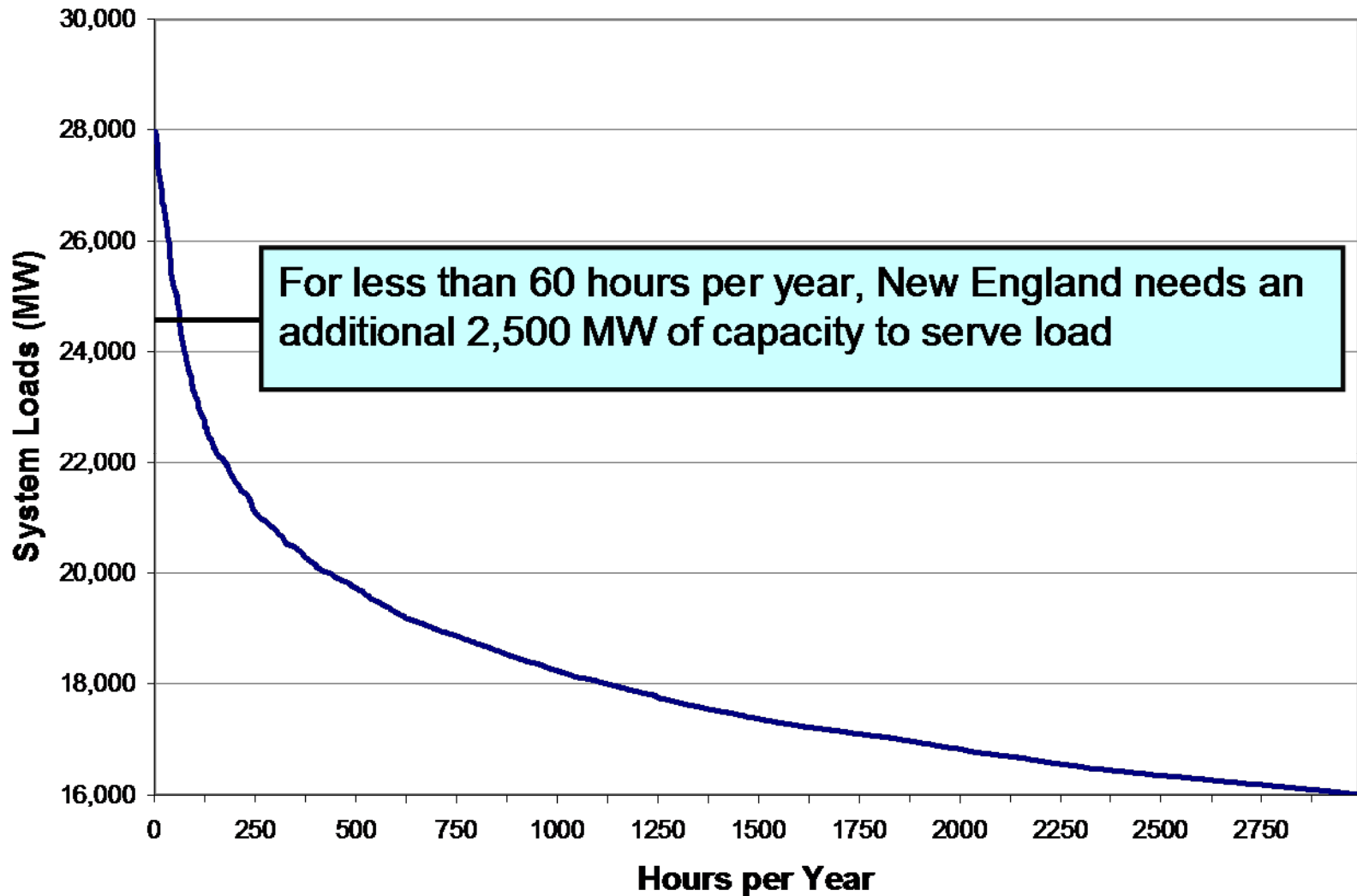
Forward Capacity Auction - Phases

- **Qualification Period:** Determine which Resource projects can be submitted into the auction.
- **Planning/Construction Period:** Gives suppliers sufficient time to install/construct new Resources to fulfill capacity obligations.
- **Commitment Period:** The period that suppliers are obligated to deliver capacity
 - Existing resources: 1 year
 - New resources 1-5 years

Demand Participation is Important

- The **Load Factor** of the New England electricity system has been steadily declining over time resulting in:
 - Peaky loads,
 - Higher energy and capacity costs, and
 - Higher average retail rates
- A small amount of demand participation in markets can go a long way in mitigating peaks, lowering costs, and ultimately lowering electricity prices to retail consumers

New England Load Duration Curve (2006)



Demand Resource Types and Qualification Process

Demand Resource Types

- Demand Resources are defined ***by the way in which they reduce load***, not by technology.
 - Different technologies (energy efficiency equipment, energy management systems, direct load control, distributed generation, etc.) can reduce load in different ways depending on how they are designed and operated.

Demand Resource Types

1. On-Peak
2. Seasonal Peak
3. Critical Peak
4. Real-Time Demand Response
5. Real-Time Emergency Generation

On-Peak Demand Resources

- Designed for non-dispatchable measures that are *not weather sensitive* and reduce load across pre-defined hours (e.g., lighting, motors, distributed generation, etc.).
- On-Peak Demand Resources must reduce load during the following hours:
 - **Summer On-Peak Hours:** 1 p.m. to 5 p.m. Non-Holiday Week Days in June, July and August
 - **Winter On-Peak Hours:** 5 p.m. to 7 p.m. Non-Holiday Week Days in December and January



Seasonal Peak Demand Resources

- Designed for non-dispatchable, weather-sensitive measures such as energy efficient HVAC measures.
- Seasonal Peak Demand Resources must reduce load during when the ***Real-Time New England Hourly Load*** is equal to or greater than **90%** of the Expected Peak Load Forecast for the applicable Summer or Winter Season.



Critical Peak Demand Resources

- Designed for measures that can be dispatched by the project owner based on Day-Ahead forecasted load and Real-Time system conditions.
- Critical Peak Demand Resources must reduce load during the ISO's Day-Ahead Forecasted Peak Load Hours and emergency operating conditions.



Real-Time Demand Response Resources

- Designed for dispatchable measures with no air quality permitting restrictions on their use.
- The ISO will send Dispatch Instructions to Real-Time Demand Response Resources.
- The ISO will dispatch Real-Time Demand Response Resources during Day-Ahead Forecasted Peak Load Hours and emergency operating conditions.

Real-Time Emergency Generation Resources

- Designed for Emergency Generators with Federal, State and/or Local air quality permit restrictions.
- The ISO will instruct the Emergency Generators to operate when there are extreme system emergencies that coincide with the ISO implementing 5% voltage reduction.
- The total quantity (MW) of Emergency Generators in the Forward Capacity Market will be limited.



Measurement & Verification Standards

M&V Standards - Overview

- Project Description Requirements
- Approved Methodologies
- Baseline Calculations
- Statistical Sampling
- Calculations of Demand Reduction Value
- Measurement Equipment Standards
- Data Collection, Validation and Management
- Monthly Performance Reporting
- Independence and Auditing

Goals and Objectives

- **The M&V Standards should.....**
 - Provide Market Participants with confidence on the accuracy and precision of reported MWh reductions from Demand Resources
 - Provide Demand Resource Suppliers with reasonable and clear requirements
 - To the greatest extent possible, be comparable with the measurement and verification requirements of traditional Supply Resources

Option A: Spot or Short-Term Measurement with Stipulated Values



- Description:
 - The approach is intended for DR projects where either performance or operational factors can be measured on a spot or short-term basis during pre and post-installation periods.
 - Demand Reduction Value is stipulated based on engineering assumptions, analysis of historical data, or manufacturer's data.
- Requirements:
 - Stipulated factor must not be subject to fluctuation over the Performance Hours or Measure Life of the Demand Resource.
 - Requires baseline measurement calculations
 - Supplier must demonstrate a correlation between the metered proxy variables and energy consumption (MWh) during Performance Hours.
- Example:
 - Measuring HVAC system temperatures and flow rates to calculate MWh consumption using manufacturer's equipment data.

Option B: End-Use or System Interval Metering



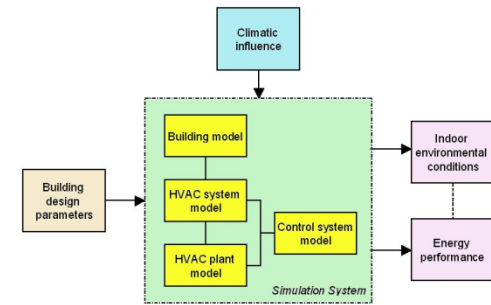
- Description:
 - Demand Reduction Value is measured at the component or system level using interval meters installed on the affected end-use.
- Requirements:
 - The Supplier must measure factors continuously during the performance period and Measure Life of the resource.
 - Requires baseline measurement calculations
 - Consideration must be given to the possibility of interactive effects that may significantly alter loads on other end-use equipment.
- Examples:
 - Measuring the MWh output of a Distributed Generator during Performance Hours.
 - Measuring the MWh consumption of a large electric motor

Option C: Whole Facility Metering and Analysis



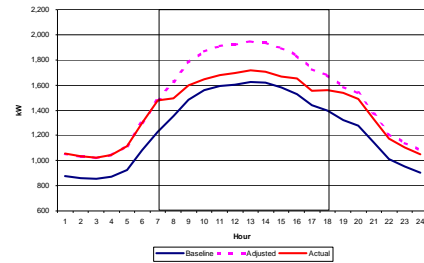
- Description:
 - Demand Reduction Value is determined by studying overall energy use in a facility and identifying the impact of the implemented measure on total building or facility energy use patterns.
- Requirements:
 - Interval metering of facility MWh consumption during Performance Hours.
 - Requires baseline measurement calculations
 - Approach may not be appropriate if the Demand Reduction Value is expected to be small relative to the total facility load, due to the small “signal-to-noise ratio,
- Example:
 - Residential weatherization measures reducing air-conditioning load

Option D: Calibrated Simulation



- Description:
 - Demand Reduction Value is determined using calibrated computer simulation models of either a system or whole building energy consumption to determine measure energy savings.
 - Engineering simulation models (such as DOE-2) can model both residential buildings (homes, apartments and condominiums) as well as more complex commercial buildings.
- Requirements:
 - Simulation models must be calibrated to actual kW and kWh data from the site or process being examined.
 - Requires baseline measurement calculations or simulation
- Example:
 - Installation of high efficiency HVAC and control systems in new construction project.

Baseline Conditions



- **Description:**

- A DR Project's Baseline is an estimate of the amount of electricity that would have been consumed during performance hours had the DR Project not been implemented *and all other conditions remaining the same*.

- **Requirements:**

- The Baseline methodology will be dependent on the proposed DR Project and Resource Type.
- Baseline must be reflective of operating fluctuations as it relates to the use of the equipment or practice over performance hours and may include such things as production, occupancy, weather dependant variables, equipment related variables (load and efficiency).

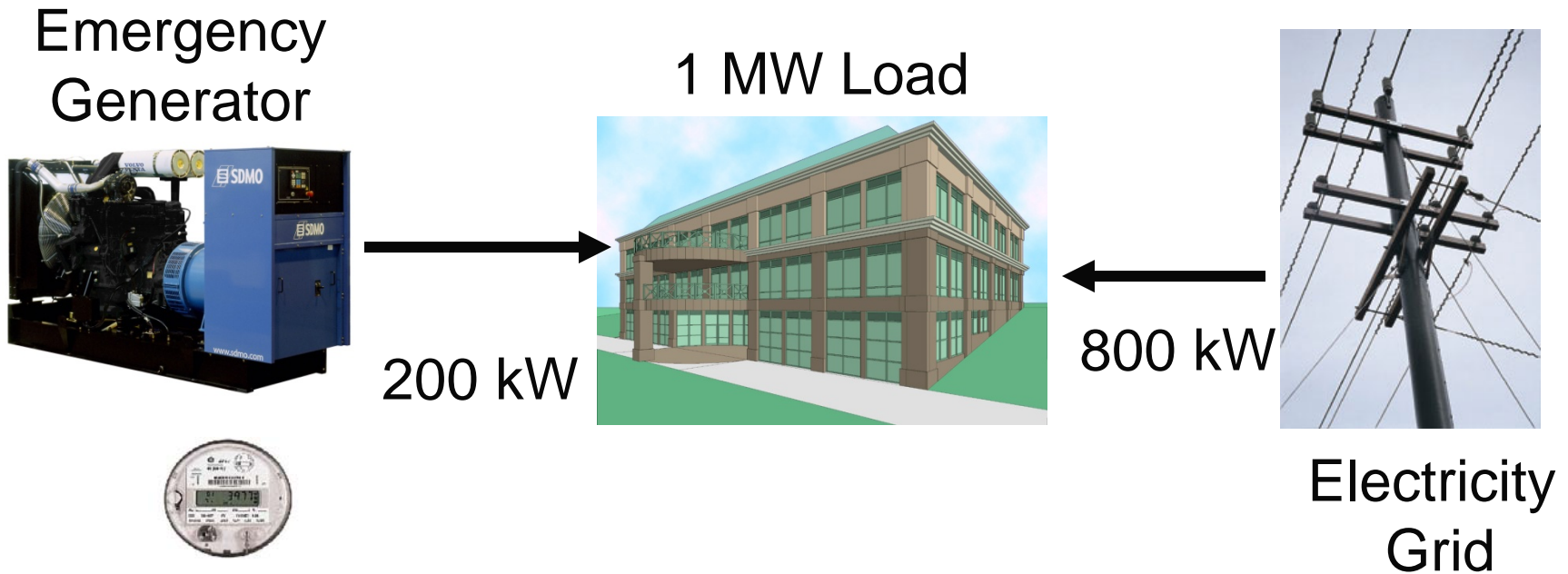
Baseline Conditions (Continued)

- **New Construction and Major Renovation**
 - Applicable state code or Federal product efficiency standard, or
 - Standard practices if there are no applicable state codes or Federal product efficiency standards, or
- **Replaced Failed Equipment**
 - Baseline Condition shall be the nameplate rating of the equipment meeting the level of efficiency required by applicable state code, federal product efficiency standard, or standard practice, whichever is most stringent.
- **Replaced Operating Equipment**
 - Baseline Condition is the kW load of that operating equipment across the Performance Hours.

Customer Baseline:

Typical Emergency Generator Configuration

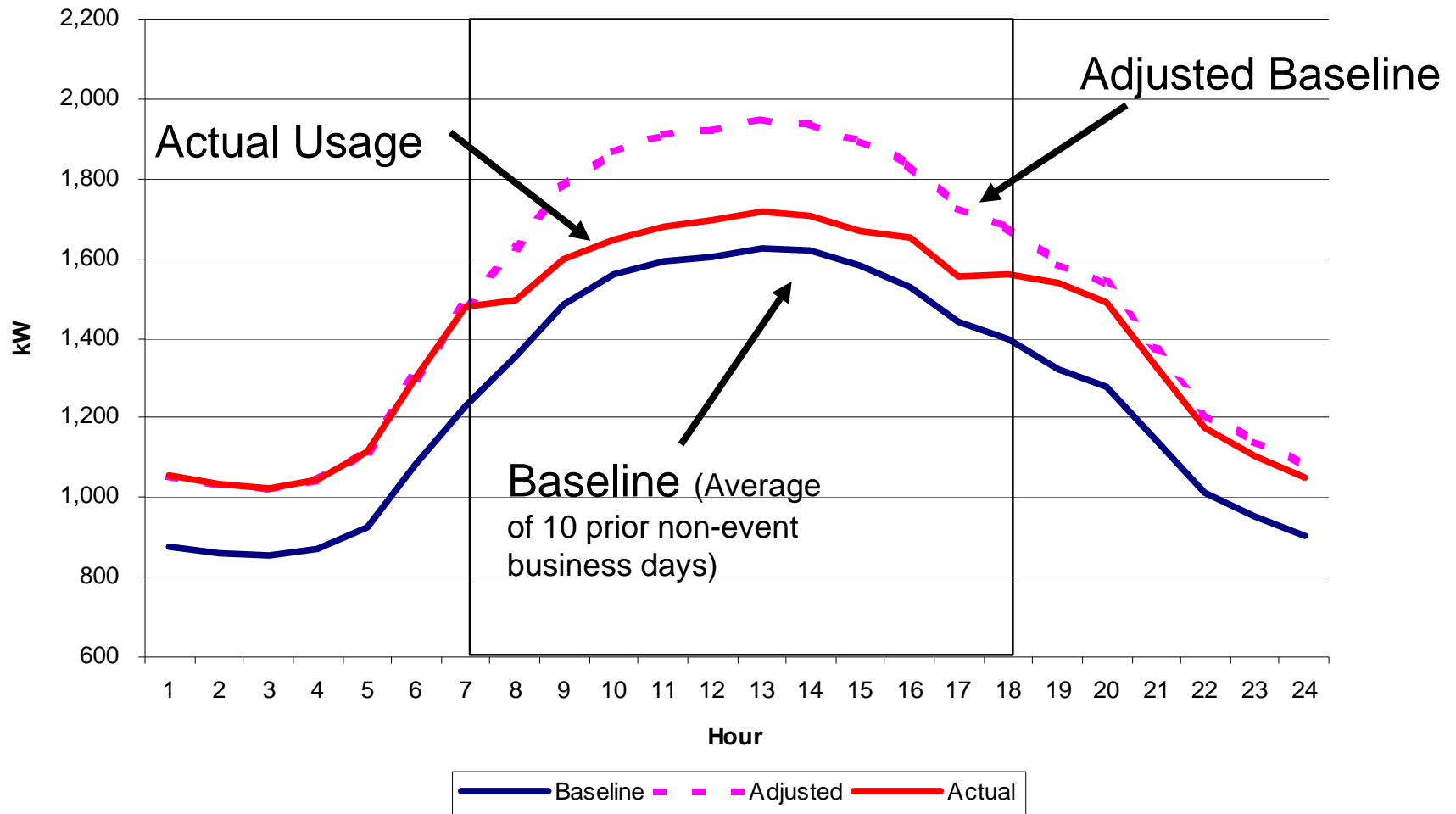
Operating during Reliability Events Only (OP4 Action 12)



IBCS Metering reports 5-Minute Output

Customer Baseline

Real-Time Demand Response Program



Direct Measurement

- **Description:**
 - Measurement of electrical demand (kW) that are used in the calculation of equipment or facility electrical consumption.
- **Requirements:**
 - The measurement of demand (kW) must use a true RMS measurement device with an accuracy of at least $\pm 2\%$.
 - Demand measurements for three-phase devices should be conducted on all phases in order to account for any phase imbalance.

Source: M-LRP V 9.0 Appendix E

Indirect Measurement

- **Description:**
 - Measurement of volts, amperes, temperature, flow rates or other variables that are used in the calculation of equipment or facility electrical consumption.
- **Requirements:**
 - If alternative methods of measuring demand are proposed (i.e. proxy variables, voltage, current, etc.) the **calculated** demand (kW) values from the monitoring data should achieve an accuracy of $\pm 2\%$ on the **calculated** demand (kW).
 - If the proposed methods rely on the measured current (amps) and the nominal voltage, the power factor of the end-uses must be included in the demand (kW) calculations.
 - Instruments or transducers for the analog or digital measurement shall conform to appropriate ANSI standards.

Statistical Sampling

$$n' = \left\{ \frac{t_{\alpha, \infty} \times \text{c.v.}}{p} \right\}^2$$

- **Description:**

- Demand Reduction from multiple installations of similar Demand Resources may be developed by sampling from the total population.

- **Requirements:**

- Specify the population to be sampled,
- Samples must be sized and selected to achieve 80% Confidence \pm 20% Precision,
- Describe the planned sample size, plus contingencies for attrition due to metering equipment failure and the like,
- Show all calculations for determining the sample size,
- Describe the method for selecting sample points, and
- Describe the method for monitored the accuracy and precision of the sample over the Measure Life.

Independence

- **Description:**

- The Measurement and Verification implementation shall not be biased by any financial interest in the results or efforts resulting from the implementation of evaluation recommendations.

- **Requirements:**

- The Supplier's shall demonstrate independence of the entity implementing the pre- and post-installation inspections of Demand Resource measures, such that the evaluation is independent of the Project supplier design, management and implementation.

Show of Interest for the 1st Forward Capacity Auction

Show of Interest Results

- ISO New England received more than 400 Show of Interest Forms from new Supply and Demand Resources totaling over **17,200 MW**
 - Over **15,000 MW** from new Supply Resources including traditional generation, renewables and imports.
 - Over **2,200 MW** from new Demand Resources including energy efficiency, load management, distributed generation and demand response

Demand Resources Show of Interest

MW by State and Resource Type

State	Resource Type					Grand Total
	Real-Time Demand Response	Real-Time Emergency Generation	Critical Peak	On Peak	Seasonal Peak	
Massachusetts	311	226	286	262	29	1,113
Connecticut	143	141	112	61	120	577
Maine	122	33	27	32	2	215
Rhode Island	68	74	9	35	4	190
New Hampshire	24	41	18	45	4	131
Vermont	17	22	8	6	1	54
Grand Total	685	536	460	440	159	2,279

80% of the proposed MWs are from non-utility suppliers such as energy services companies, third-party energy suppliers, equipment vendors and retail customers.

Source: ISO New England Press Release May 16, 2007