Home Energy Management (HEMS)

National Grid MA&RI Smart Lighting Study

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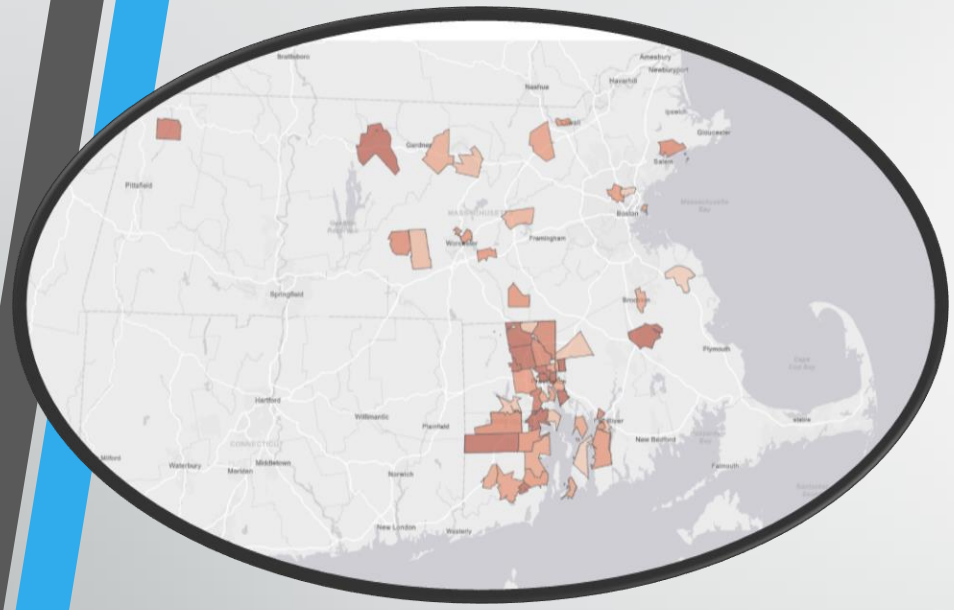
DOCUMENT PROTECTION GOES HERE

SMART LIGHTING STUDY OVERVIEW



- 85 Homes Between MA and RI
- Connected Lamps, Light level (lux) sensors; Room Level and Whole Home Level Occupancy Sensors
- Test and Evaluate Baseload Simulation Validation Methodology
- In Home and Electronic System Trainings\
- 20 week Baseload period
- 12 Month Observation Period

PILOT DEMOGRAPHICS

Survey Size	85 *Households*			
Participant Gender	79% *Male*	21% *Female*		
House Type	89% *Single-Family*	6% *Multi-Family*	5% *Condo*	
Household Size	28% *1-2 persons*	51% *3-4 persons*	21% *5+ persons*	
	58% *Households with Children*			
House Size	37% *< 1,500 Sq Ft*	30% *1,500 - 2,000*	33% *> 2,000 Sq Ft*	

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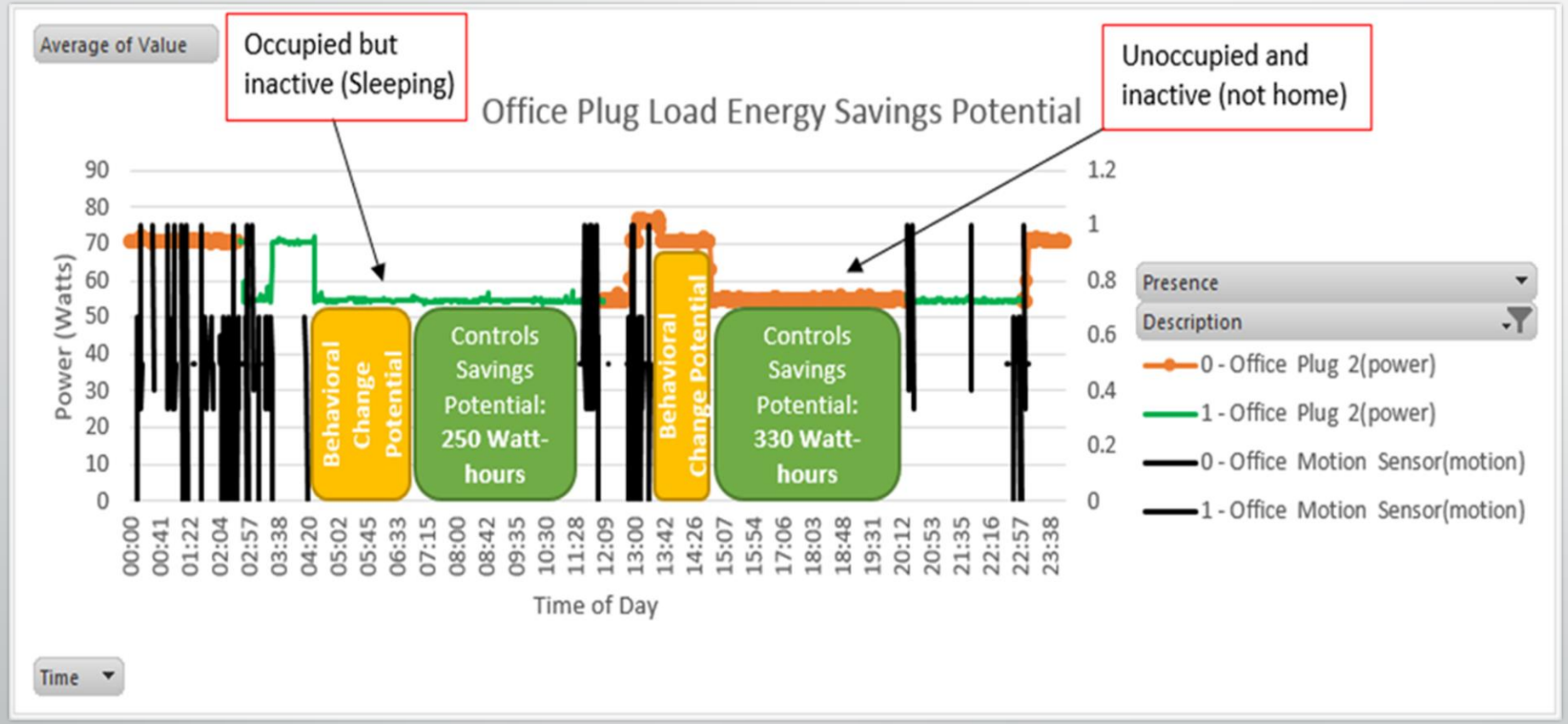
IDENTIFYING SAVINGS OPPORTUNITES



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SYSTEM COMPONENTS

Smart Product Type	Max Quantity per Home
Hub	1
Smart Lamps	15
Illuminance and Motion Sensors	6
Geo-fencing Sensors	5
Total	**27**

Hardware Details

- All hardware was researched, tested, and tracked to ensure interoperability.
- All hardware was screened to ensure commercial availability, positive reviews from early adopters outside of the Pilot, and pertinent data for M&V.

OCCUPANCY TRENDS

Pilot Period	Average Occupancy	All Sensors Average Illuminance (lux)
Baseline (Oct 2017 - Jan 2018)	55%	100.7
Occupant-Controlled (Feb 2018 - Dec 2018)	65%	64.6

- Actual participant interaction with the smart lighting HEMS was monitored during the occupant-controlled period and compared to the total occupancy-based control opportunities observed using the Base Load Simulation Method.
- The occupant-controlled period savings were slightly higher than the Base Load Simulation method.

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FINDINGS

Savings Attribute	Average Electricity Savings (kWh/yr)
Retrofit Savings per Smart Lamp	34.1
HEMS Geo-Fencing Controls Savings per Smart Lamp	5.1
Total Retrofit and Geo-Fencing Controls	***39.2***
HEMS In-Room Occupancy Controls Savings per Smart Lamp*	6.6
Total Retrofit with Geo-Fencing and In-Room Occupancy Controls	***45.8***

*Savings based on Base Load Simulation Method and limited data from participants that enabled deeper level of controls.

- Features, software and components can very greatly between manufactures
- Per lamp savings assists program design flexibility, allowing savings to be accounted for by piece and feature or by “system”.

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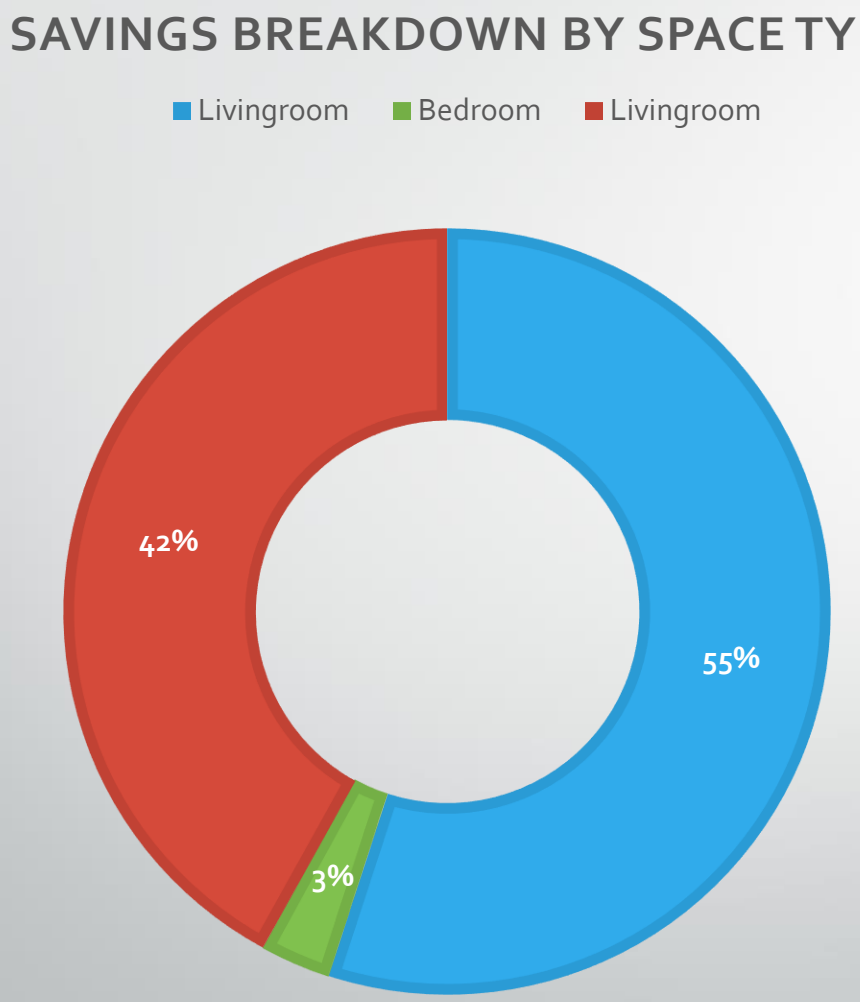
FINDINGS CONT...

Smart Lighting HEMS Validation Methodology	Average Electricity Savings (kWh/yr)
Base Load Simulation Method (Away from home) Estimated Savings	206
Occupant-Controlled Period Calculated Savings	229

- Whole home energy savings were calculated using average home lighting characteristics published by the Energy Information Administration and regional lighting inventory studies.
- Annual whole home energy savings from smart lighting control events calculated during the occupant-controlled period represented a 3% whole home electricity reduction.

FINDINGS CONT...



- Highest savings were attained in kitchens and living rooms, while only a small amount of savings were achieved in bedrooms.
- Higher lighting loads and more variable occupancy in the shared spaces (e.g. kitchen and living room) yield increased savings.

FINDINGS CONT…

Sensor Type	Per Unit Cost	Quantity Recommendation
Hub	$70	One per home
Smart Lamps	$15 ($11 incremental compared to standard LED)	1:1 replacement for primary light sources
Geo-fencing Sensors	$30	One per home key-holder
In-Room Occupancy Sensors	$25	One per room with smart lamps

- The hub and sensors are fixed costs but expanding the quantity of smart lamps to the whole home will increase savings and reduce payback. Also, increasing smart products (e.g. plugs, thermostat) that can be controlled by the existing hub and geo-fencing sensors will further increase savings and shorten payback because of the shared measure costs. Therefore, incentivizing hubs with multiple measure (sensor) capabilities is recommended over hubs that only control lighting measures.

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