

Estimating Regional and Utility Demand Response Potential - A Case Study at Con Edison

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Overview

- Context
- Approach
- Market Characterization
- Modeling Demand Response Potential
- Simulation Results
- Analysis Considerations Summary

Context

- “increase by 20% current levels of participation in [demand response programs] as registered through Con Edison.¹”

- Con Edison Service Territory
 - > Bronx, Brooklyn, Manhattan, Staten Island, Queens, Westchester County
 - > ~ 3.2 million customers
 - > 2007 peak of 12,807 MW

- Summit Blue Role:
 - > Estimate DR potential
 - > Identify target customer segments
 - > Recommend programs & strategies
 - > Public Service Commission report².

1. Con Edison, Request for Proposal Evaluating Peak Reduction/Callable Load Opportunities in New York City/Westchester County, Request for Quote (Event 14038), September 2007.
2. See CON EDISON CALLABLE LOAD STUDY Submitted To: Consolidated Edison Company of New York (Con Edison) May 15, 2008.

http://www.summitblue.com/dyn_downloads/1224695582.pdf

Approach

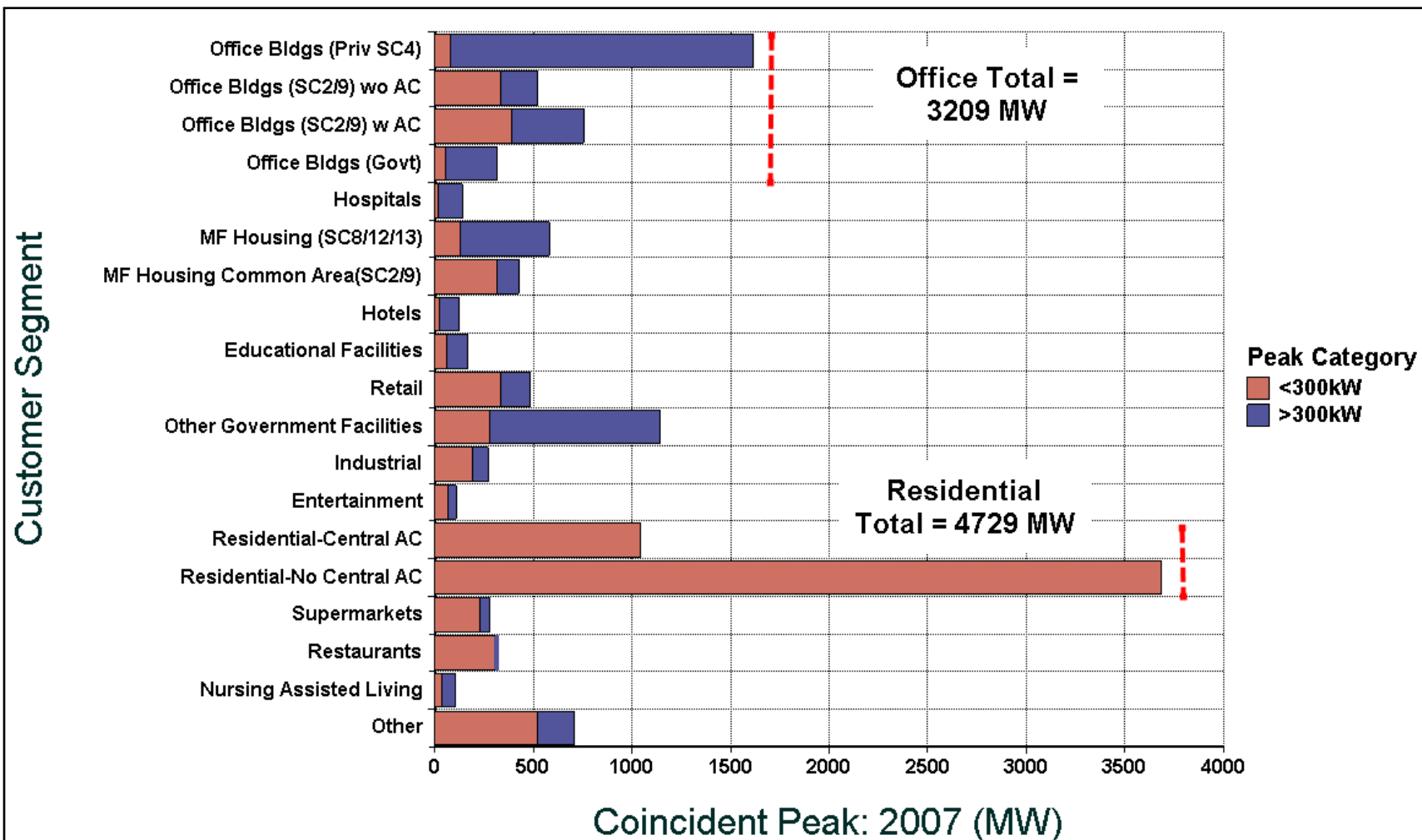
- Agree upon “potential” definitions
- Characterize & segment the market
- Estimate load shed fractions
- Estimate DR potential from emergency generation
- Estimate/calculate key uncertainties
- Monte Carlo simulation & scenario analysis
- Identify gaps and recommend actions

Potential – as defined for this study

- Achievable
 - > That which can reasonably be achieved using a diverse portfolio of demand response programs that address multiple market segments and curtailment methods with reasonable incentives
 - > Combines *participation* and *curtailment ability*
- Technical
 - > Assumed the same load *curtailment ability* as under the achievable scenario, but with 100% *participation*
- Economic
 - > Perspective of the program vs. perspective of participant
 - Difficult to value customer's benefits foregone due to avoided usage
 - Unlike with EE, costs may often be zero for a DR participant
 - > Many DR potential studies ignore Economic Potential altogether
 - > This study focused on benefit/cost tests
 - Utility Cost Test, Total Resource Cost

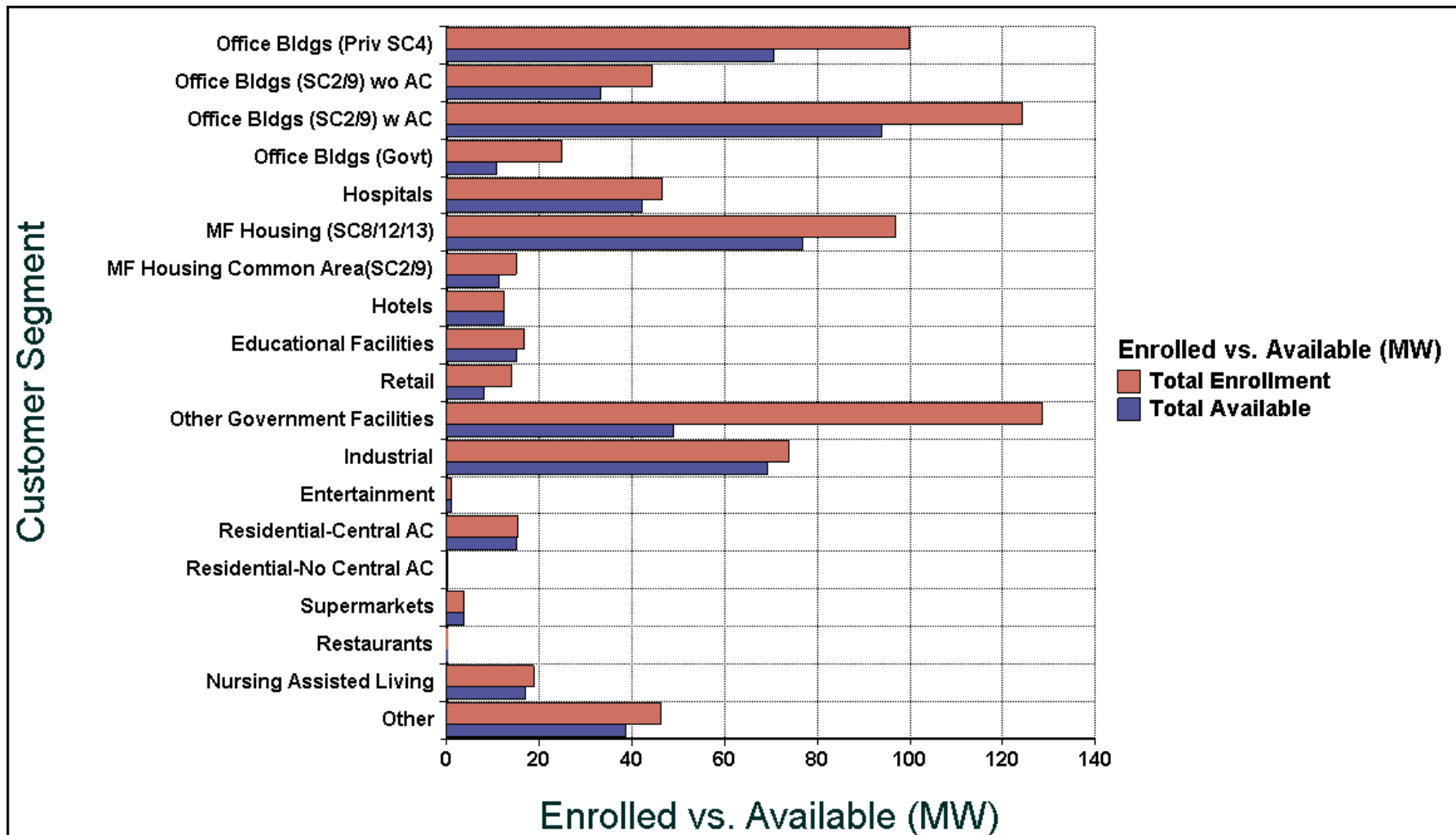
Market Characterization

Customers were segmented to account for differences in participation rates & load shed potential by segment & size category. Demand data & NAICS classification (millions of records) were analyzed.



Market Characterization

For comparison with potential, currently “available” demand response resources must be estimated (considering enrollment overlap and opt-out rates for voluntary and mandatory programs).



Modeling Demand Response Potential



Demand Response Simulator (DRSim) Model



Model Details

Key Input

Input based on analysis of Con Edison data

Non Coincident Peak: 2007	(MW)	Result mid	Edit Table
Coincidence Factor	(fraction)	Result mid	Edit Table
Emergency Gen. Capacity	(MW)	Calc mid	Edit Table
Current Enrollment	(MW)	Result mid	Edit Table

Other Input

Load shed parameters	(fraction)	Edit Table
Load shed parameter weights	(dmnl)	Edit Table
Baseline participation rates	(%)	Edit Table
Participation scenario factors	(dmnl)	Edit Table
Generation participation rates	(%)	Edit Table
Percent of generation eligible	(%)	Edit Table
Percent of capacity connected	(%)	Edit Table
Load growth (over 10 years)	(%/10-year)	Edit Table
Available within 10 minutes	(%)	Edit Table

Key Output

Coincident Peak - 2017 Projection

Coincident Peak: 2017 Proj.	(MW)	Result μ
Total Coinc. Peak: 2017 Proj.	(MW) :	14.9K mid

Callable Load Potential - 2017 Projection

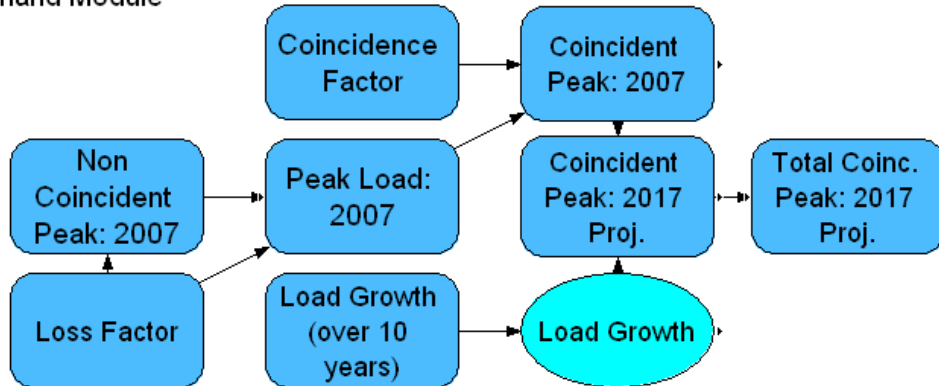
Load Shed	(MW)	Calc μ
Emerg. Generation for DR	(MW)	Calc μ
<hr/>		
Callable Potential	(MW)	Calc μ
<10 minute notification	(MW)	Calc μ
Total Potential	(MW)	Calc ↙
Potential as % of Peak	(%)	Calc ↙

Gap Analysis - Enrolled vs. 2017 Projection

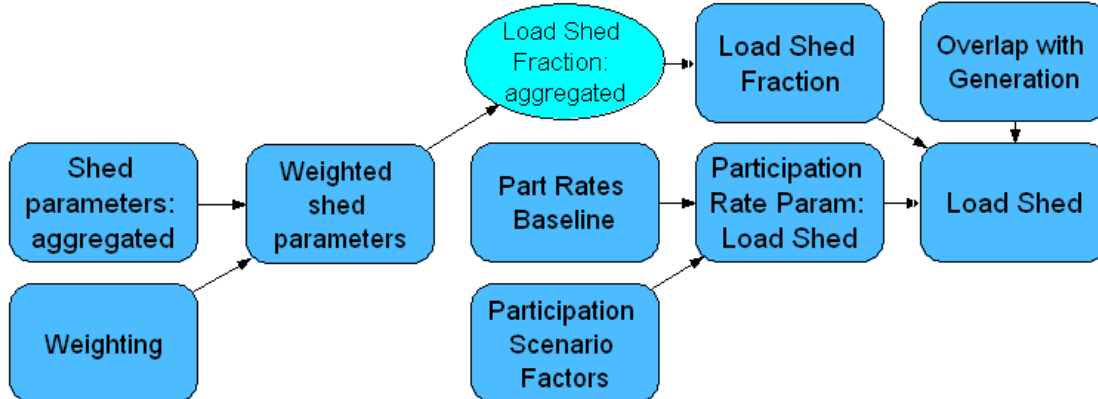
Achievable vs Available	(MW)	Calc μ
"Gap"	(MW)	Calc μ
Total Available vs. Achievable	(MW)	Calc μ

DRSim module examples

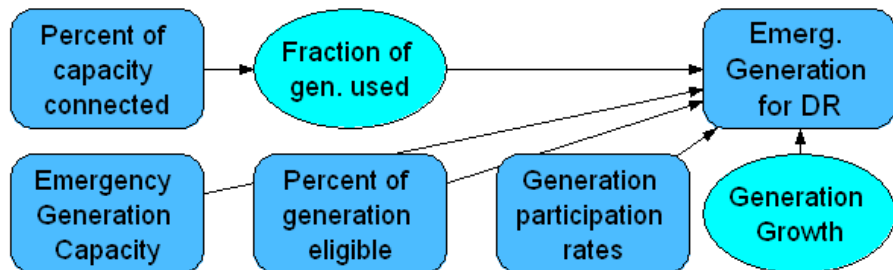
Peak Demand Module



Load Shed Module



Emergency Generation Module



Variables disaggregated by:

Customer segment

(18 customer segments)

Peak Category

(2 size categories -- <300 kW customers, >300 kW customers)

Shed Scenario

(3 scenarios -- High, Medium, Low)

Generation Scenario

(3 scenarios -- High, Medium, Low)

Potential Type

(2 types -- Market, Technical)

Curtailment Type

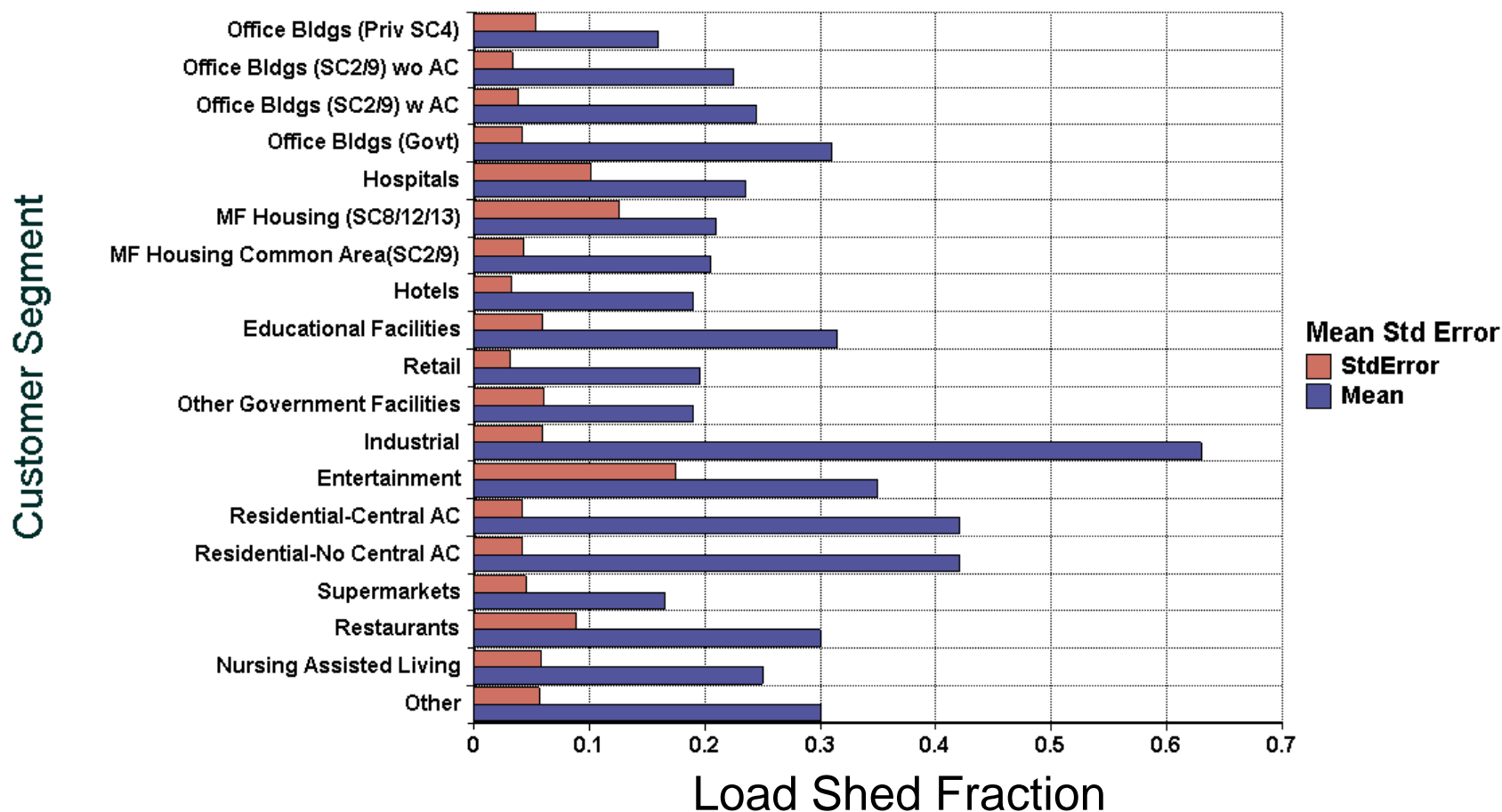
(2 types, Emergency Generation or Load Shed)

Notification Time

(2 categories, <10 min, >10 min)

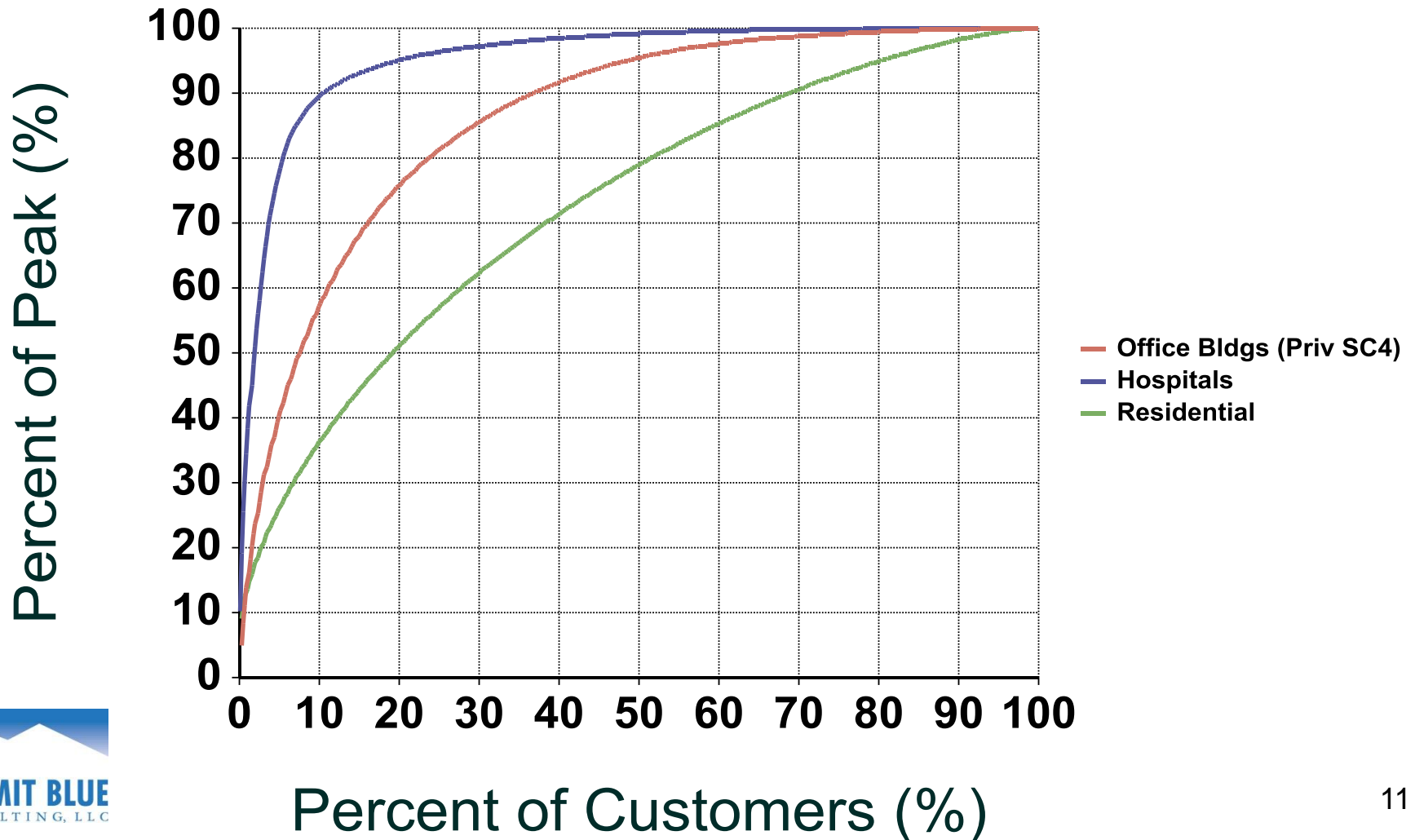
Modeling Demand Response Potential

Load shed fractions were estimated combining literature review results & analysis of individual customer curtailments during actual DR events – cross-checked with survey data.



What is "participation?"

For modeling purposes, participation is defined as the % of peak load enrolled (as opposed to % of customers), since heterogeneity among segments can vary dramatically



Participation Assumptions

Baseline assumed participation rates varied by customer size & segment. Scenario analysis conducted to explore uncertainty in participation rates, which is significant.

Table 4-3. Load Shed Participation Rate (% of kW demand) vs. Peak Demand

Peak Demand Category	Participation Rate (% of kW)
<20kW	10%
20-100kW	10%
100-200kW	15%
200-300kW	20%
300-500kW	30%
500-1000kW	40%
>1000kW	50%

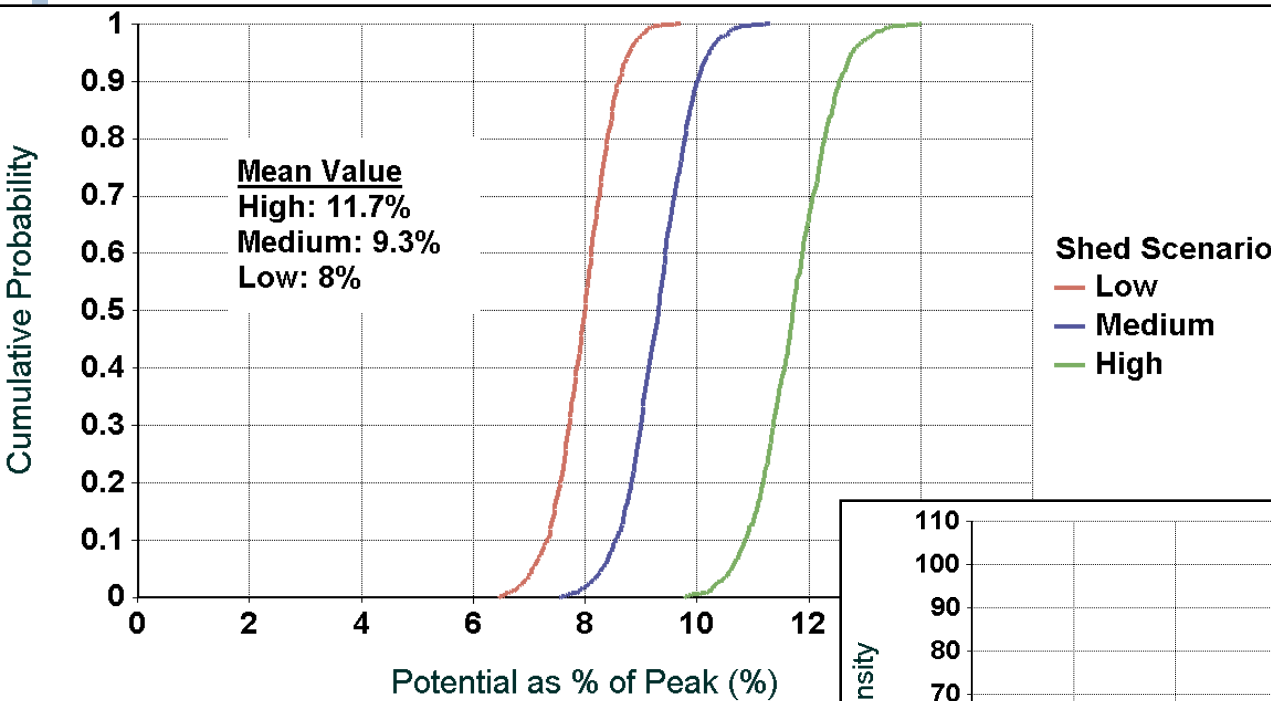
Table 4-4. Load Shed Participation Rates (as a % of peak kW) – Baseline

Customer Segment	Peak Category	
	<300kW	>300kW
Office Bldgs (Priv SC4)	15%	47%
Office Bldgs (SC2/SC9) - w/HVAC	11%	45%
Office Bldgs (SC2/SC9) - w/o HVAC	12%	45%
Office Bldgs (Govt)	15%	48%
Hospitals	13%	48%
MF Housing - (SC8/12/13)	16%	41%
MF Housing Common Area (SC2/9)	11%	43%
Hotels	14%	45%
Educational Facilities	13%	43%
Retail	11%	42%
Other Government Facilities	15%	44%
Industrial	25%	50%
Entertainment	13%	41%
Residential - Central AC	20%	N/A
Residential - No Central AC	0%	N/A
Supermarkets	12%	33%
Restaurants	11%	39%
Nursing Assisted Living	15%	38%
Other	11%	44%

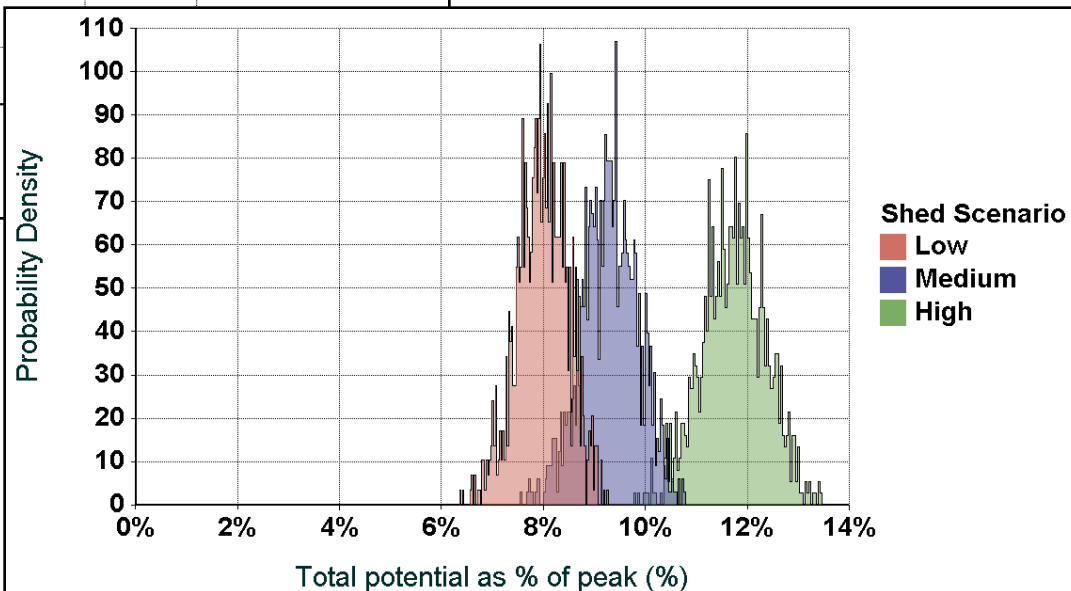
This procedure was not applied to residential customer accounts with central air conditioning, where a 20% participation rate is assumed for the baseline value, based on the experiences of other utilities that have operated long-standing residential DLC programs. Residential accounts without central AC are assumed to have no participation in the base case. Also, the industrial customer segment was assigned a higher participation rate, as industrial customers tend to have unique opportunities for load curtailment and often comprise a disproportionate share of DR program participation.

Simulation Results

“Shed Scenarios” reflect different assumptions regarding participation rates – the largest uncertainty in the estimation of potential.

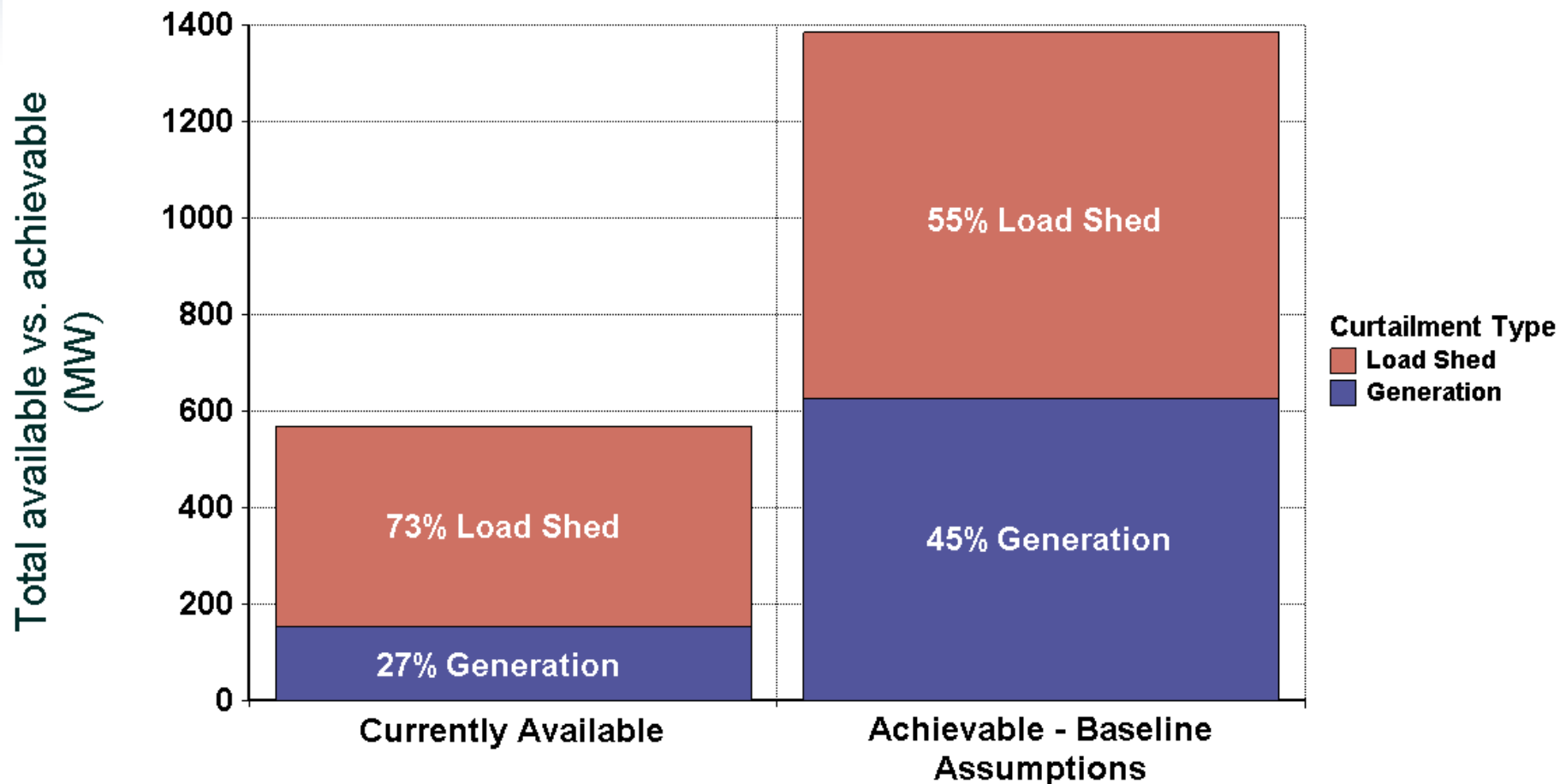


Monte Carlo Analysis:
1000 Runs



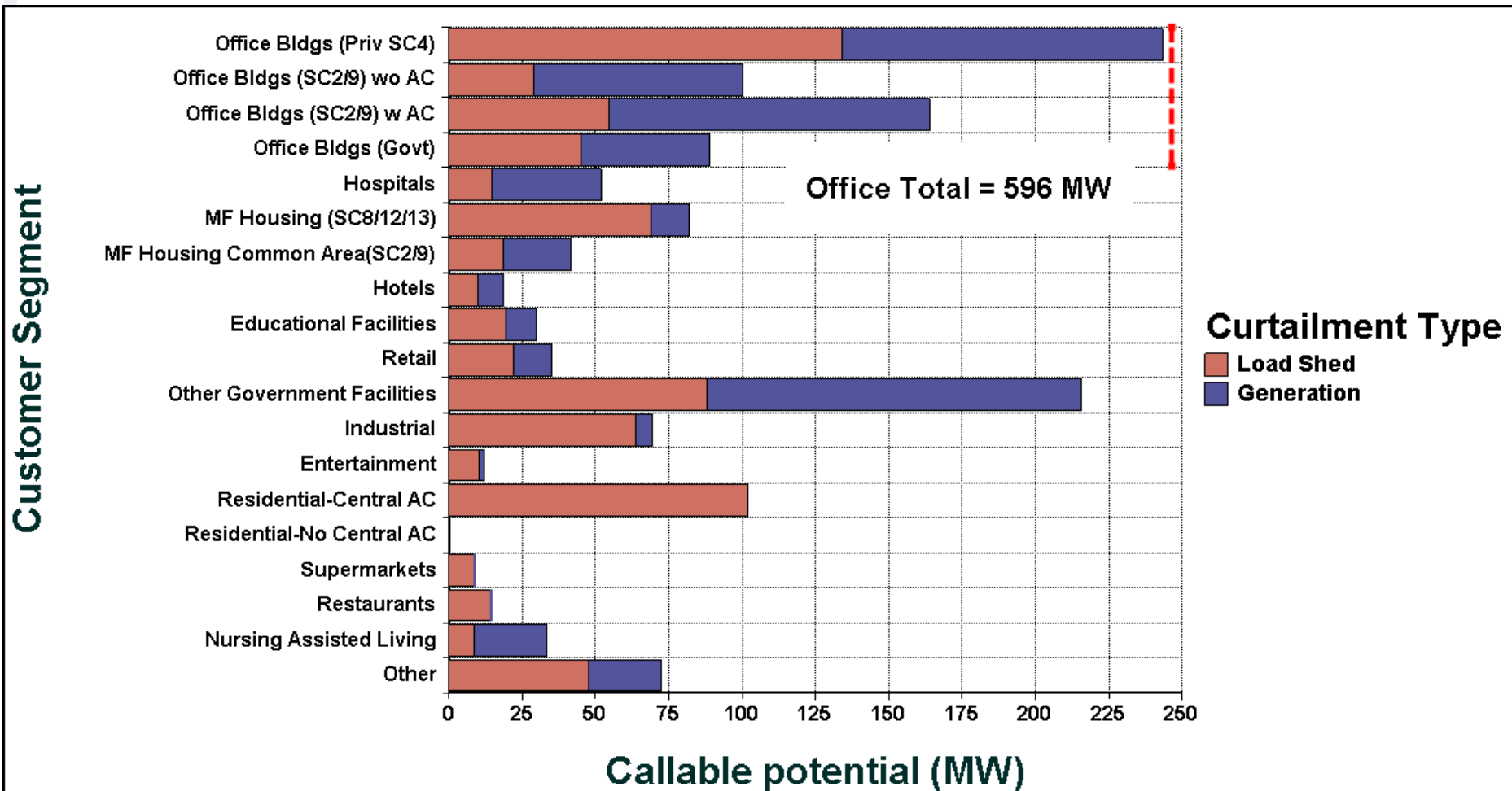
Simulation Results

Significant additional DR resources were determined to be achievable. A growing percentage could come from emergency generation, depending largely on assumptions re: future eligibility (emissions requirements, etc.).



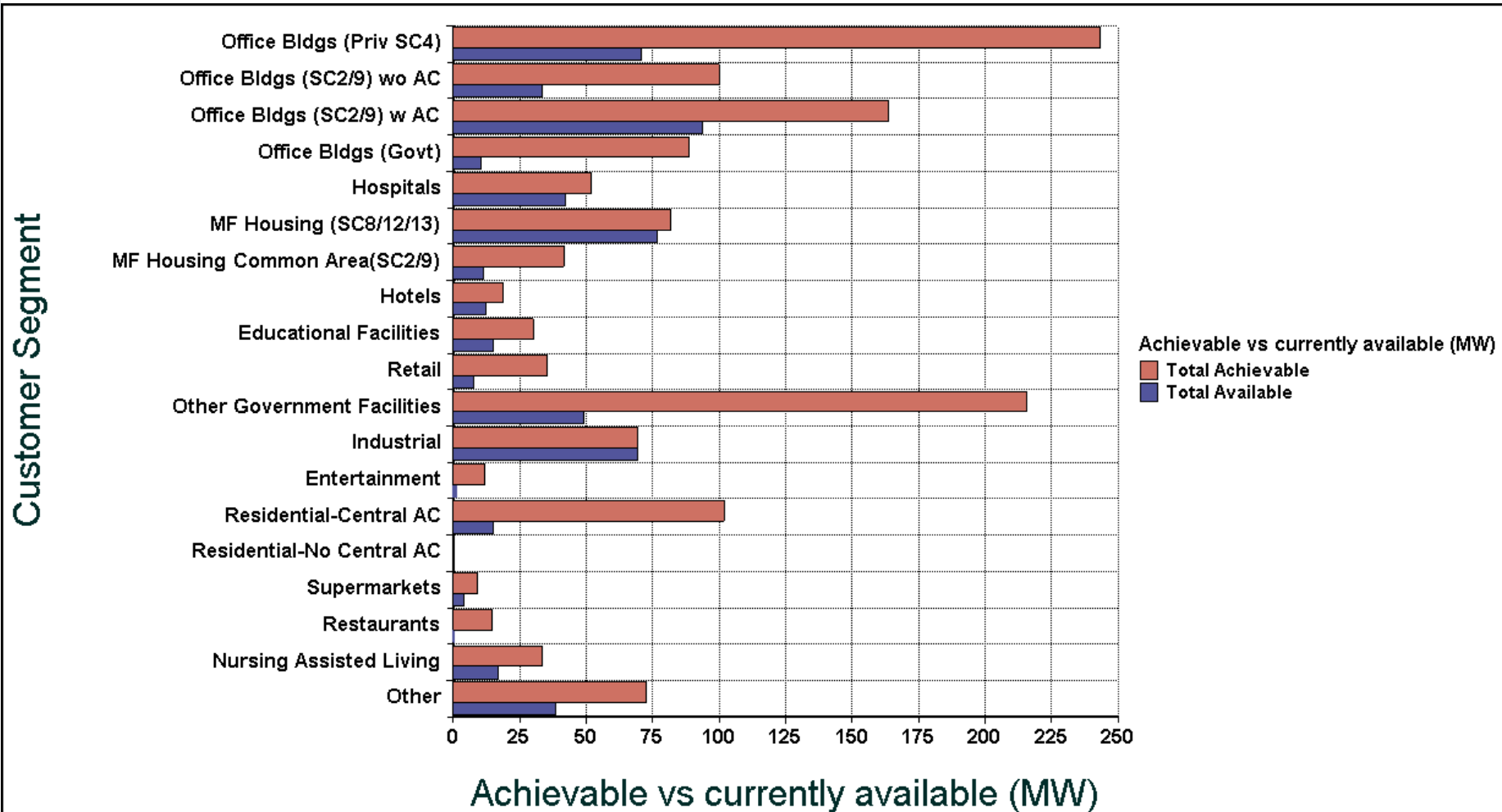
Simulation Results

Significant heterogeneity exists in the breakdown of DR achievable due to curtailment vs. emergency generation.



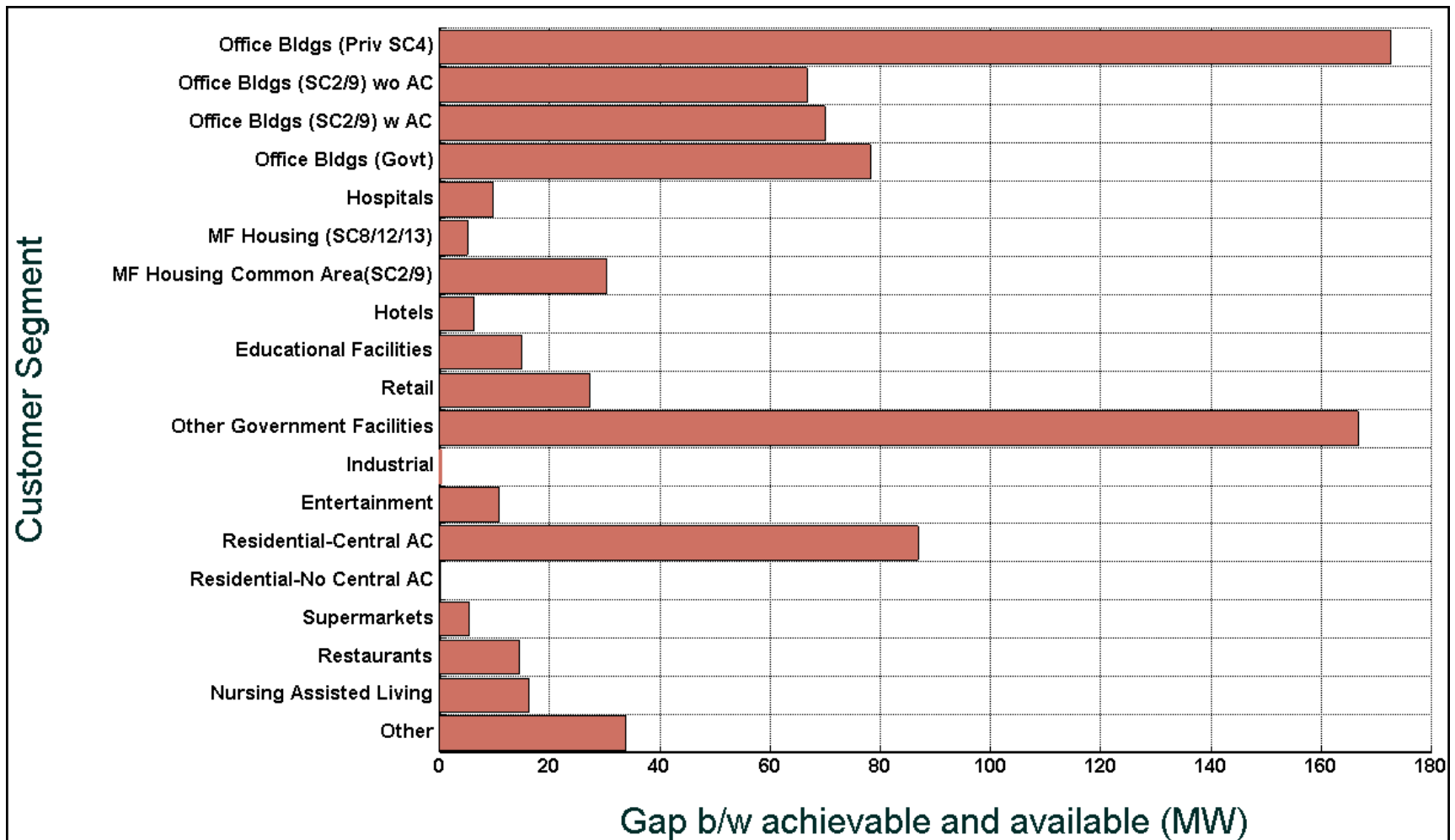
Simulation Results

Industrial and multi-family housing segments may be near saturation, whereas other segments have significant additional DR resources.



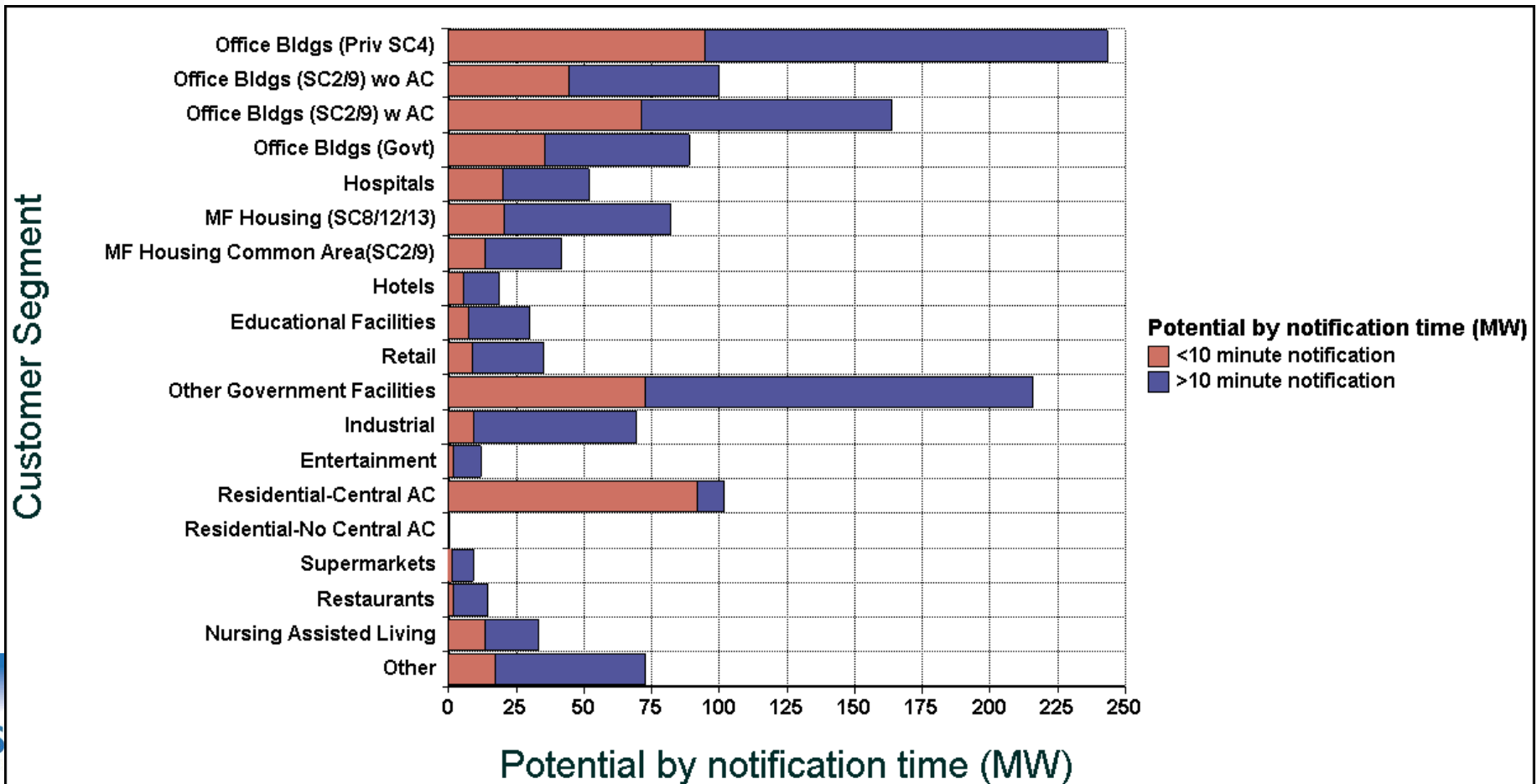
Simulation Results

Office building, government facilities, and residential segments accounted for ~2/3 of the gap between potential and currently available DR resources.



Simulation Results

Identification of DR resources available in short notice (i.e., w/in 10 minutes) is important for valuing the resource (spinning reserves, ancillary services, T&D issues).



Analysis Considerations Summary

- Disaggregation
 - > Customer segment, notification time, customer size

- Emergency generation
 - > Eligibility, connected load, synchronization
 - > Eligibility w.r.t. emissions requirements could largely impact potential

- Uncertainty & false precision
 - > Monte Carlo and/or scenario analysis in lieu of point estimates
 - > Avoid measuring with a micrometer and then cutting with a chainsaw

- Estimating participation
 - > Contributes significant uncertainty to estimates
 - > Most studies provide single, round number estimates
 - > Scenario approach & size/customer segmentation used in this study
 - > Additional research is definitely warranted

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