

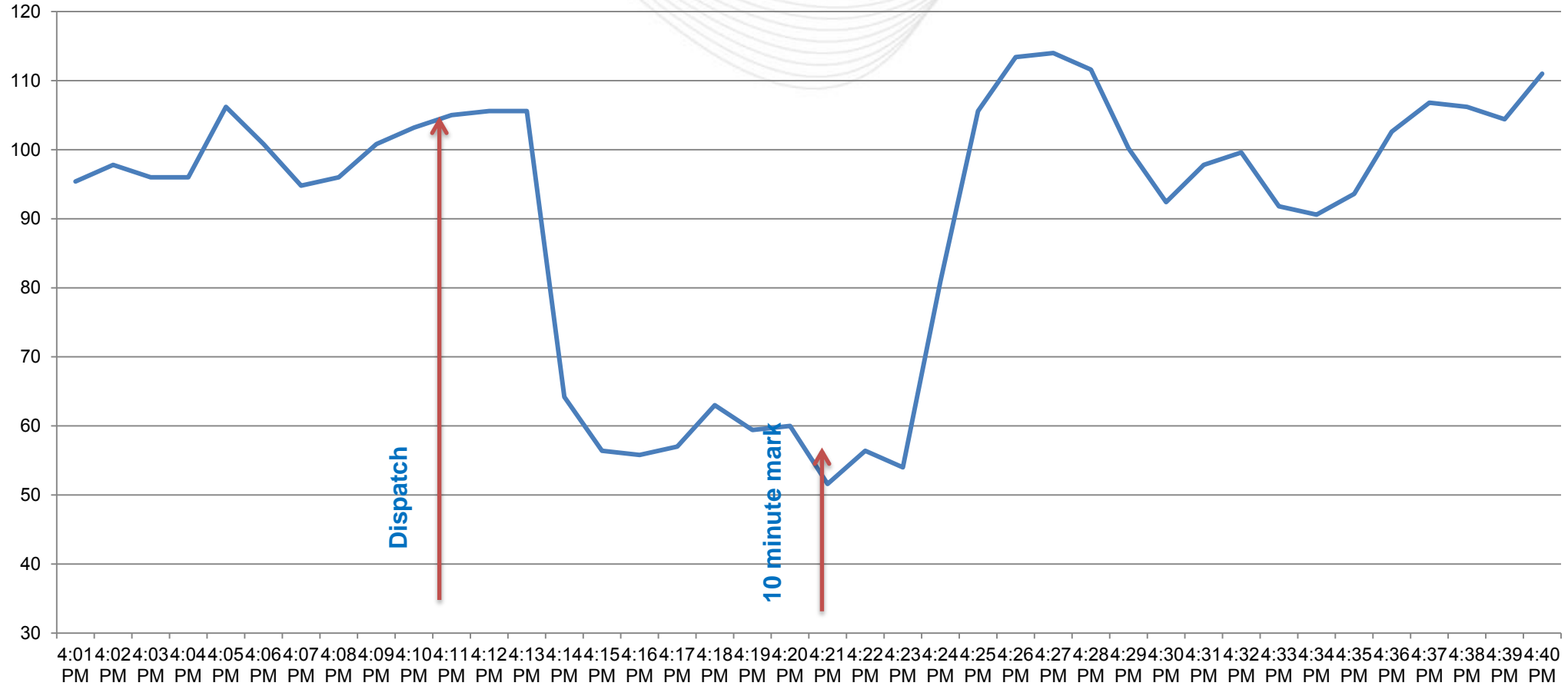
Residential DR: Participation in Synchronized Reserves M&V for Energy and Load Management

Operating Committee
November 6, 2014

- Residential DR SR
 - Issue charge approved at 3/5/2014 MIC
- M&V for Residential DR
 - Issue charge approved at 5/7/2014 MIC
- Both issues worked at DRS
 - Proposals combined at 8/27/2014 DRS
 - Consensus reached on single proposal at 8/27 DRS
- MIC endorsement 10/8/2014
 - Approved with 13 objections and 3 abstentions
- MRC first read 10/30/2014

1. **Synchronized Reserves:** Residential DR can provide quick response for SR but it is cost prohibitive to install & maintain 1 minute meter on every house.
2. **Measurement & Verification:** Residential DR M&V in Energy and Capacity market is outdated and not accurate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 - Load Research & Switch Operability Studies may be outdated

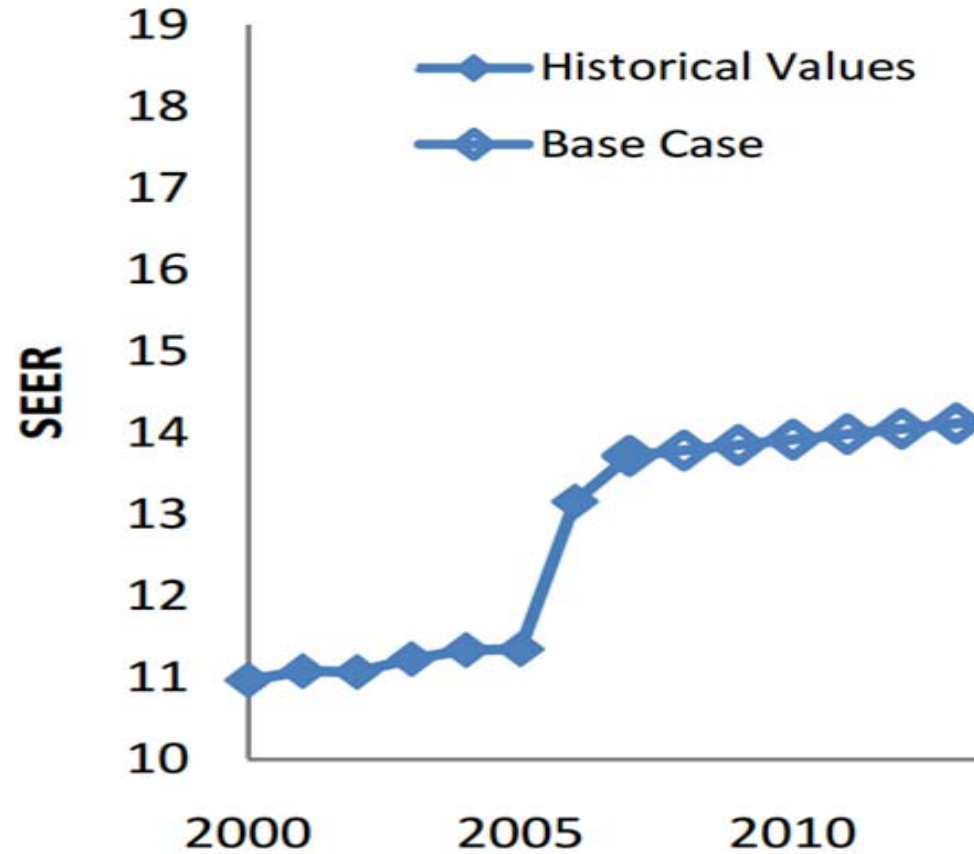
COMVERGE SR Test Event Aug 21, 2013



- Outdated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

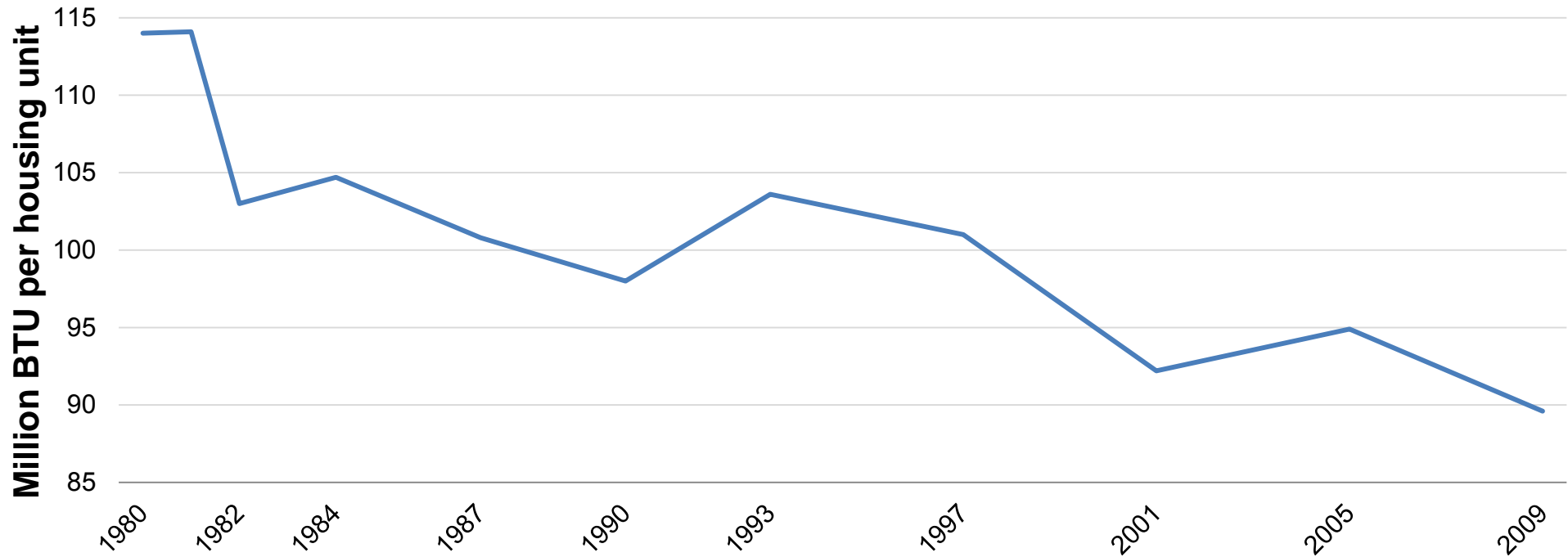
Air conditioner efficiency dramatically increased since 2005

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

Average energy consumption per home



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

- Statistical sampling
 - Use a statistical sample of interval meters to represent a population of residential customers for residential customers with non-interval meters
- Clarify rules for all residential customers
 - More consistency between non-interval meter and interval metered residential customers

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

- Deemed Savings Report and load research studies – not valid after 6/1/2016
- Statistical sampling in real time
 - measurement & verification for compliance/settlements
 - Energy, capacity, SR

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

- Based on actual load response during event - more accurate than study
- Cost effective participation of large, fast responding resource
- More consistency between residential and C&I

- Participation qualifications – to ensure methodology is appropriate for resource
- Sample design and stratification to ensure accurate and representative sample
- Variance study and Measurement & Verification Plan
- Switch operability
- Data validation
- Churn
- Transition mechanism

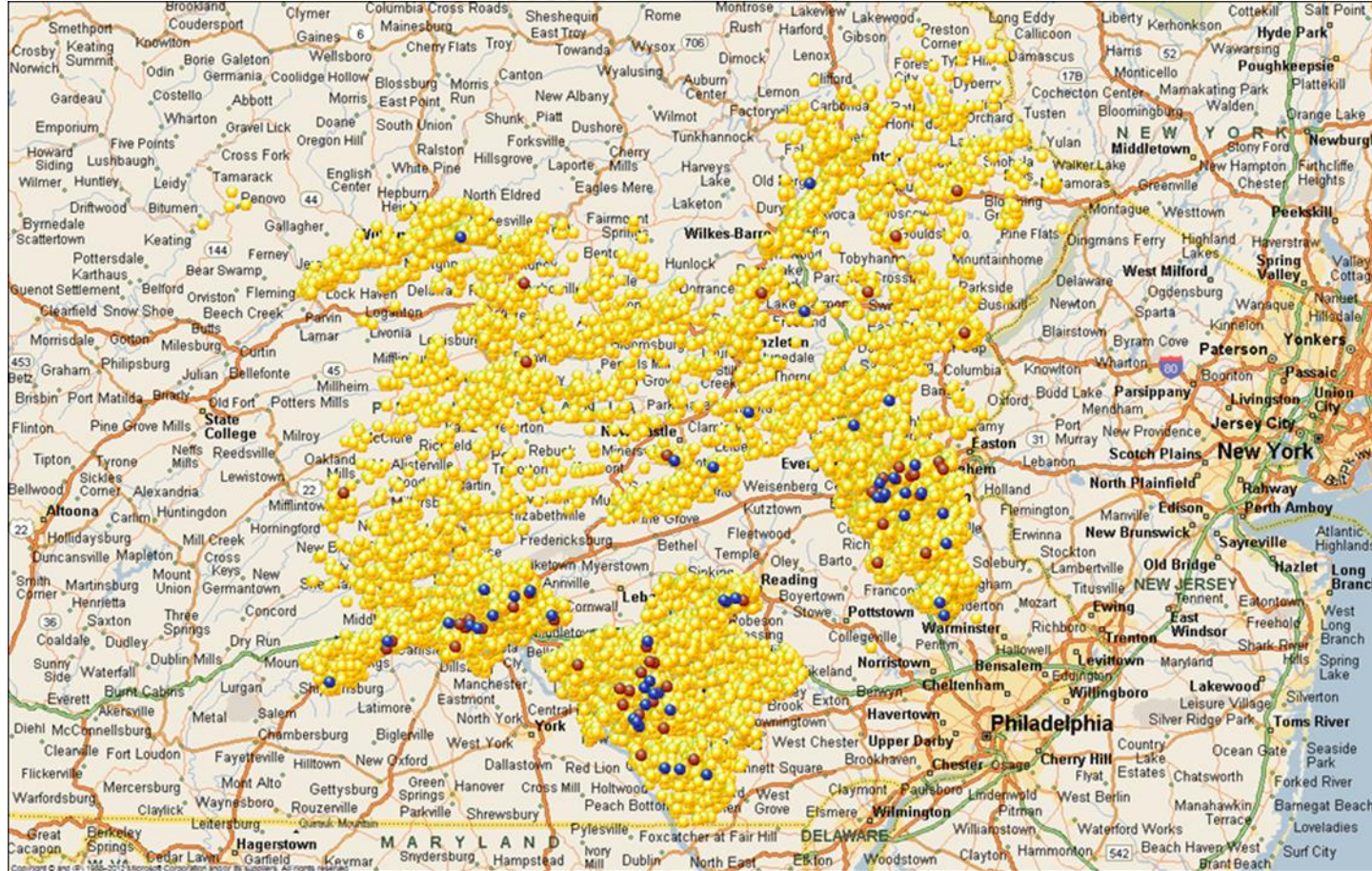
- Load Management (Capacity)
 - Residential direct load control
 - qualifies for load management
 - No interval metering (hourly or better)
- Economic Energy
 - Residential direct load control
 - Qualifies for economic energy markets
 - No interval metering (hourly or better)
- Synchronized Reserves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

- 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

- MRC endorsement: 11/20/2014
- MC endorsement: 1/22/2015
- FERC Filing: 2/15/2015
- Effective date: 6/1/2015
- End of participation under legacy programs: 5/31/2016

APPENDIX

- 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

- 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

- 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

- 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

- 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

- 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 2nd or 3rd IA schedule
 - 17/18 – CSP must notify based on 1st, 2nd 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

- **[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