Performance Evaluation Methods for Capacity Demand Response Programs

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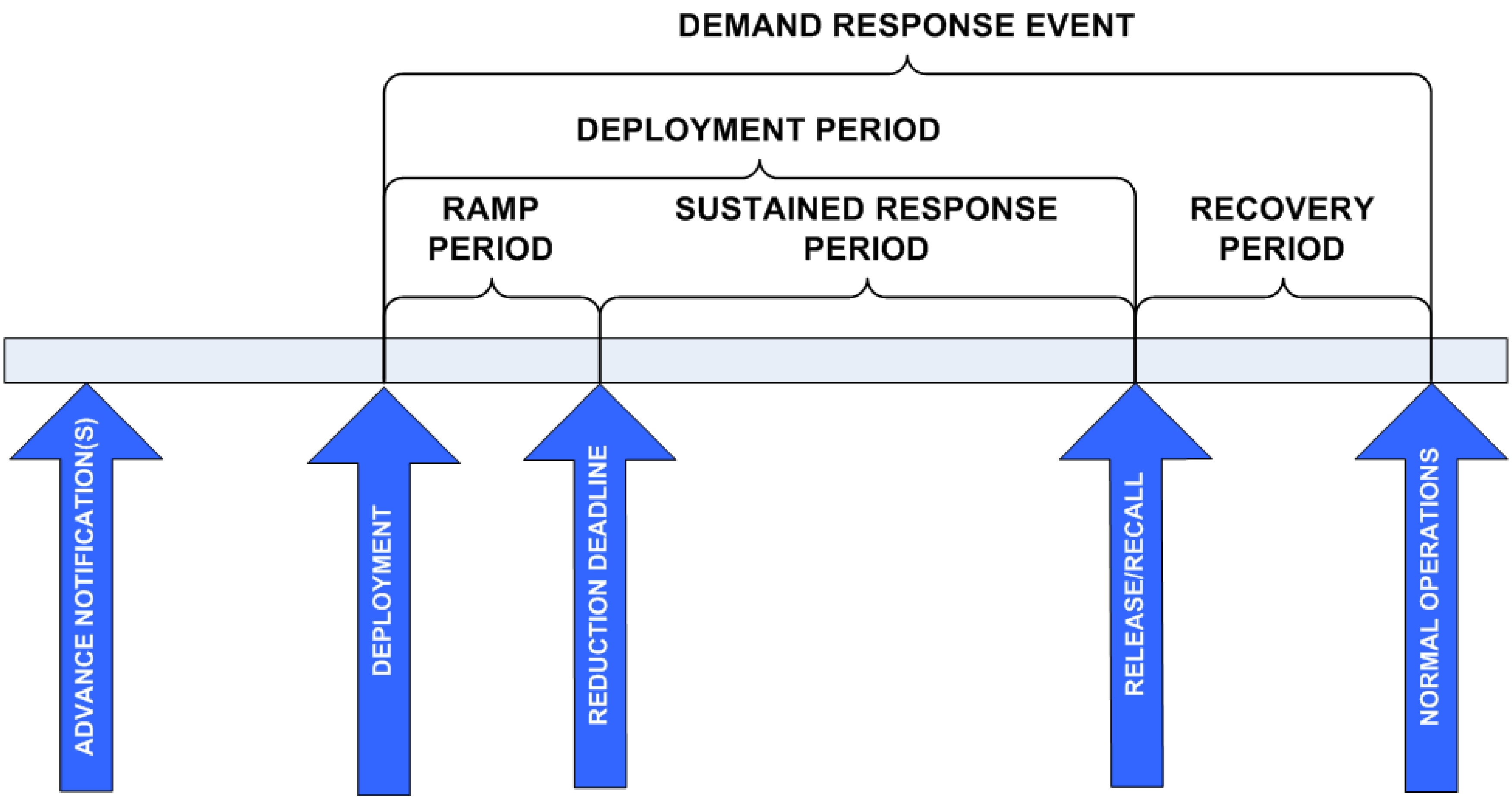
Topics

- NAESB Standards for Wholesale Demand Response
- IRC Demand Response Matrix
  - *Performance Evaluation Methods*
    - Maximum Base Load and Baseline Type – I
  - *DR Capacity programs similar to ICAP/SCR*
    - <u>Examples: Other ISOs'/RTOs' Methods and Programs</u>
- NAESB Performance Evaluation Standards
- Baseline Literature

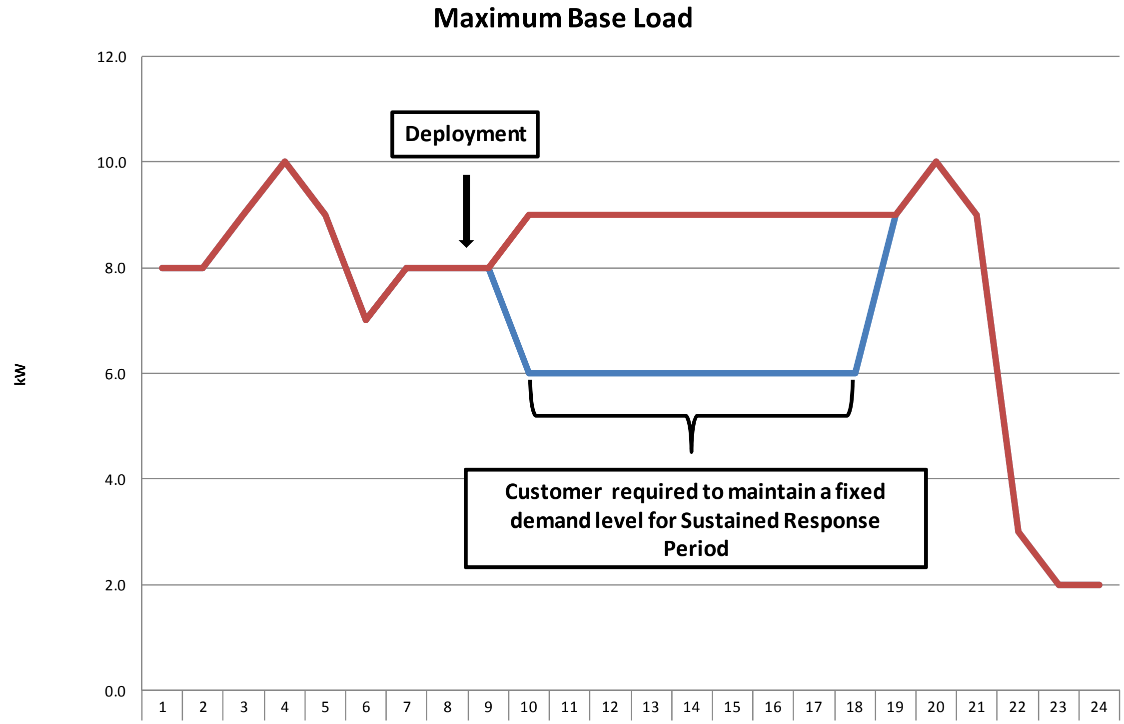
Demand Response Event Timing



Applicable Performance Evaluation Methods: NAESB Matrix

Performance Evaluation Type	Service Type			
	Energy	Capacity	Reserves	Regulation
Maximum Base Load	✓	✓	✓	
Meter Before / Meter After	✓	✓	✓	✓
Baseline Type-I	✓	✓	✓	
Baseline Type-II	✓	✓	✓	
Metering Generator Output	✓	✓	✓	✓

Maximum Base Load



- A performance evaluation methodology based solely on a Demand Resource's ability to reduce to a specified level of electricity demand, regardless of its electricity consumption or demand at Deployment

Chart from NAESB draft Retail Standards for Measurement & Verification

Maximum Base Load

- The NYISO APMD performance calculation falls into this M&V method
  - *Maximum Base Load = Committed Maximum Demand (CMD)*
- Five ISOs/RTOs use this method, including NYISO
  - *Energy products: AESO*
  - *Capacity products: ERCOT, MISO, NYISO and PJM*

Maximum Base Load: ERCOT

- "Alternate Baseline" in Emergency Interruptible Load Service program
  - *Specifically designed for highly variable loads*
- Capacity (bid) should be based on anticipated hourly average load minus Maximum Base Load (MBL) for committed Time Period
- Event performance based on Load's ability to stay at or below MBL throughout event
  - *Interval metered load must be less than or equal to Maximum Base Load + (Commitment * .05)*
  - *15-minute interval-level performance factors capped at 1*
  - *Average of interval performance factors for all event intervals*
- Availability requirements also apply
  - *Average hourly load must be ≥ committed capacity minus MBL over committed hours in the 4-month Contract Period*
  - *Failure results in 6-month suspension from program*

Maximum Base Load: Midwest ISO

- Load Modifying Resource program
- Resource may choose Maximum Base Load or a fixed reduction amount (guaranteed load drop)
- Maximum demand coincident with LSE's monthly, revised monthly (month before operating month)
- Difference between maximum coincident demand and Target Load Level is available capacity
- Performance based on event
  - *Non-compliance penalty if less than 100% of Target Load Level*

Maximum Base Load: PJM

- Full Emergency Load Response program
- Peak Load Contribution (PLC) is the resource's contribution to the zone's peak load for a planning year based on five coincident system peak hours
  - *Effective for entire delivery year*
- Difference between PLC and Firm Service Level (FSL) determines capacity
- Performance is measured by event
  - *Based on difference between FSL MW and average metered MW during whole hours of event*
    - Penalties are based on CSP portfolio performance by zone for each event

Comparison of Maximum Base Load methods used for Capacity Programs

	Description	Baseline Window	Calc. Type	Performance Measurement	Calculated by	Applicable to
ERCOT	Alternate Baseline (designed for highly variable loads)	Same period from previous 12 months as Contract Period	15-min average of 24-hour energy use	Event metered load <= Maximum Base Load + (Commitment * .05)	ERCOT to assign baseline type and after events	Contract Period (4-months)
Midwest ISO	Maximum Base Load	Monthly demand coincident with LSE	Maximum	Event metered load <= Target Load Level	LSE	Month
NYISO	Average Peak Monthly Demand (APMD)	Maximum monthly demand between 12pm and 8pm for middle 4 months of previous "like" Capability period	Average	Event metered load <= Contract Minimum Demand	CSP/RIP	Capability Period (summer or winter)
PJM	Peak Load Contribution (PLC)	5 coincident system peak hours from previous year	Average	Event metered load <= Firm Service Level	Electric Distribution Company calculates PLC PJM calculates performance	Entire delivery year

Baseline Type - I

- A Baseline performance evaluation methodology based on a Demand Resource's historical interval meter data which may also include other variables such as weather and calendar data
- Seven ISOs/RTOs use this method, including NYISO
  - *Energy products: IESO, ISO-NE, MISO, NYISO, PJM, SPP*
  - *Capacity products: ERCOT, ISO-NE, MISO, PJM*
  - *Reserve products: ISO-NE*

Baseline Type - I: ERCOT

- "Default Baseline" in Emergency Interruptible Load Service program
  - *Assigned by ERCOT after evaluation of 12 months of historical interval data*
- Three types of Default Baseline:
  - *Statistical Regression, Middle 8-of-10 Preceding Like Days, Matching Day Pair*
- Capacity (bid) should be based on the minimum load that can be curtailed during committed Time Period(s)
- Middle 8-of-10 Preceding Like Days
  - *Data for 10 days immediately preceding the deployment*
  - *Highest and lowest consumption days, based on full 24-hour energy use, are eliminated*
  - *Baseline is interval-level average of remaining 8 days*
- Event-day scalar adjustment based on actual load for hours preceding the event
  - *Eight intervals (2 hours) beginning three hours before Deployment*
  - *Adjustment is symmetric, no limit*
- Availability requirements also apply
  - *Load must exceed committed capacity for at least 95% of committed hours in the 4-month Contract Period*
  - *Failure results in 6-month suspension from program*

Baseline Type - I: ISO-NE

- Similar to a 10-day rolling average
- 90% of the prior qualifying baseline + 10% of the previous qualifying day
- 5-minute or hourly interval data
  - *Varies by program*
  - *Every interval of every weekday*
    - Exclusions for holidays and DR-events
- Baseline adjustment for actual load
  - *2 hours prior to Advance Notification*
  - *Asymmetric, positive only*
    - Changing to symmetric in 2010
- Capacity payment based on:
  - *credit for maximum interruption in any recording interval*

Baseline Type - I: Midwest ISO

- Load Modifying Resource program
- Resource may choose Maximum Base Load or a fixed reduction amount (guaranteed load drop)
- Fixed reduction amount compared to difference between baseline and meter read
- Baseline method using interval data is proposed to Midwest ISO by the market participant
  - *Resources using this method have historical performance with utilities, which Midwest ISO has agreed to accept*
  - *Standard baseline method under development by Midwest ISO*
- Performance based on event
  - *Non-compliance penalty if less than 100% of Target Load Level*

Baseline Type - I: PJM

- Full Emergency Load Response program
- Option: Capacity based on Guaranteed Load Drop (GLD)
  - *Effective for entire delivery year*
- GLD compared to difference between baseline and meter read
- Window: 45 calendar days
- Calculation: Hourly average of highest 4 out of 5 days (for weekdays) or highest 2 out of 3 for weekends/holidays
  - *Highest days determined by energy use during event*
- Adjustments based on three-hour window ending one hour prior to Deployment
  - *Weather-sensitive options*
    - Regression analysis using temperature-humidity index (THI) ***OR***
    - Simplified analysis based on temperature exceeding 85 degrees Fahrenheit during each hour of event and difference of 5% or more between pre-event hours and corresponding hours of CBL
    - Weather-adjusted CBL may not exceed historical, seasonal, on-peak non-coincident load
  - *Symmetric Additive Adjustment*
    - Difference between average energy use over three-hour period ending one hour prior to event start and average energy use over same three-hour period of CBL
    - Each hour of CBL modified by the Symmetric Additive Adjustment
- Performance based on difference between baseline and average metered MW during whole hours of event

Comparison of Baselines used for Capacity Programs

	Description	Baseline Window	Calc. Type	Baseline Adjustment	Adjustment Window	Calculated by
ERCOT	Middle 8-of-10	10 days immediately preceding Deployment	15-min average of middle 8 days based on 24-hour energy use	Symmetric scalar No limit	2 hours, beginning 3 hours before Deployment	ERCOT to assign baseline type and after events
ISO-NE	10-day rolling average	10 days	90% of prior baseline + 10% previous qualifying day	Asymmetric, positive No limit Change to symmetric in 2010	2 hours prior to Advance Notification	ISO-NE
Midwest ISO	Resource - specific	Resource - specific	Resource -specific	Resource -specific	Resource - specific	MP & Midwest ISO
NYISO*	Highest 5 of 10	Most recent 10 eligible out of last 30 days	Hourly average of highest 5 event period use days	Symmetric scalar +/- 20%	2 hours prior to Advance Notification	CSP/RIP
PJM*	Highest 4 of 5	Most recent 5 eligible out of last 45 days	Hourly average of highest 4 event period use days	Temperature-based or Symmetric Additive	3 hours ending one prior to Deployment	PJM

Differences apply to weekday and weekend events

NAESB Performance Evaluation Standards Overview

Baseline Information	Event Information	Special Processing
◆ Baseline Window ◆ Calculation Type ◆ Sampling Precision and Accuracy ◆ Exclusion Rules ◆ Baseline Adjustments ◆ Adjustment Window	◆ Use of Real-Time Telemetry ◆ Use of After-the-Fact Metering ◆ Performance Window ◆ Measurement Type	◆ Highly-Variable Load Logic ◆ On-Site Generation Requirements

Baseline Literature

- Related to measurement of reduction in energy use
  - *XENERGY/KEMA – Protocol Development for Demand Response Calculation (2002)*
  - *LBNL – Estimating Demand Response Load Impacts: Evaluation of Baseline Load Models for Non-Residential Buildings in California (2008)*
  - *AEIC Demand Response Measurement & Verification – Applications for Load Research (2009)*
- No mention of methods for determining available capacity or M&V of capacity performance

XENERGY/KEMA

- Executive Summary
  - *For summer loads, high 5 of 10 reduces otherwise negative bias*
  - *For summer loads using additive adjustment, High 5 of 10 gives the lowest bias of any of the averages, for both weather-sensitive and non-weather-sensitive, and comparable variability*
  - *For non-summer loads, High 5 of 10 average inflates positive bias*
  - *Regression approaches introduce errors if operations change in the interim (during the season)*

XENERGY/KEMA

- Goals of baseline (3-3)
  - *Estimated level of load in absence of DR event*
  - *Ease of use*
  - *Deterrence of gaming*
- Use of adjustments mitigates the average's understatement of baselines and demand reductions for weather-sensitive accounts (5-3)
  - *Weather models all have lower magnitude bias than any of the averages. However, the High 5 of 10 method is nearly as good (5-12)*
- Baseline criteria - ERCOT (3-4)
  - *Simplicity*
  - *Ease of use*
  - *Ease of understanding*
  - *Verifiability*
  - *Accuracy*
  - *Lack of bias*
  - *Handle weather-sensitive loads fairly*
  - *Minimize gaming*
  - *Known prior to commitment/event*
  - *Low cost to implement*
  - *Consistency with other ISOs*

LBNL Study – Jan. 2008

- Scope limited to estimating what the load would have been on the day of the event without any DR actions
- Several average daily usage models and regression models evaluated
  - *Weather-sensitive regression shows the least bias, but is extremely complex to administer*
  - *Morning adjustment factor significantly reduces the bias and improves the accuracy of all models examined*
- Key load characteristics to consider are weather-sensitivity and variability of loads

AEIC: Individual Measurement

Baseline Methodology	Description
Previous Day	Average hourly load data using a subset of days from an historical period; same day type
Average Daily Usage	Average hourly load data. Daily energy used to choose which days to include; same day type
Proxy Day	Hourly loads of a single day that has the same characteristics as the loads of the DR event day
Regression Methods	Models that include variables in addition to hourly demand or load

Association of Edison Illuminating Companies – "Demand Response Measurement & Verification, Applications for Load Research", March 2009

AEIC: March 2009

Baseline Methodology	Pro	Con
Previous Day	• Most likely the same usage pattern as the event day • Easy method for customer to understand	• Does not take into account the effects of weather on load • The need for a baseline adjustment
Average Daily Usage	• Easy method for customer to understand • Averaging takes out the variability in load for the days used to create the average day	• An average load shape created from multiple day load shapes will not totally capture the usage pattern for an event day • The need for a baseline adjustment
Proxy Day	• Matches a day based on defined variables uniform with event day	• Finding a day based on the defined variables • The need for a baseline adjustment • There might not be a day to use as the proxy day
Regression Model	• Concept of variable relationship is easy to understand	• Customer understanding of the process used • Selecting the correct variables to use in the model

Association of Edison Illuminating Companies – "Demand Response Measurement & Verification, Applications for Load Research", March 2009

The New York Independent System Operator (NYISO) is a not-for-profit corporation that began operations in 1999. The NYISO operates New York's bulk electricity grid, administers the state's wholesale electricity markets, and provides reliability and resource planning for the state's bulk electricity system.

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