

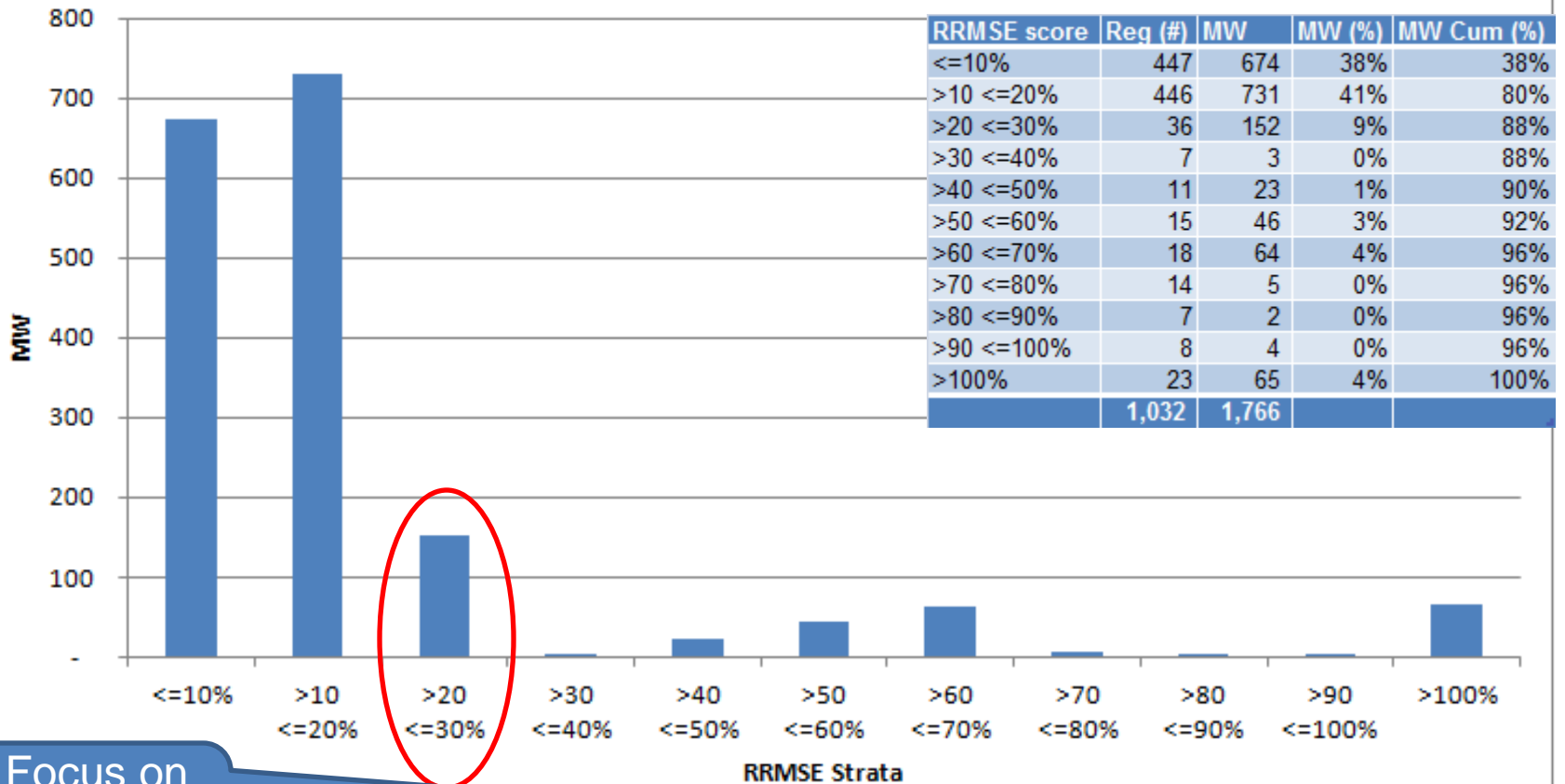


Measurement and Verification for Variable DR Economic Resources

DRS
6/4/2013

- Variable Resources: Load cannot be forecasted accurately
 - If cannot be forecasted, cannot measure load reduction
 - RRMSE >20%
- RRMSE: objective metric to determine accuracy of forecast
 - Average of forecast error squared (%)

MW registered by RRMSE score strata



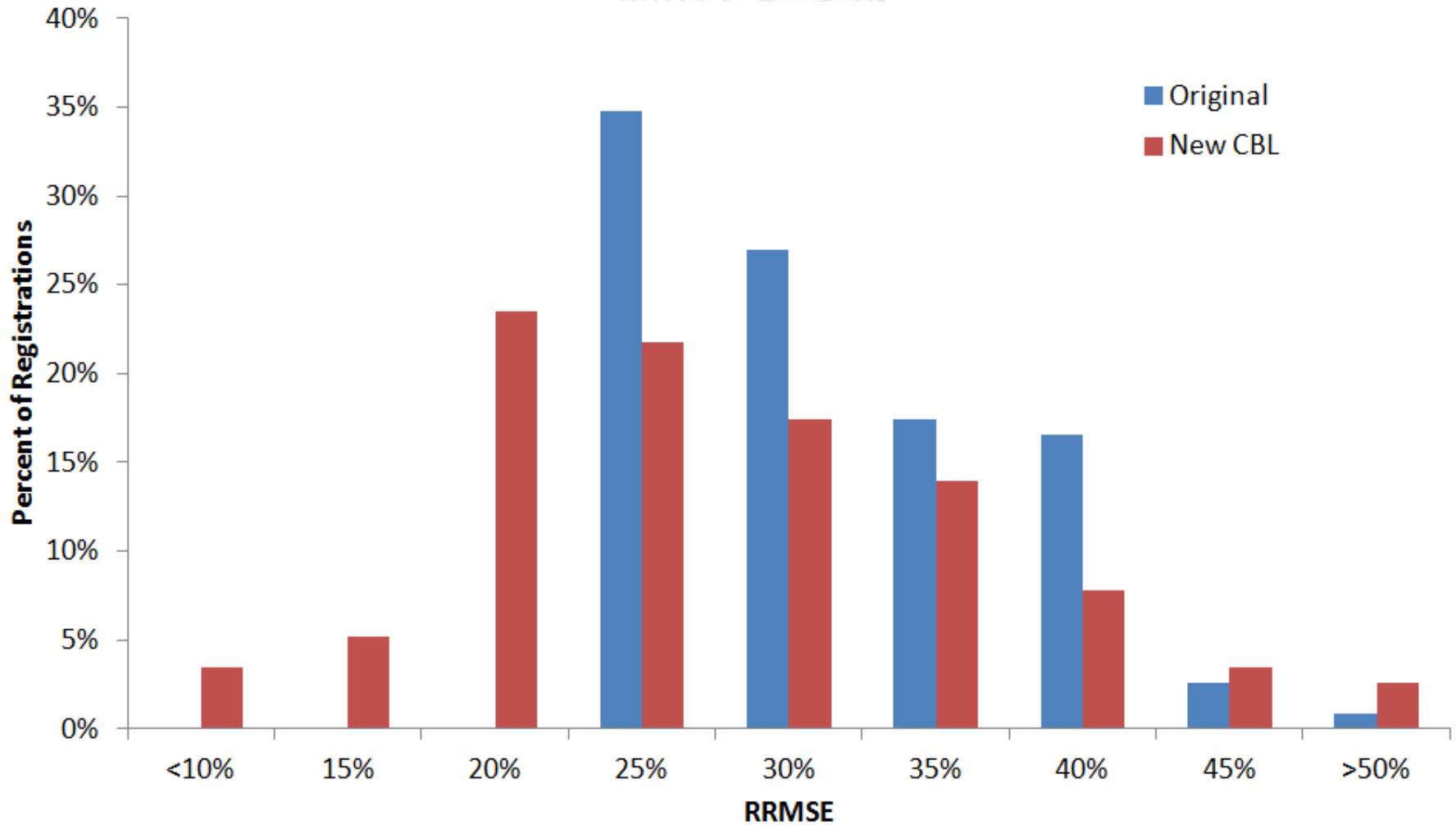
Focus on these customers

- **Max Base Load (MBL)**
 - Developed to accommodate random load which can not be forecast.
 - Dynamic FSL type approach to determine quantifiable load reductions
- **3 Before + 2 After (3+2) - testing approach**
 - Developed to capture intra-day variation where daily usage is fairly consistent but hourly usage is variable
- **7 Day Types (3 day average)**
 - Developed to capture reasonably consistent inter-day variation
 - Monday is fairly consistent but different than Tuesday

- **Inter-day variation**
 - Group like days, compare same hour each day
 - 3 day type: Weekdays, Sat., Sun. + Holidays
 - 5 day type: Tues – Thurs, Mon, Fri, Sat., Sun. + Hol.
 - 7 day type: Sun., Mon., Tues.,....
- **Intra-day variation**
 - Look at one day only, group several hours on each day
- **Both**
 - SAA – Symmetric additive adjustment
 - ARIMA

- 20 CBLs
 - Standard CBL: High 4/5 – 2/3 like days
 - 3 day type: Mean, Mean + SAA (Standard CBL)
 - 25% usage threshold
 - Past 5/5 – 3/3 like days
 - 3 day type: Mean, Median, Mean + SAA, Median + SAA
 - 5 day type: Mean, Median, Mean + SAA, Median + SAA
 - 7 day type: Mean, Median, Mean + SAA, Median + SAA
 - All hours mixed – Mean, Median
 - 3+2
 - ARIMA
 - MBL: Mean, Median
- 115 Registrations
 - RRMSE 20-40% using existing methods

	RRMSE range	Min. RRMSE across existing CBL	Mean - 3 day SAA	Mean 7 day SAA	3 + 2	ARIMA	Min. RRMSE across variable options
Percent of Registrations	<20%	0%	11%	9%	13%	13%	24%
	20%-30%	63%	44%	38%	23%	3%	48%
	>30%	37%	44%	53%	64%	2%	28%
Percent of MW	<20%	0%	2%	2%	32%	6%	33%
	20%-30%	26%	22%	18%	12%	1%	17%
	>30%	74%	77%	81%	56%	0%	50%
Average Bias	<20%		0.9%	-0.3%	-1.6%	-0.9%	
	>30%		3.0%	3.2%	15.9%	2.0%	



- 3 + 2
- 3 Day type (5 of 5, no usage threshold)
- 7 Day type (no usage threshold)
- ARIMA? Work in progress.

- 3 Before + 2 After CBL
 - Average hourly load for 3 hours before event (skip 1 hour before start) plus 2 after (skip 1 hour after)
- Only available upon PJM approval based on:
 - Must be available for dispatch or offer in DA market for at least 4 contiguous hours
 - Another method is not more accurate (including potential for regression model)
 - RRMSE >20% and <=30%
 - Daily usage fairly consistent (intra-day hourly volatility)
 - No significant pre or post change in operations that will impact CBL calculation
 - Thermal load (pre-cooling or snapback)
 - Change in typical operations (including on-site generation schedule)
 - Test results do not have significant positive bias

Worked well for some of the larger loads

- 5 of 5 (non-holiday weekdays) and 3 of 3 (holidays/Sundays or Saturdays)
- Eliminate usage threshold
- 45 day CBL lookback window

Move 13 of 115 registrations from variable to non-variable load (<20%)

- 3 of 3
- CHANGE - Eliminate usage threshold
- 60 day CBL lookback window

- Expect events < 6 hours (longer the event the more difficult it is to predict)
- Inconclusive, but promising results
 - Custom fit for each location and potentially for each settlement
 - Requires 2 months of interval data for each settlement
 - Significant effort/cost to implement in PJM system

- Autoregressive integrated moving average
- Potentially use hours 2, 3, 24, 26, 27
 - For example Hour 2 is hour 2 hour before event
 - Each hour will have different weight based on ability to predict load in the future
 - Weighted moving average