Residential DR: Participation in Synchronized Reserves M&V for Energy and Load Management

September 3, 2014

First Read - MIC

2 Problem Statements

1. Residential DR can provide quick response for Synchronized Reserves but it is cost prohibitive to install & maintain 1 minute meter on every house
2. Residential DR measurement and verification in Energy and Capacity market is outdated and not accurate
   - Residential DR evolved over last 20 years
   - Deemed Savings Estimate Report is not accurate
   - Load Research & Switch Operability Studies may be outdated

Joint solution overview

- Leverage statistical sample with appropriate meters to represent population
  - More accurate solution based on actual load data during response instead of a study
  - More cost effective solution
  - Allows more flexibility for retail programs to customer
- Clarify rules where hourly data is available (AMI, etc) for all residential customers
  - Ensure reasonable consistency between non-interval meter and interval metered residential customers

Changes based on Non-interval meter pilots over last 5 years

What is NOT changing

- Compliance calculations
- Non-performance penalties
- Flexible/inflexible rules
- Meter accuracy requirements – 2%
- Data submission timeline
- DR limitation in SR – 33%
- Meter level – entire EDC account number, no submetering

Requirements for using statistical sampling

- Load Management (Capacity)
  - Residential direct load control
  - qualifies for load management
  - No interval metering (hourly or better)
- Economic Energy
  - Residential direct load control
  - Qualifies for economic energy markets
  - No interval metering (hourly or better)
- Synchronized Reserves
  - Residential direct load control
  - Qualifies for SR
  - No interval metering (1 minute or better)

Sample requirements

- Stratified simple random sample
  - Stratification to ensure sample is representative of population
- Must achieve less than 10% error at 90% confidence
- Sample size based on variance study
- Sample must be recalibrated annually
- Annual M&V plan submitted to PJM

Switch operability

- 2 way switch communication
  - Operability factor for each event based on actual performance
- 1 way switch communication
  - Value is implicit in sample
  - Cannot repair switches in sample without repairing switches in population

- Must follow NAESB VEE protocol.
  - NAESB VEE protocol is intended for hourly data
  - Replace “hour” with “interval” in NAESB protocol for 1 minute data
- Maintain data for 2 years from date of event or offer
  - List of participating/offered customers
  - Meter data from sample

- Replacement
  - Customer moves or leaves DR program
  - Non-interval metered customers: replacement must maintain integrity of sample strata
  - Interval metered Load Management: replacements must maintain PLC and load drop
- LSE
  - Difficult to manage for residential customers on registration
  - LSE not required on residential registration if not participating in DA market

Transition

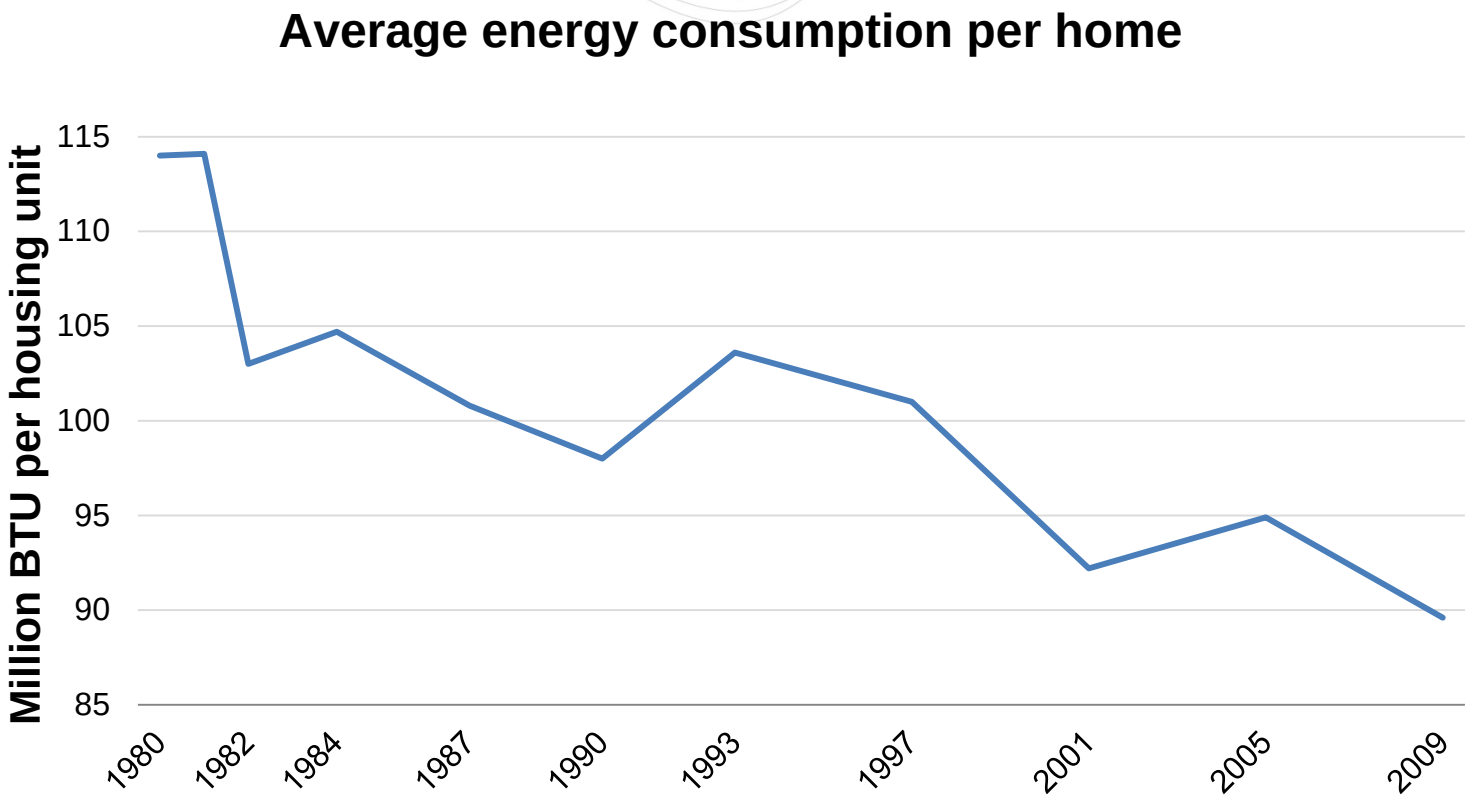
- Statistical sampling is effective June 1, 2015
- Traditional DLC, Deemed Savings Report, Load Research studies cannot be used after June 1, 2016
- Transition mechanism for MW that cannot meet new requirements for DY16/17 and DY17/18

- PJM will report results 1 year after participation for transparency

APPENDIX

- Outdated
  - completed in March 2007 with data from 2001 – 2005
  - AC's are substantially more efficient, usage patterns change
- Geographically limited
  - Data from BGE, PSEG, JCPL
  - Footprint has substantially increased
  - Potentially settling DR in Chicago and Kentucky with data from NJ & MD
- Assumptions may no longer be appropriate (new capacity products)
  - Only used during design conditions
  - Focused on one specific hour
  - Impact of multi-day events

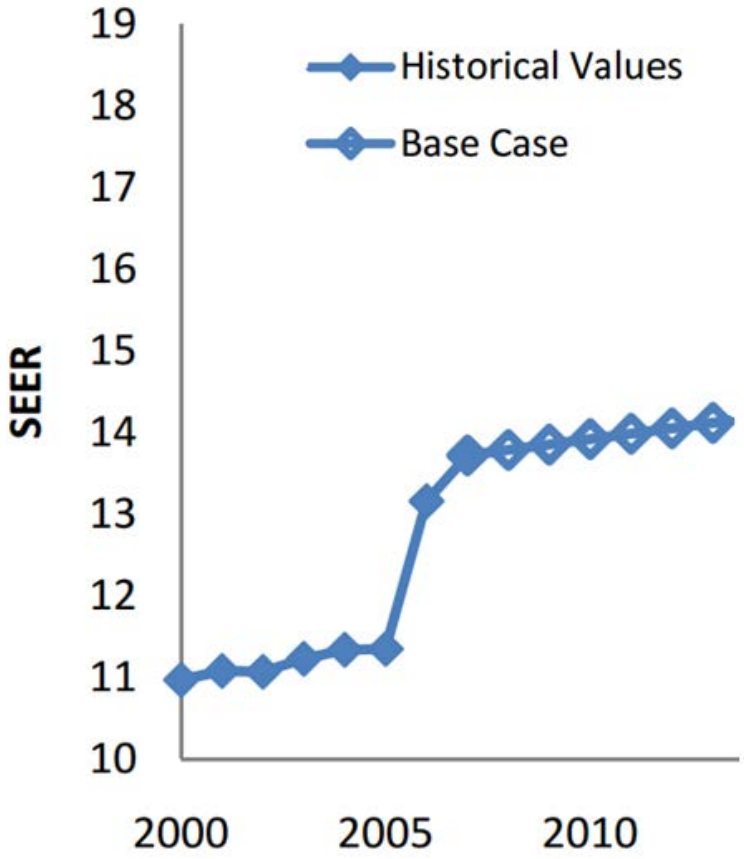
Residential energy usage decreasing



Source: EIA Residential Energy Consumption Survey 2009 — Release date: June 6, 2012

Air conditioner efficiency dramatically increased since 2005

SEER – measure of AC efficiency. Higher is more efficient.



Source: Robert De Kleine, “Life Cycle Optimization of Residential Air Conditioner Replacement” University of Michigan, Report No. CSS09-12, December 2009

- Separate samples
  - End use device/device grouping
    - e.g. AC, water heater, both
  - Curtailment algorithms
    - e.g. 50% cycling, 100% cycling, thermostat set point
  - Different switches with same curtailment algorithm
    - Necessary if switch capability is substantially different
  - SR: SR Subzone, Dispatch group or registration
  - Energy/Load Management: EDC, CSP

- Sample stratification
  - Control device size in 2 groups roughly at median
    - e.g. median AC size is 3.1 kW, stratification by AC size < 3.1 kW and > 3.1 kW
    - Based on sum of device sizes at EDC account level
  - Geographic Stratification
    - PJM discretion, based on size, variability within region, etc.
    - e.g. AEP wide program would likely require geographic stratification, RECO probably not
  - CSP may propose alternate stratification to reduce variance
  - PJM will adjust stratification requirements as experience is gained to reduce sample size

Variance Study Requirements

- At least 75 randomly selected participants
- Data collection during season that end use device is in use/will be curtailed
  - e.g. June – September for Acs
- Load Management/Energy
  - At least 4 weeks of contiguous hourly meter data
- SR
  - At least 2 weeks of contiguous 1 minute meter data

- Annual sample calibration
  - Based on annual sample variance update
  - Proportion of each stratum in the sample must be within +/- 1 sample of population proportion
    - e.g. Sample size = 150 customers

      Population proportion stratum A= 20%

      Stratum A should be 30 customers

      does not need to be recalibrated if 29 – 31 customers
  - Replacements if necessary must be randomly selected, maintain strata integrity, etc.
  - If population is expanded in non-random manner, sample must be expanded appropriately

- 2 way communication
  - Performance factor for each event based on actual population operability
  - Inoperable switch in sample
    - Sample size > M: do not report load data from in-operable switch
    - Sample size < M: must report load data from switch
  - Can repair faulty switch in sample or population at any time

Switch Operability – 1 way

- 1 way communication
  - Must report data from all switches, even if inoperable
  - Cannot repair failed switches until:
    - Repair faulty switches in population
    - OR Reselect entire sample
    - Includes any system/device that would cause end-use device not to reduce load properly in the population
  - Metering and metering communication
    - Can be fixed in sample
    - Includes only systems/devices that would not affect load reduction in population
    - Component that is related to both metering and switching cannot be repaired
  - Switch failures in sample must be reported to PJM within 2 business days

Data Validation and Estimation

- NAESB Validating, Editing & Estimating (VEE) Protocol
  - EEI Uniform Business Practices for Unbundled Electricity Metering Volume II, 12/5/2000
- Must follow NAESB VEE protocol.
  - NAESB VEE protocol is intended for hourly data
  - Replace “hour” with “interval” in NAESB protocol
- If X intervals or more are missing for 1 meter
  - X = 5 for SR; X = 2 for Energy & Load Management
  - If still enough meters to satisfy sample size: do not submit data from meter
  - If less than sample requirement - data from that meter must be submitted as all 0’s for that event

Residential customers with interval and non-interval metering in Energy, LM and SR:

- CSP must submit initial list of customers
  - EDC account number and address
- Replacement
  - Customer who moves from their premises
  - Customer who terminates their own contract with CSP for participation in DLC/SR
  - CSP must maintain list of all replacements and furnish to PJM within 2 business days of request

- Load Management
  - CSP must maintain list of customers for each event for 2 years from event date
  - CSP may not add/remove customers other than for replacement
  - If number of customers falls below registered number, CSP must report to PJM within 2 business days
  - Interval metering
    - Replacement customer must be randomly selected to maintain load drop and PLC
  - Non-interval metering
    - Replacement customer must be randomly selected to maintain integrity of strata and to maintain load drop and PLC

- Economic Energy & SR
  - CSP must maintain list of customers for each offer for two years from date of offer
  - Value on location in eLRS must be accurate every day an offer is made
  - CSP may add/remove customers but must maintain documentation and update value on location in eLRS
  - Interval metering
    - No restrictions on replacement customer
  - Non-interval metering
    - Replacement customer must be randomly selected to maintain integrity of strata

- Economic Energy and SR
- Number of customers offered cannot exceed number of registered customers
- List of offered customers must be finalized at time of offer
- Non-interval metered
  - Offered customers must be randomly assigned from pool of all registered customers

- CSP must maintain list of:
  - registered customers (daily) – determined day before operating day
  - offered customers (for all eMKT offers) – determined before offer is submitted
  - cycled customers – for all events – determined immediately after cycling is initiated based on actual customers who are cycled
- Data to be furnished to PJM within 2 business days of request
- If data cannot be furnished in timely manner, or number of customers falls below registered/committed value without reporting:
  - CSP may referred to MMU for review
  - Deficiency penalties may be assessed
  - Registered value may be reduced and offered value capped

- M&V Plan
  - Annual
  - Details of variance study
  - Meter qualification
  - Meter quality assurance
  - Data validation, error correction protocol
  - Sample selection and stratification detail
  - PJM to publish template

- [1 week prior to posting planning parameters for IA] – CSP to provide PJM cleared MWs from prior RPM auction(s) that cannot be delivered due to statistical sampling requirement by product by zone.
  - 16/17 – CSP must notify based on 3rd IA schedule
  - 17/18 – CSP must notify based on 2nd IA and/or 3rd IA schedule
  - CSP IA offer restriction
    - CSP is not permitted to sell MWs in any modeled LDA (including any modeled sub-LDA of the LDA) for which non-viable DR MWs are declared
- [planning parameters posting date for IA] – PJM to publish aggregate non-viable DR MWs

Proposed Transition Mechanism
16/17 and 17/18 Delivery Years (continued)

- [IA start date] – PJM to aggregate all adjustments (CSP non-viable MWs, forecast adjustment ,etc.) and include in 1st or 2nd auction if amount exceeds threshold (lessor of 1% or 500 MW – *as currently defined in tariff*) and if it does not exceed threshold then include in 3rd IA
  - PJM to increase capacity procured (or reduce capacity released) in IA (as necessary)
    - Cost will be allocated *consistent with current tariff* provisions for forecast adjustment
  - Bilateral transaction are subject to review and referral to MMU and/or FERC Office of Enforcement and should not be executed for non-viable MWs for financial gain.
- [Prior to start of DY] PJM to reduce CSP capacity commitment in eRPM by product by zone and prorate amount of non-viable MW as necessary if CSP cleared MWs in multiple auctions
- [Prior to start of DY] CSP responsible to register enough DR to cover final capacity commitment or receive daily deficiency charge.
- [normal bill cycle during DY] PJM to only pay capacity revenue based on final CSP capacity commitment