

Commercial Lighting Controls Metering Study

June 18, 2013



Overview

Study Purpose

Meter and analyze data of commercial lighting equipment to inform MEMD estimates of energy and demand impacts of occupancy sensors.

Two Groups: (1) Participants – controlled lighting, (2) non-participants – no controlled lighting.

Major Findings

- Runtime reduction = 30.7%, extremely close to MEMD estimate of 30%.
- Participants and non-participants differed in terms of facility operating hours, accounted for in runtime reduction.
- Study peak coincidence factor: non-participants = 40.6%, participants = 36.2%, Difference of 4.4%; MEMD = 0%.

Agenda

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**Background and
Objectives**

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Methods

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Results

①

Background and Objectives

Background and Objectives

Study Rationale

- Past impact evaluations suggest the MEMD per-unit savings of occupancy sensors undercount the actual savings.
 - Consumers Energy PY2010 Direct Install Evaluation: Engineering Adjustment Factor (EAF)=1.162
 - Consumers Energy PY2010 Business Solutions Evaluation: EAF=1.60
- Occupancy sensors are expected to be significant contributor of savings for both utilities in 2012-2015 project plans:
 - 10% of the projected electric energy savings for Consumers Energy
 - 14% of the electric energy savings for Detroit Edison

Background and Objectives

Study Objectives

- Metering study to inform MEMD estimates of energy and demand impacts of occupancy sensors for commercial and industrial lighting.
- Study outputs:
 - Lighting hours-of-use (HOU)
 - Peak coincidence factors (CF)
 - Facility operating hours
 - Runtime Reductions (RR)

Background and Objectives

Workpaper Calculations ^a

Annual kWh Savings =

(Watts controlled/1,000) × 3,680 Annual Operating Hours ^b × 30% Runtime Reduction = 1,104 kWh saved

Annual kW Savings =

(Watts Controlled/1,000) × 30% Runtime Reduction × 90% Coincidence Factor = 0.27 kW saved

Summer Peak Savings - None – occupancy sensors may reduce load at peak but not for many applications. Average demand savings are 0.270 kW.“

^a FES-L7 Occupancy Sensors Mich 121608.doc

^b 3,680 assumed for deemed applications; for other applications (e.g., CE Direct Install), one of five levels.

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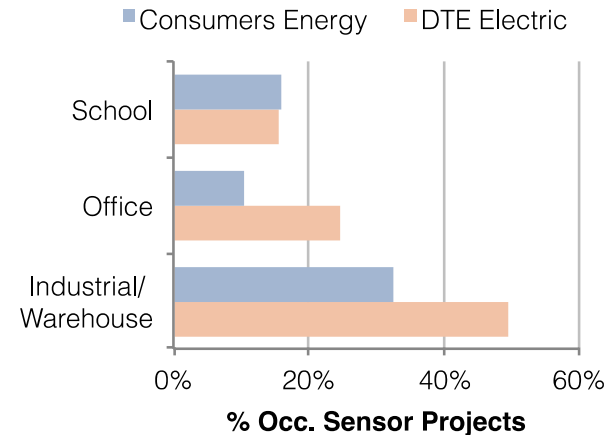
Methods

Methods

Facility Types

In PY2010 and PY2011, in excess of 70% of all occupancy sensors installed through Consumers Energy or Detroit Edison EO programs occurred in three facility types:

1. Industrial/Warehouse
2. Offices
3. Schools



Methods

Two Populations

1. **Participants**: Commercial customers that had an occupancy sensor installed under an EO program in PY2010 or PY2011.
2. **Non-Participants**: Commercial customers with relevant space types that had uncontrolled lighting.
 - Participants were recruited first to determine the list of appropriate space types for non-participant metering.

Methods

Population Data

Both utilities provided data:

1. Participants - All commercial customers that had occupancy sensors installed under an EO program in 2010 or 2011
2. Non-Participants - Complete nonresidential customer population files

The participant data files contained accurate facility type designations; the non-participant files did not

- NAICS and/or SIC codes were mapped to the three eligible facility types in order to develop an initial sample frame
- Extensive screening was conducted during the recruitment phase to ensure the customer represented the appropriate facility type

Methods

Sample Design

Non-Participants

Facility Type	Sample Frame – Non-Participants						Realized Sites						
	CE		DTE		Total		CE		DTE		Total		
	Count	% of Fac. Total	Count	% of Fac. Total	Count	% of Total	Count	% of Fac. Total	Count	% of Fac. Total	Count	% of Total	Total Loggers
Industrial & Warehouse	19,495	61%	12,490	39%	31,985	32%	45	62%	28	38%	73	35%	632
Office Buildings	24,478	39%	38,641	61%	63,119	64%	23	38%	38	62%	61	29%	538
Schools (K-12 & Colleges)	1,990	60%	1,318	40%	3,308	3%	44	59%	30	41%	74	36%	826
Total	45,963	47%	52,449	53%	98,412	100%	112	54%	96	46%	208	100%	1,996

Participants

Facility Type	Sample Frame - Participants						Realized Sites						
	CE		DTE		Total		CE		DTE		Total		
	Count	% of Fac. Total	Count	% of Fac. Total	Count	% of Total	Count	% of Fac. Total	Count	% of Fac. Total	Count	% of Total	Total Loggers
Industrial & Warehouse	308	48%	340	52%	648	66%	33	46%	39	54%	72	41%	519
Office Buildings	70	33%	139	67%	209	21%	15	30%	35	70%	50	33%	319
Schools (K-12 & Colleges)	68	57%	52	43%	120	12%	24	51%	23	49%	47	27%	390
Total	446	46%	531	54%	977	100%	72	43%	97	57%	169	100%	1,228

Methods

Recruitment and Onsite Visit

1. Recruitment

- Customers were contacted via phone and screened to ensure eligibility (i.e., appropriate facility and space types; appropriate lighting equipment).

1. Onsite Visit

- Engineers completed comprehensive inventories of facility space types and lighting equipment.
- Spaces were randomly selected from inventory and loggers (Hobo U09-002 or U12-012) were installed.

Methods

Example Logger Placement



Methods

Study QA/QC

1. Field Engineers

Ride-alongs were conducted with field engineers to ensure quality and consistency across personnel.

2. Site Visit Forms

20% of all forms were reviewed for completeness/accuracy.

3. Logger Data

All logger data was reviewed for technical accuracy of the HOU estimates; bad cases were flagged for further review and eliminated if data was deemed unreliable.

Ultimately, data from 12% of participant loggers and 6% of non-participant loggers were dropped; 3% of participant loggers and 1% of non-participant loggers were unable to be recovered.

Methods

Weighting

Two forms of weights were used for aggregating data for this study:

1. **Wattage of logged space**

- Accounts for the variability in the size of the lighting equipment

2. **Design weights**

- Accounts for facility type stratification in the research design

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Results

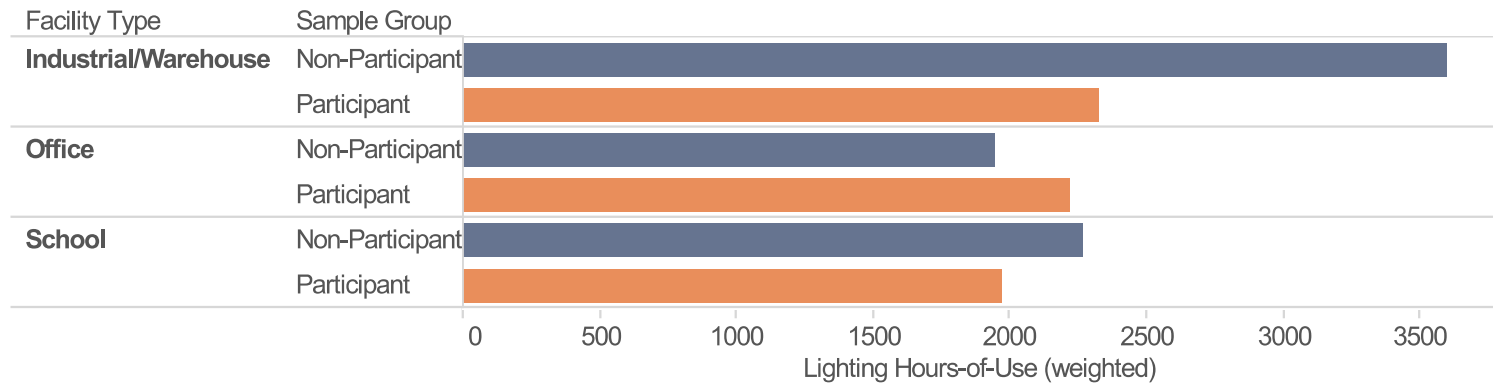
Results

Descriptives

- **Facility Types:** Industrial & Warehouse, Office, School
- **Space Types:**
 - Break Room
 - Cafeteria (Schools-only)
 - Classroom (Schools-only)
 - Conference Room
 - Gym (Schools-only)
 - Hallway
 - Kitchen
 - Library/CPU (Schools-only)
 - Office-Enclosed
 - Office-Open
 - Production (Industrial, Office only)
 - Restroom
 - Storage/Closet
 - Warehouse (Industrial, Office only)
 - Other
- 3,224 total loggers deployed
- Loggers deployed for 42 days on average
- Data collected for 135,921 days in total

Results

Lighting Hours-of-Use



Hours-of-Use (weighted) for each Sample Group broken down by Facility Type. Color shows details about Sample Group.

Lighting Hours-of-Use (HOU)

= Logged hours (annualized) that the lighting was on

Results

Overall Average Lighting HOU *

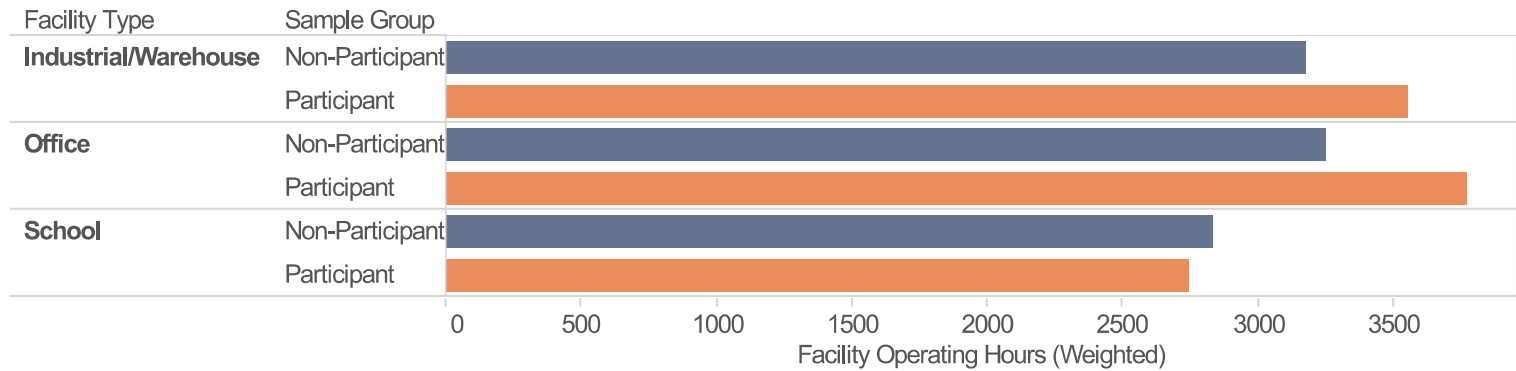
Sample Group	Lighting Hours-of-Use
Non-Participants	2,878.74
Participants	2,218.57
Difference	660.16

22.9% reduction in HOU

* Values shown weighted by wattage and design weights.

Results

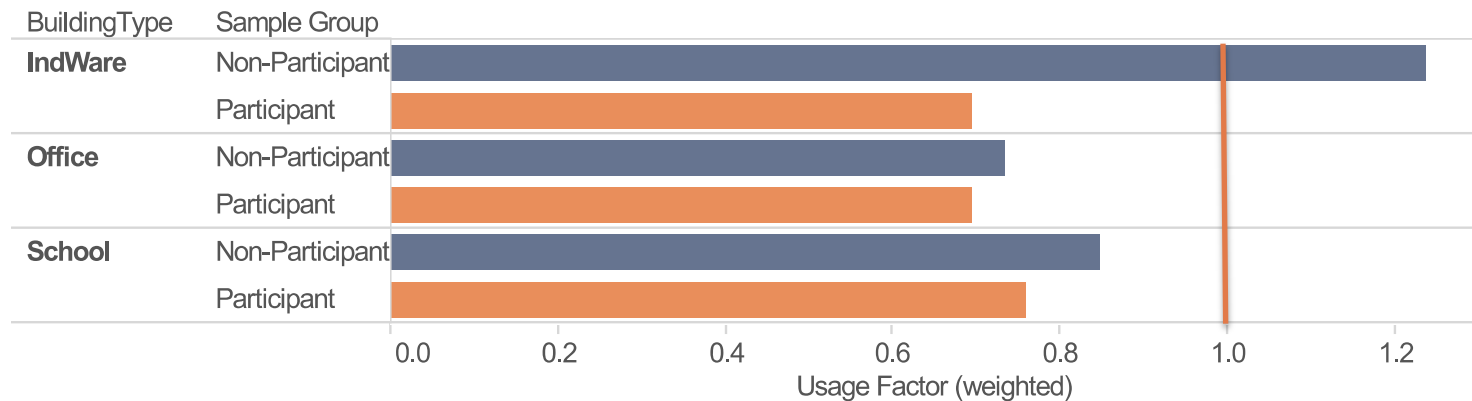
Facility Operating Hours



Facility Operating Hours (Weighted) for each Sample Group broken down by Facility Type. Color shows details about Sample Group.

Results

Lighting Usage Rates

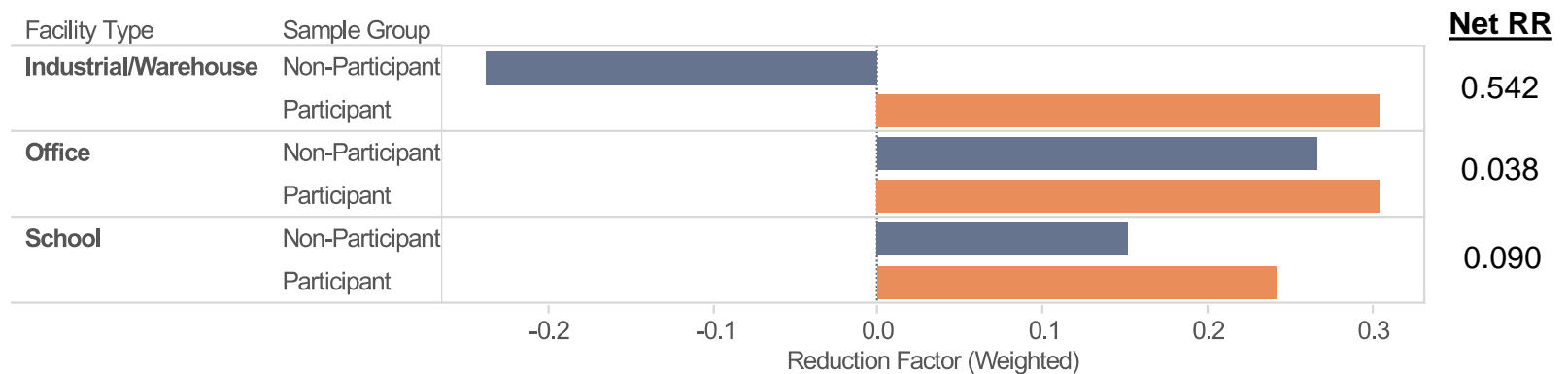


Usage Factor (weighted) for each Sample Group broken down by BuildingType. Color shows details about Sample Group.

Lighting Usage Rate
= Percent of facility operating hours that lights are on
= $\text{HOU} / \text{Facility Operating Hours}$

Results

Runtime Reductions



Reduction Factor (Weighted) for each Sample Group broken down by Facility Type. Color shows details about Sample Group.

Runtime Reduction

= Percent of facility operating hours that the lights are off

$$= 1 - (\text{HOU} / \text{Facility Operating Hours})$$

$$= 1 - \text{Lighting Usage Rate}$$

Results

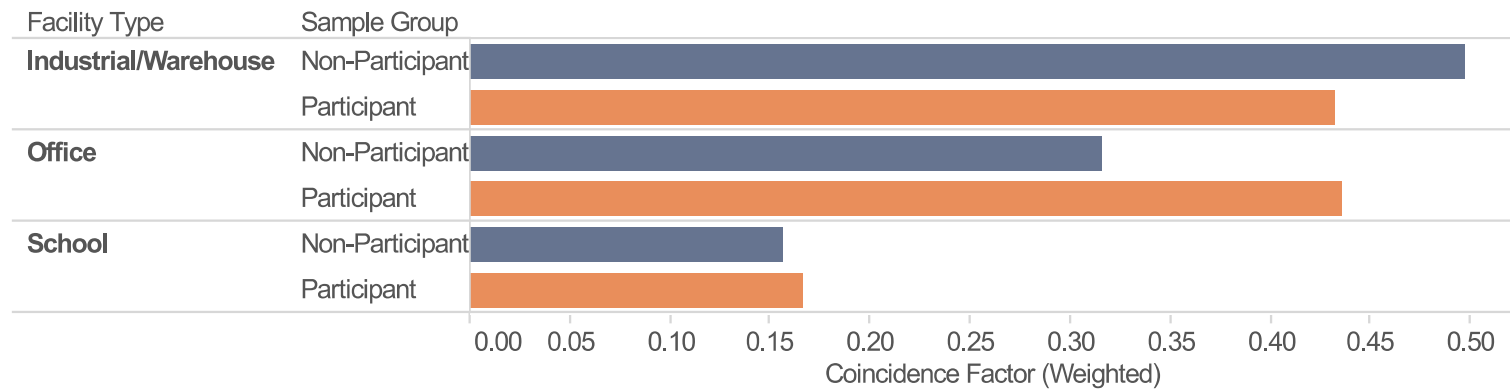
Overall Runtime Reductions *

Sample Group	Runtime Reduction
Non-Participants	-0.019
Participants	0.288
Net Factor	0.307
MEMD Assumption	0.300

* Values shown weighted by wattage and design weights.

Results

Peak Coincidence Factors



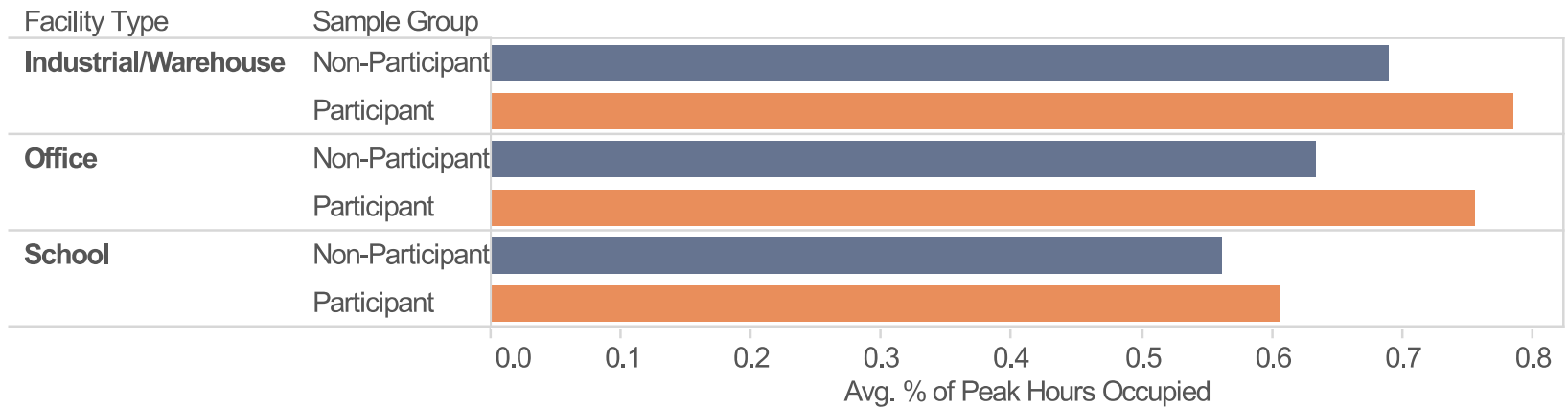
Coincidence Factor (Weighted) for each Sample Group broken down by Facility Type. Color shows details about Sample Group.

Peak Coincidence Factors

= Percent of peak period (3-6PM) that lights were on

Results

% Peak Period Occupied



Average of % of Peak Hours Occupied for each Sample Group broken down by Facility Type. Color shows details about Sample Group.

% Peak Period Occupied

= Percent of peak period (3-6PM) that the facility has operating hours

Results

Overall Peak Coincidence Factors *

Sample Group	CF
Non-Participants	0.406
Participants	0.362
Net	0.044
MEMD Assumption	0.000

Note that the differences between the participant and non-participant facility operating hours suggest this is likely a *minimum* net difference – the precise net difference cannot be determined from this study.

* Values shown weighted by wattage and design weights.

Conclusions

Conclusions

- Runtime reduction = 30.7%, extremely close to MEMD estimate of 30%.
- Participants and non-participants differed in terms of facility operating hours, accounted for in runtime reduction.
- Study peak coincidence factor: non-participants = 40.6%; participants = 36.2% → net decrease = 4.4%. MEMD = 0%.
 - The kW savings claimed via the MEMD *IS NOT* peak coincident savings; it is average demand savings—this should be changed since MISO will require peak demand

Questions?

Contact Info

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Appendices

Average HOU by Facility & Space Type

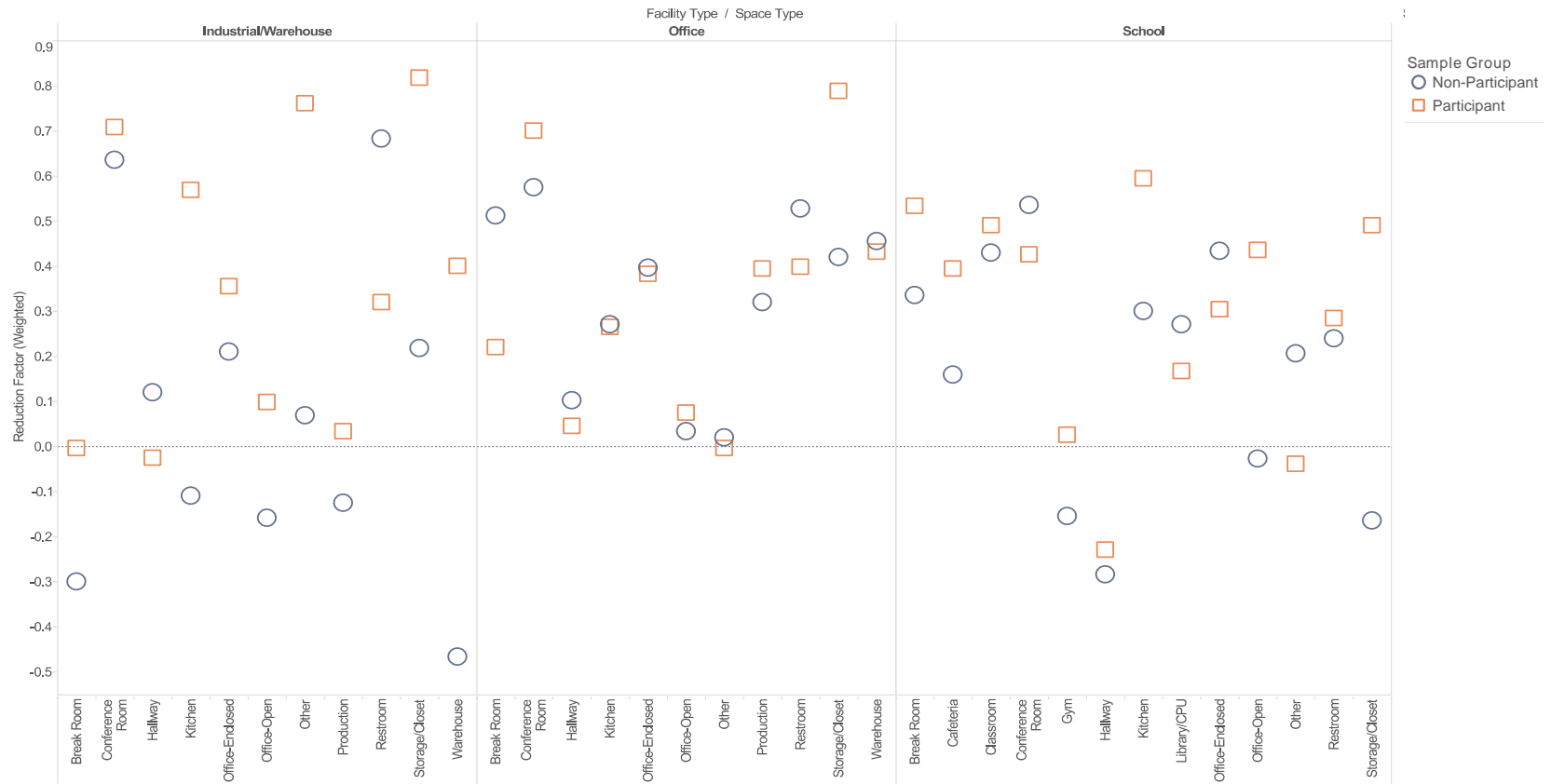
Average HOU by Facility and Space Type



Hours-of-Use (weighted) for each Space Type broken down by Facility Type. Color shows details about Sample Group. Shape shows details about Sample Group.

Average RR by Facility & Space Type

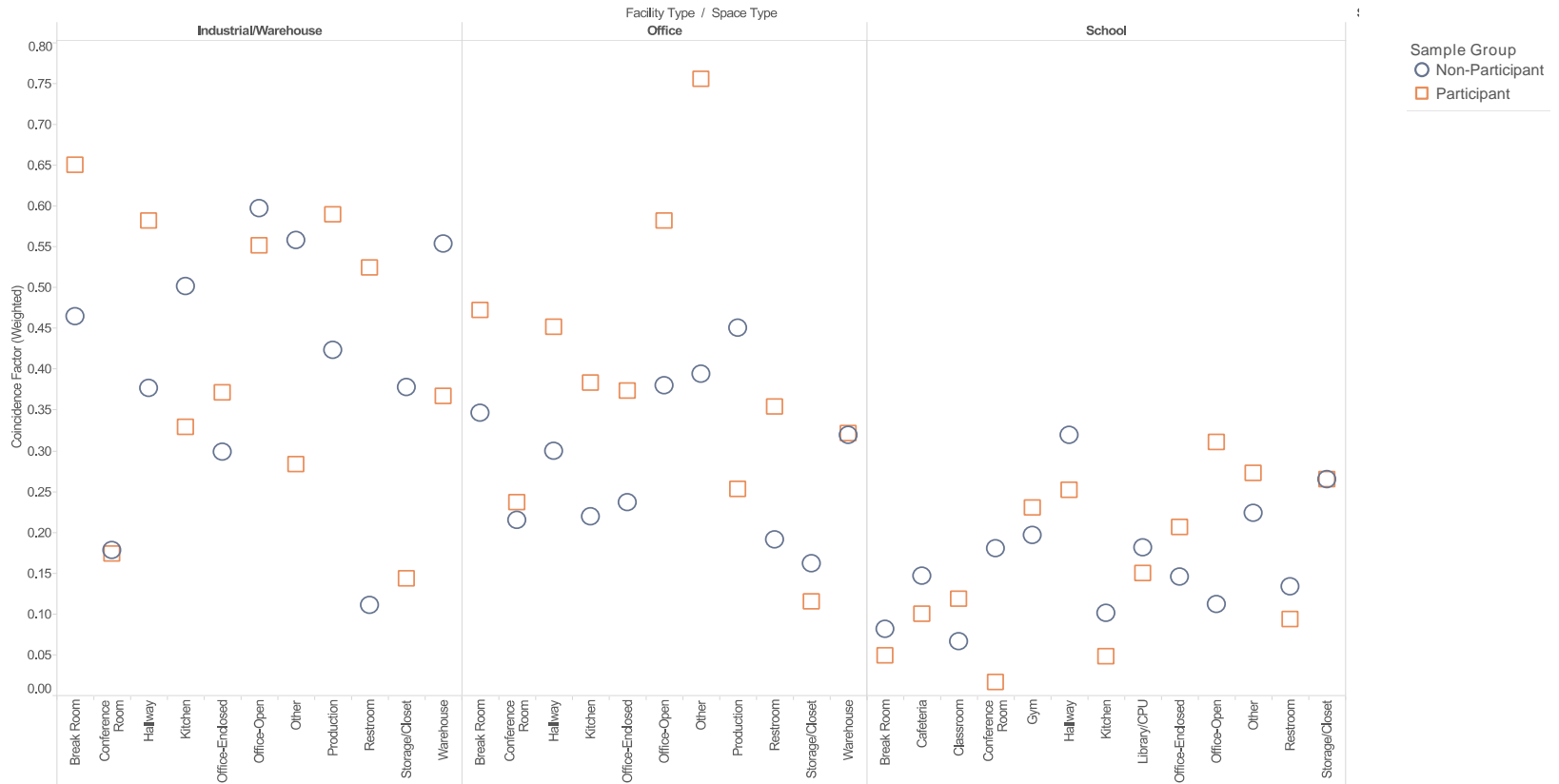
Average Runtime Reduction by Facility and Space Type



Reduction Factor (Weighted) for each Space Type broken down by Facility Type. Color shows details about Sample Group. Shape shows details about Sample Group.

Peak CF by Facility & Space Type

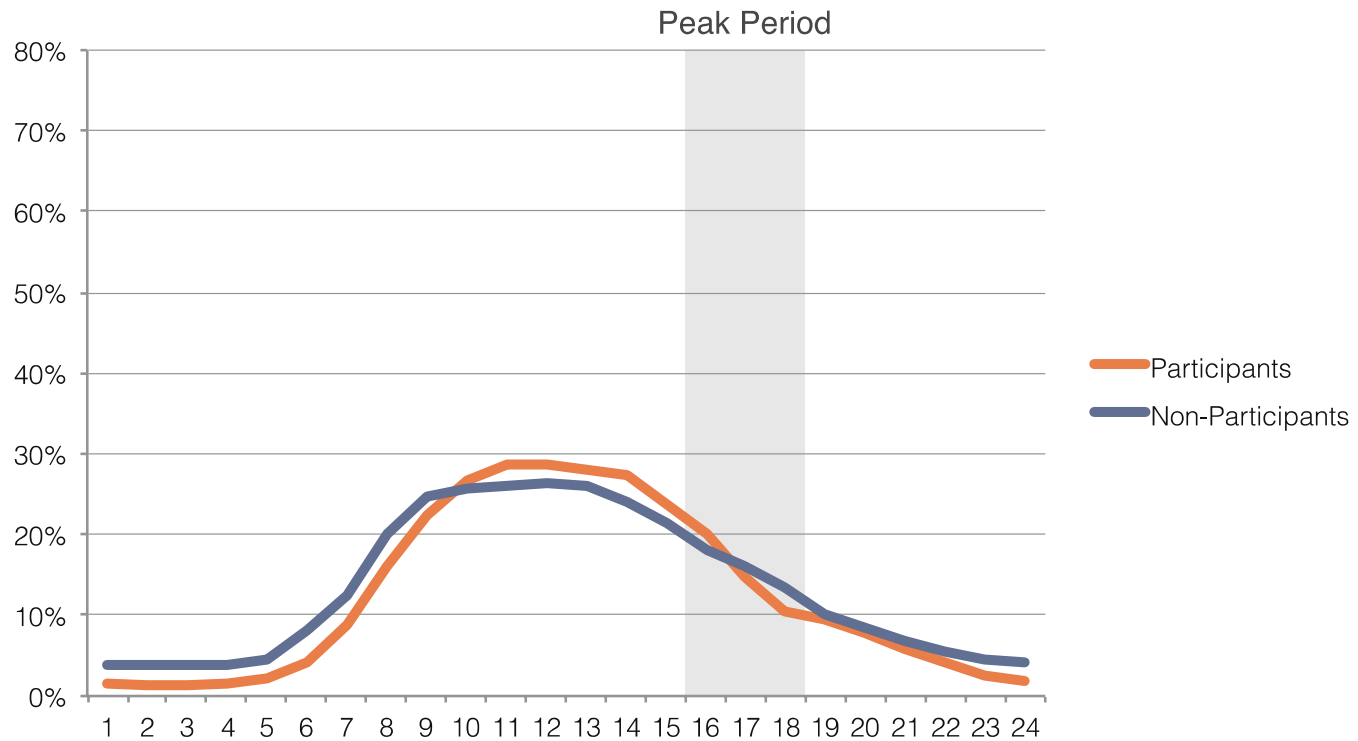
Average Peak CF by Facility and Space Type



Coincidence Factor (Weighted) for each Space Type broken down by Facility Type. Color shows details about Sample Group. Shape shows details about Sample Group.

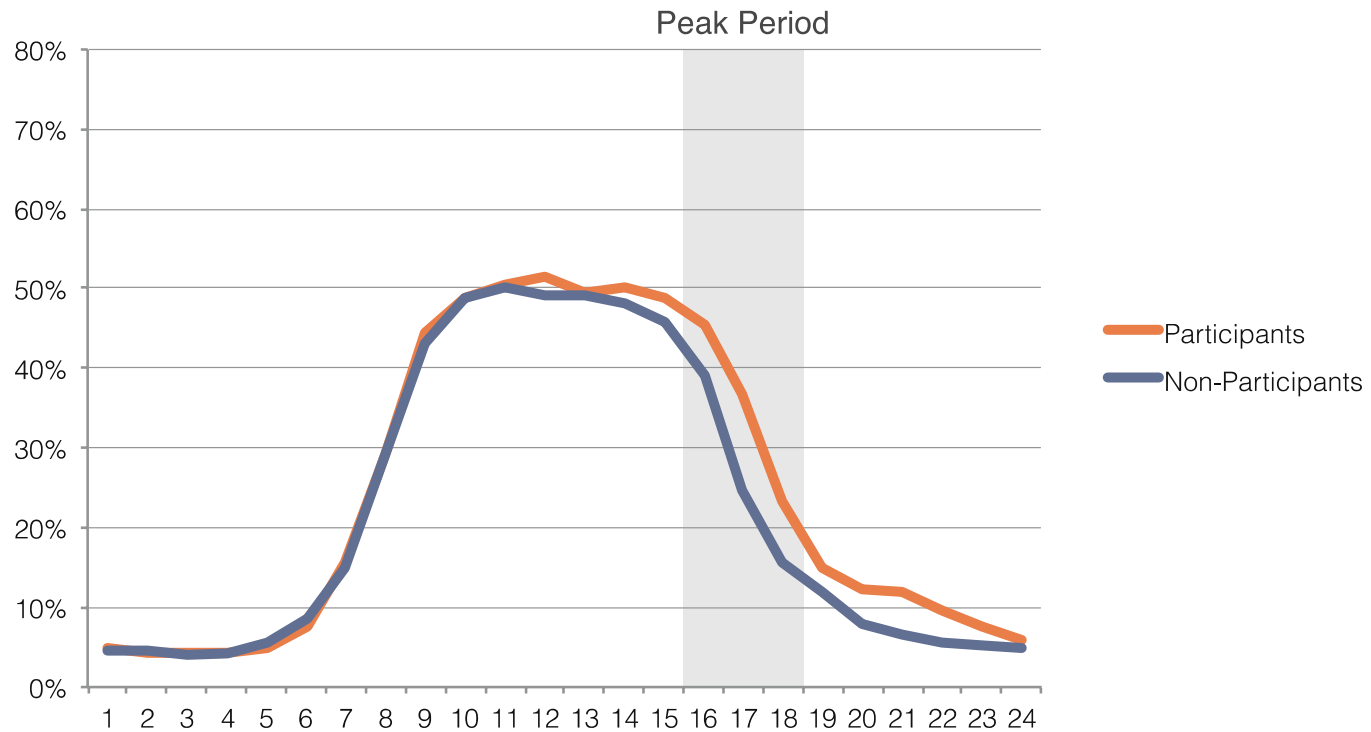
Load Shapes

School



Load Shapes

Office



Load Shapes

Industry/Warehouse

