M&V for Residential A/C Synchronized Reserve

Presentation to PJM DR Subcommittee
23 April 2014

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Outline

- Key Requirements
- Some Relevant Statistical Concepts
- Demand Response in the Capacity and Energy Markets Reporting
- Suggestions for the Sync Reserve Market

Key Requirements

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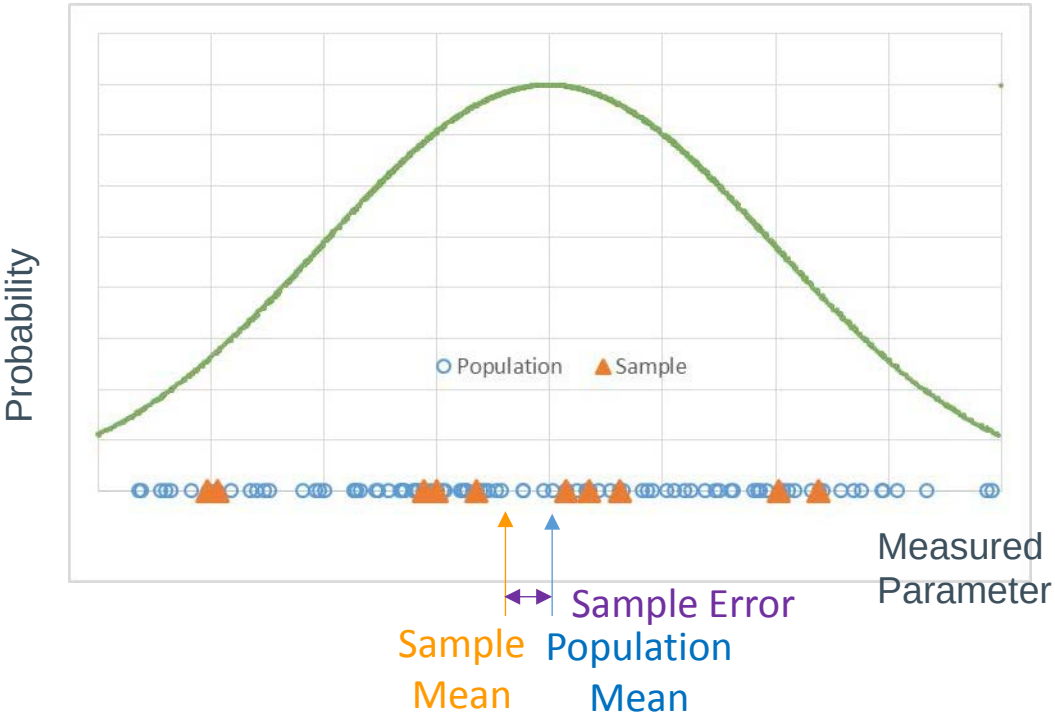
Key Requirements for a Synchronized Reserve Demand Response Capability

- Response time
  - 10 minutes
- Sustained Reduction
  - Maintained the MW reduction through the first 30 minutes

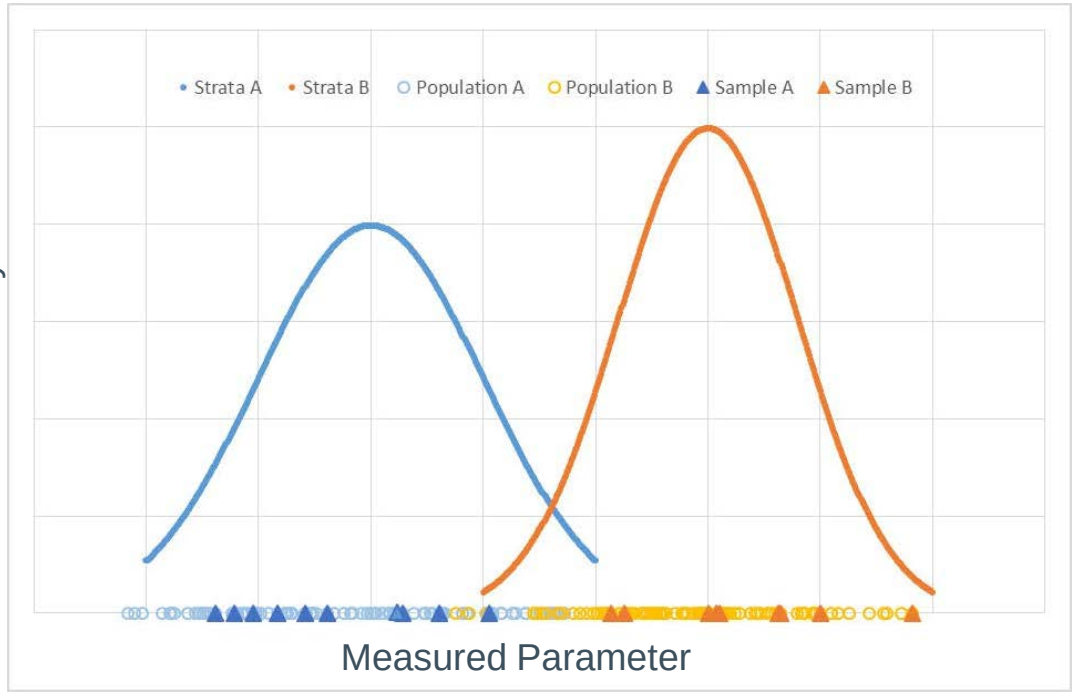
Statistical Concepts

Sampling Concepts



- Sample size is determined by the desired sample error
- Sample size is independent of the population size for large populations
- Sample size is limited by cost

Motivation for Sample Stratification

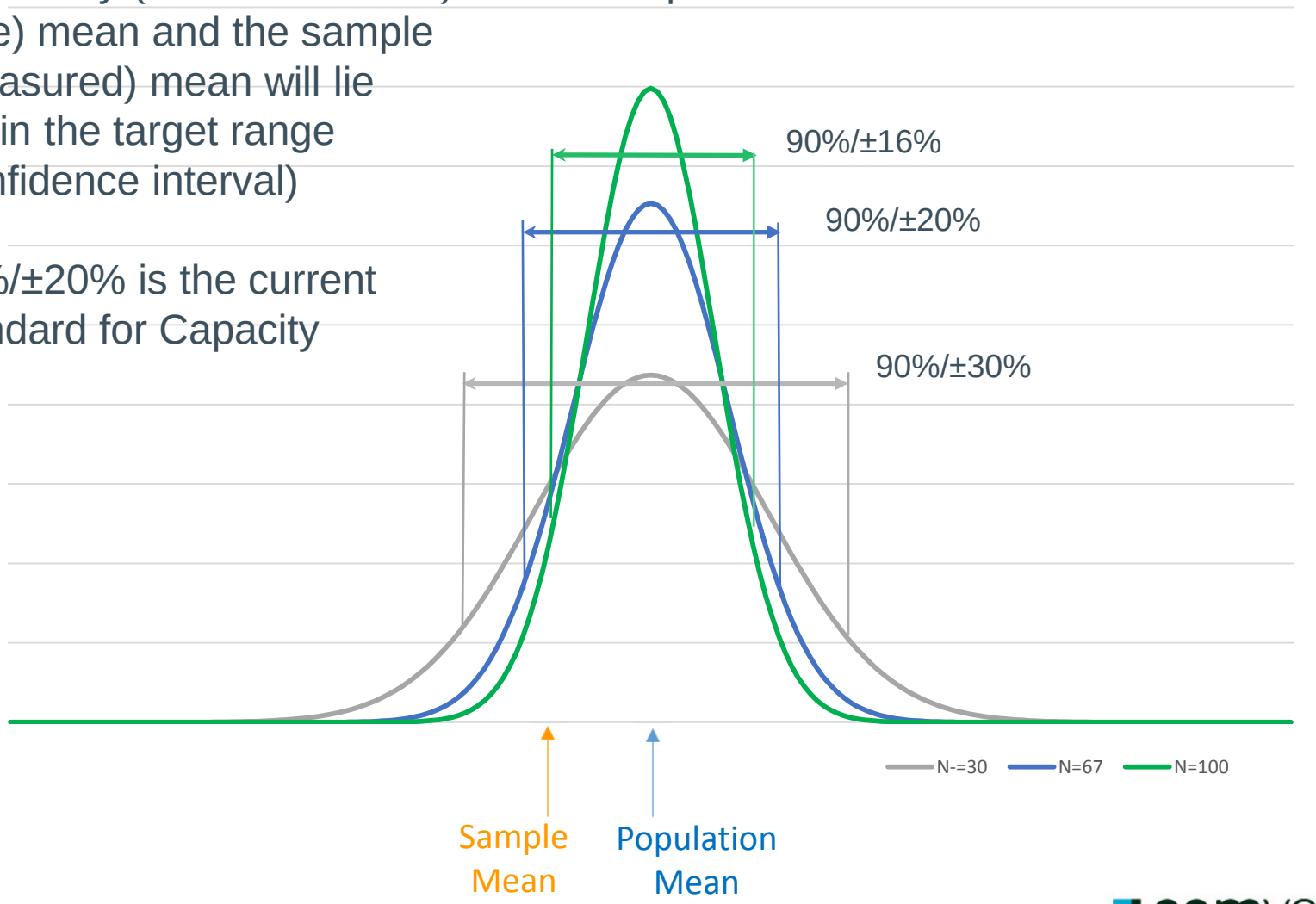


- Known or suspected differences in sub populations
- Provides added assurance that sample is representative
- Potential to reduce required sample size
- Typical stratification for A/C Demand Response
  - Regional
  - Participant type
  - Unit size
  - Device type

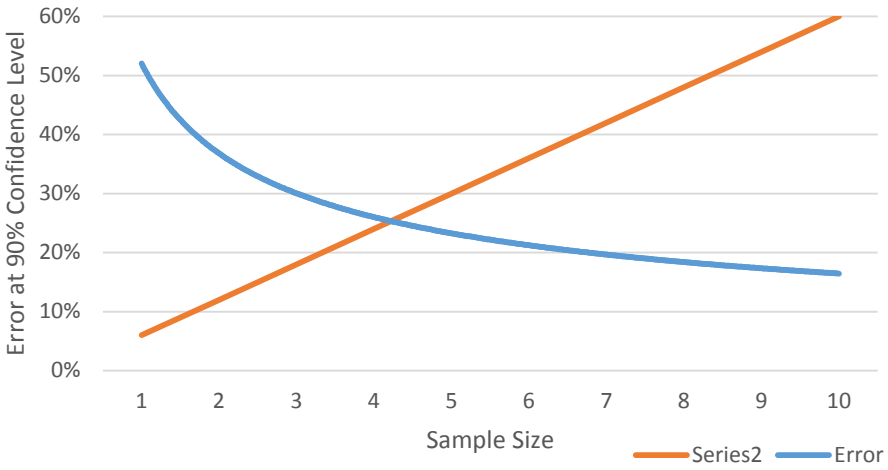
Confidence Level / Confidence Interval

Probability (confidence level) that the Population (true) mean and the sample (measured) mean will lie within the target range (confidence interval)

90%/±20% is the current standard for Capacity



Sample Size



- Minimum Sample Size depends on
  - Desired Confidence Level
  - Desired Confidence Interval
  - Population Variance
  - Population Mean
- Population Mean & Variance is always unknown
  - Use measured sample mean and variance from prior years to determine sample size for subsequent years
- Cost driven by telemetry hardware & recurring communications

Residential A/C Capacity and Energy M&V

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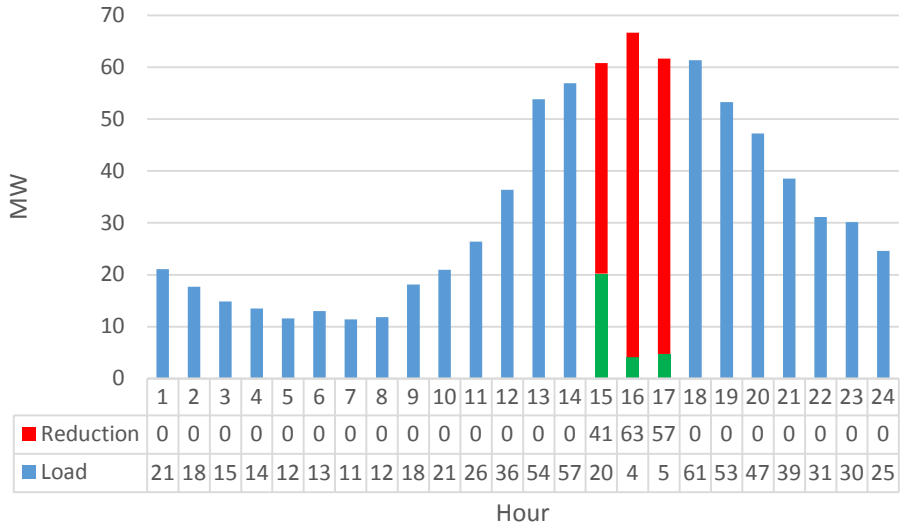
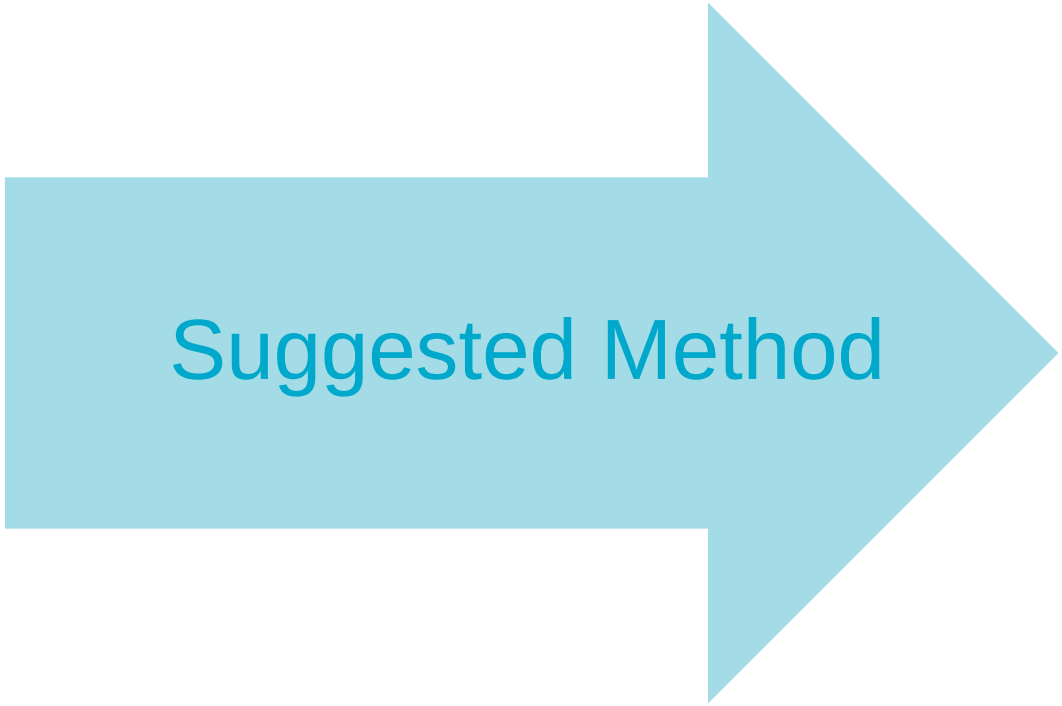
Residential A/C Capacity & Energy Reporting



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Reduction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	63	57	0	0	0	0	0	0	0
Load	21	18	15	14	12	13	11	12	18	21	26	36	54	57	20	4	5	61	53	47	39	31	30	25

- Two Samples typically used for Capacity & Energy
  - Comparison (blue)
  - Curtailed Load (green)
- Difference (red) is the estimated reduction
- Report hourly reduction values

M & V Sampling for Demand Response



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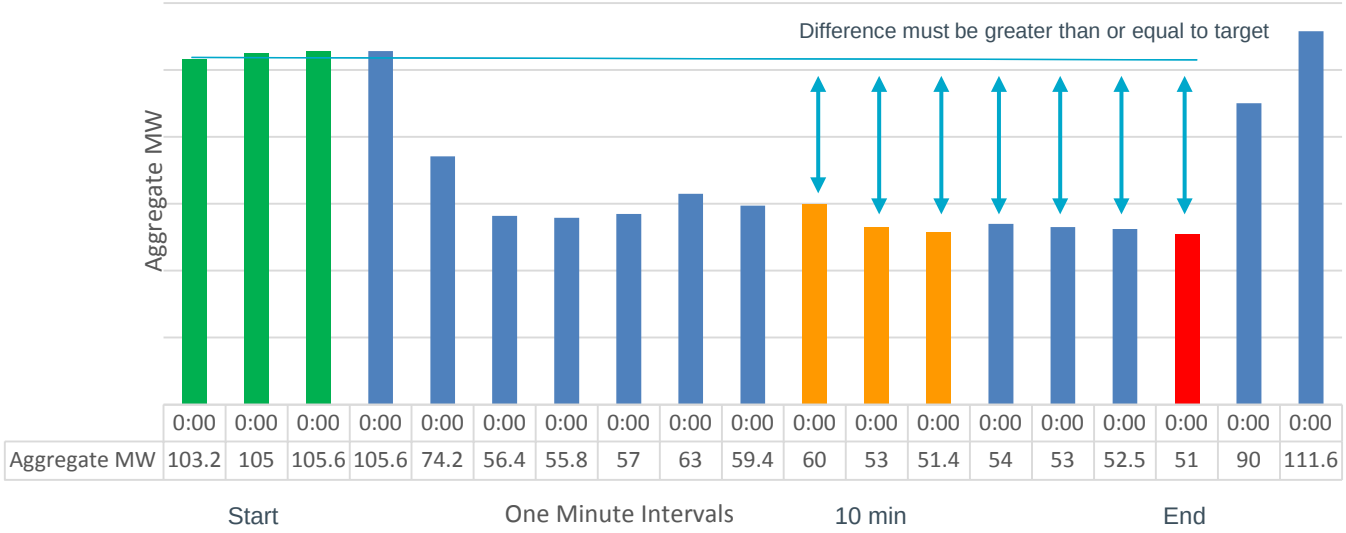
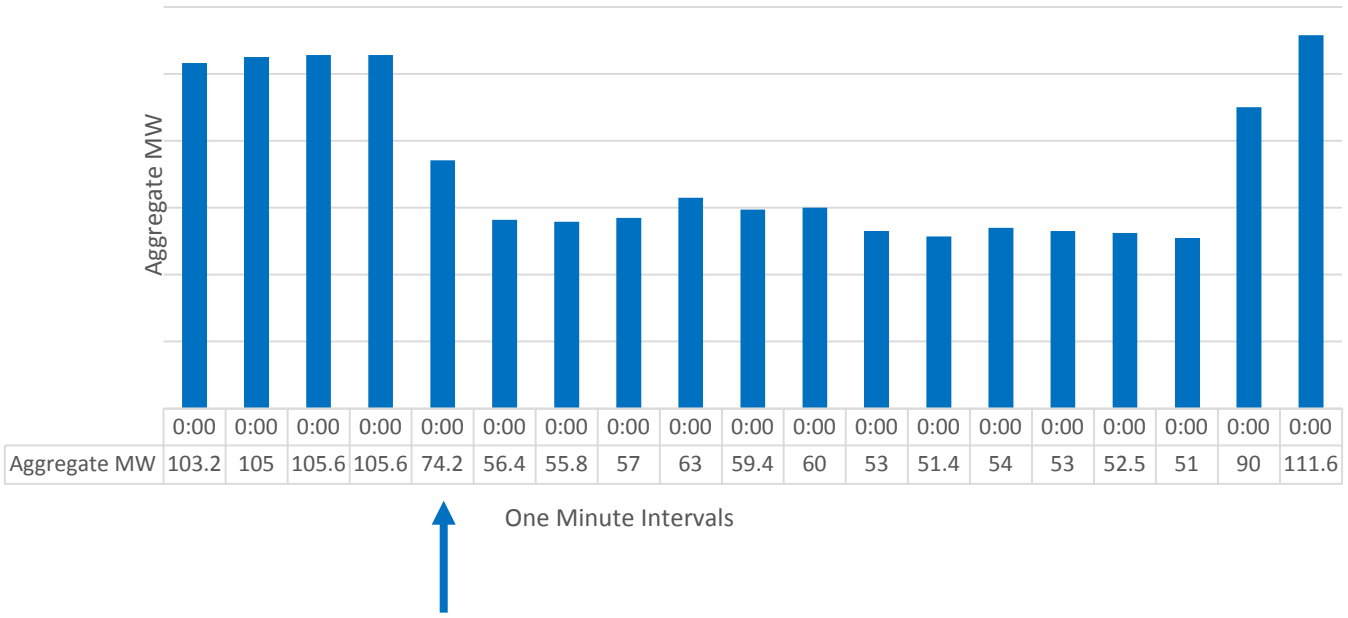
Example of Proposed Synchronized Reserve Reporting



- Aggregate power in one minute intervals reported
- Must reach reduction by 10 minute point
- Consider +/- 1 minute around notification time and 10 minute point
- Maintain reduction until end of event or 30 minutes

Individual One Minute Calculation



- Sum one minute energy measurements (kwh) for each meter in sample
- Divide by sample size
- Multiply by 0.060 (convert to power in MWs)
- Multiply by active participants for the program day (MWs for that minute)
- If AMI is used it would need one minute intervals to verify the 10 minute compliance

Key Issues driving accuracy

- Survey the non meter sampled population to verify switch performance
- Accurately track customer installs and opt-outs
- Verify meter time synchronization and
- Pulse count accuracy by survey

Timely Reporting

- Use mobile phone based telemetry to collect meter data in near real time
- Processing systems to aggregate data automatically
- Daily monitoring of meter data to minimize missing data
- Techs available to investigate any field issues

M & V Sampling for Demand Response

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Summary

- Residential A/C capacity programs have used statistical sampling for many years with good results
- For Residential A/C Synchronized Reserve M&V, one minute interval metering provides the ability to verify compliance with the 10 minute load drop requirement
- Load estimate requirements follow from implementations from Capacity programs

Thank You

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