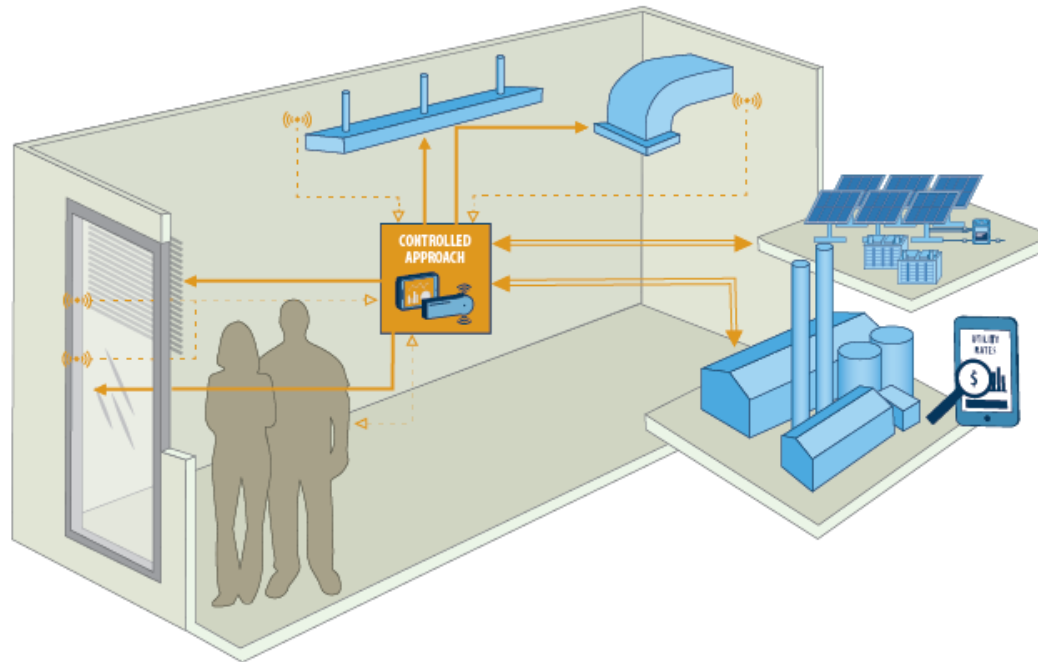


Getting Beyond Widgets – Integrated Systems for Commercial Buildings



Lawrence Berkeley National Lab

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Project Summary

Timeline:

Start date: October 1, 2014

Planned end date: TBD

Key Milestones

1. Industry report on market trends and opportunities for systems adoption; completion pending
2. Evaluate and prioritize system packages for development
3. FLEXLAB test plans and draft system specifications

Budget:

Total Project \$ to Date: \$3.4M

- DOE: \$2.8M
- Cost Share: \$650k

Total Project \$: \$3.9M

- DOE: \$3.3M
- Cost Share: \$800k

Key Partners:

ComEd	RMI
Xcel Energy	
PG&E	
SCE	
NYSERDA	

Project Outcome:

Industry report on current state of systems retrofits in commercial buildings, focusing on U.S. utility custom incentive programs, large scale retrofit programs (e.g. FEMP, GSA), and ESCOs. Study informs future systems R&D for existing buildings.

At least two new validated system packages for utility incentive programs, with cost and energy evaluative comparisons to 'widget'-based retrofits.

Team



LBNL

- Systems development and validation, energy and cost analysis
- Developing two or more new systems for utility DSM program inclusion at FLEXLAB® – DOE's integrated systems test facility
- Systems scoping study data collection, management and analysis



Utilities:

- Partner on integrated systems DSM program development (ComEd, Xcel, NCPA, PG&E, SCE and NYSEERDA)
- Systems scoping study participation – data and expertise (All)



GSA, FEMP, ESCO, Implementers & Other Stakeholders:

- Systems scoping study participation - Retrofit program data and expertise



Challenge

Problem: System retrofits can provide 50%+ additional whole building energy savings in existing buildings over ‘widget’ retrofits.

However, a number of barriers exist:

- Systems are inherently more complex and disruptive; need simplified approaches to access savings, understand interactions
- Lack of industry awareness of how systems provide deeper savings, about the state of systems deployment in industry, and the R&D needed to increase uptake

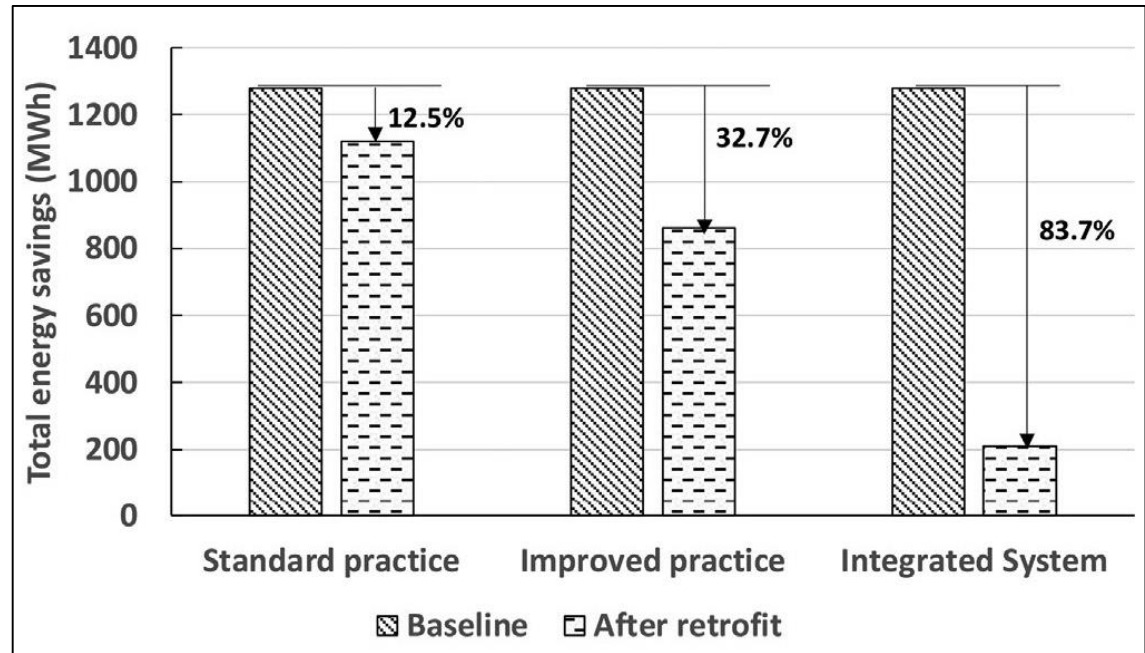
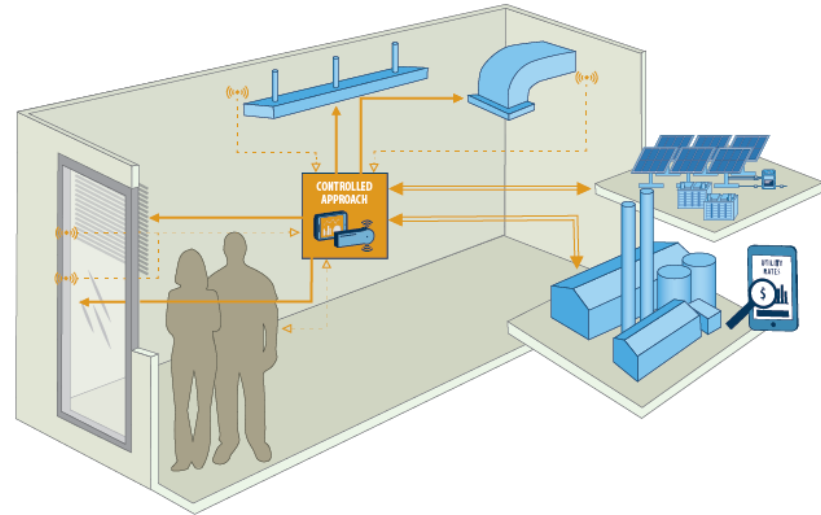


Figure – Regnier et al, Energy and Buildings, 2017 (Regnier et al, 2017)

Utility Interest in System Retrofits

Utility Demand Side Management (DSM) incentive programs are a major EE deployment channel – Investor Owned Utilities in 41 U.S. states expended \$13.4B (2009 – 15) on Commercial & Industrial programs, lifetime gross savings of 836,241 GWh².



Utilities are interested in systems

- As code becomes more stringent, opportunities for cost effective ‘widget’ based technologies are dwindling
- Program energy efficiency goals are increasing
- Other drivers include electrification, and grid efficient strategies

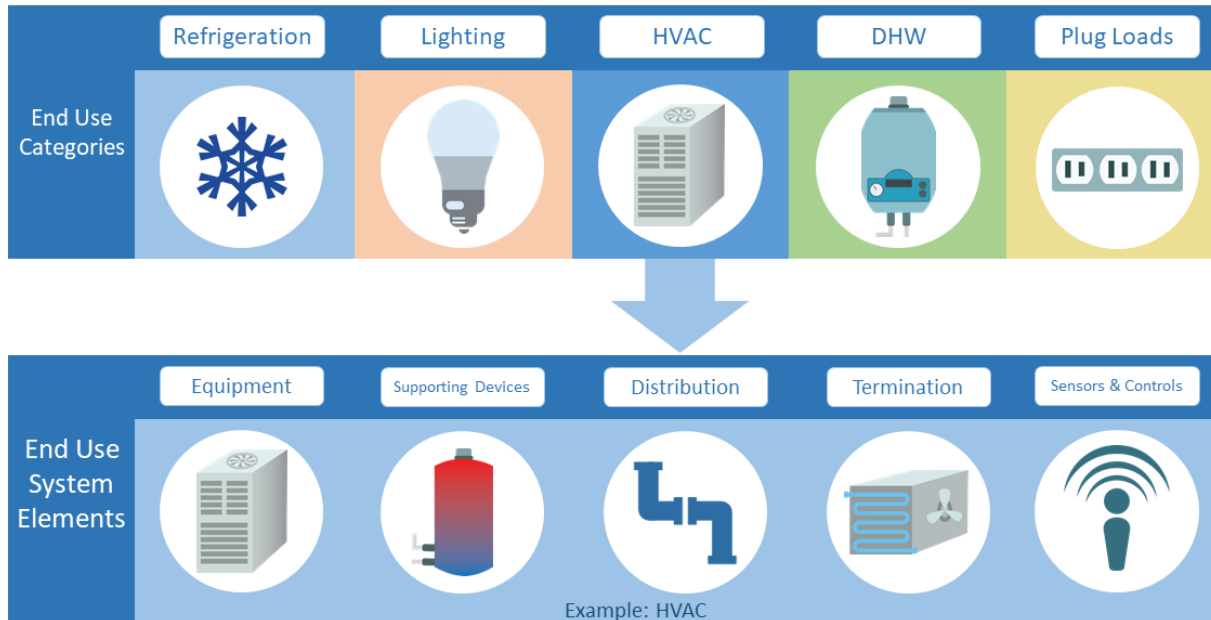
Programmatic challenges

- Streamlined ‘deemed’ programs emphasize widget-based technologies
- ‘Custom’ programs can address systems, but inherently more complex, costly to implement
- Must pass cost effectiveness test (e.g. Total Resource Cost)

Ref: Hoffman, 2018.

What is a System?

“A building system is a combination of equipment, operations, controls, accessories and means of interconnection that use energy to perform a specific function.” (ASE, 2016, 2017)



Approach Summary: Project Phases, Partners and Deliverables

FY15-17 First Utility Cohort, Systems Development

- 3 system packages developed
- Validated energy savings using FLEXLAB over a range of customer conditions
- Created specifications and simplified customer savings assessments



FY18- Analysis: Systems vs Component; System Retrofits in Practice

- Analysis of 3 systems packages vs component equivalent
- Study of industry retrofit program data on state of systems adoption; compares utility DSM, ESCO, FEMP/GSA



FY19- Second Utility Cohort, Systems Development

- Analysis of ~2 dozen EEMs and their system packages
- Develop 2 or more systems packages



Approach Part 1 –

Identifying Systems Market Trends and Opportunities

Collected market and project level data to understand current systems based retrofits – standard practice and exemplary

- Utility custom incentive programs
- Large retrofit programs (Federal)
- ESCOs
- High performance buildings case studies

Categorized and analyzed data

- Technologies deployed
- System level strategies used
- Correlations of retrofit type to energy savings

Conducted interviews with stakeholders on systems technologies of interest, perceived barriers

- Identified system strategies of strategic interest to their customers, to the evolving utility energy landscape (GEB)
- Included implementers, owners, utility program managers, other stakeholders

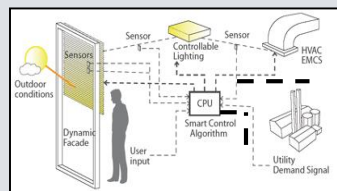
Document findings in scoping study report



Approach Part 2 – Utility Cohorts #1 & 2

Systems Package for Incentive Programs

Develop and validate one new Integrated Building Systems Package for multiple utility Demand Side Management incentive programs:



System specifications



Savings & performance metrics

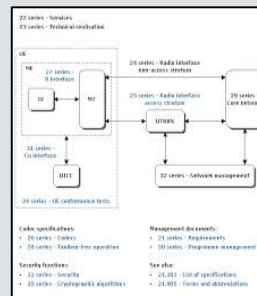
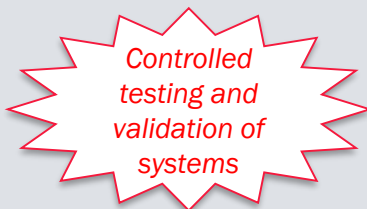


M&V specifications

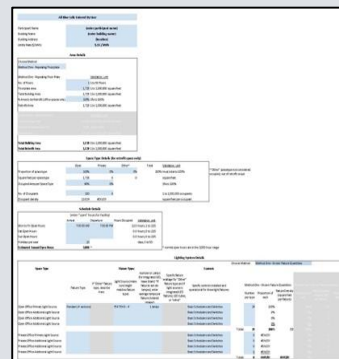
Building Systems Package



FLEXLAB-validated Savings



Implementation & savings persistence guidance



Simplified assessment method



Impact – Utility Cohort #1 Systems Packages

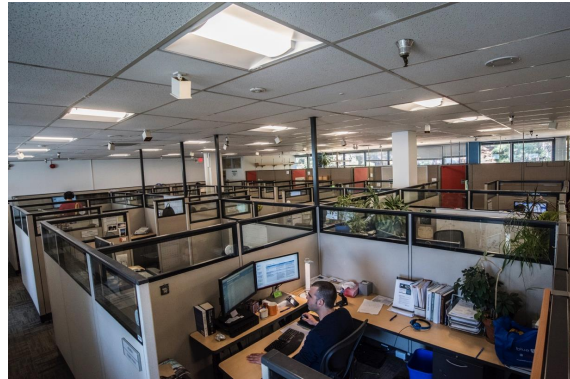
BTO program goals include reducing existing buildings EUI by 30% by 2025.

Three system packages deployed to three utility partners in 2017 for development into streamlined incentive programs (cbs.lbl.gov/beyond-widgets-for-utilities)



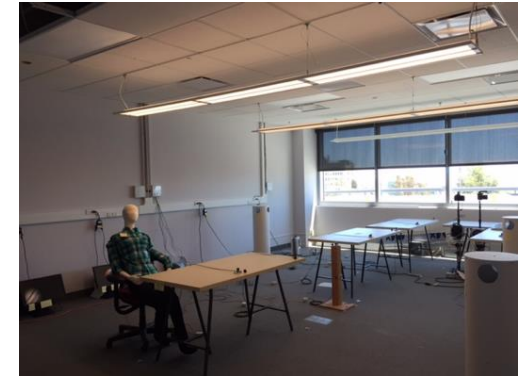
Workstation specific lighting with daylight dimming

- 82% lighting savings
- 6-15% whole building savings (med – large office)



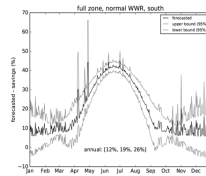
Task/ambient lighting combined with plug load occupancy controls

- 30-41% lighting and plug load savings (office)
- 12-20% whole building savings (small – large office)

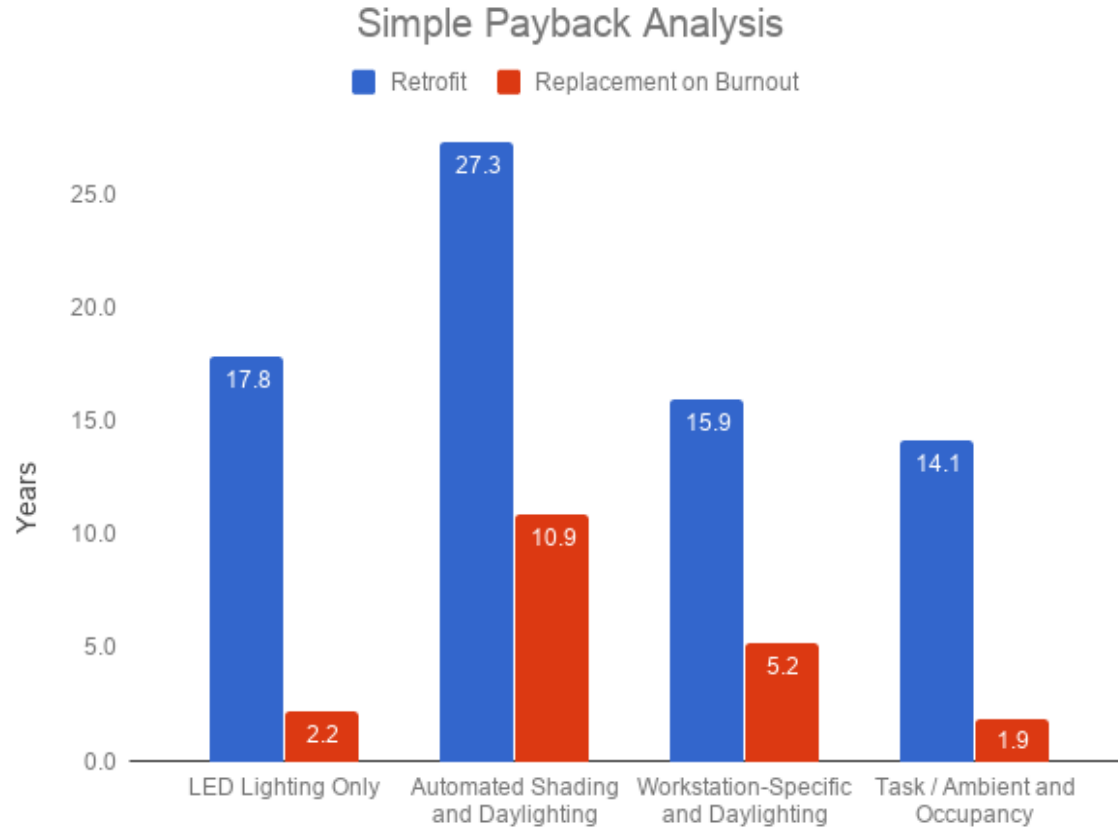


Automated shading with daylight dimming (excludes fixture upgrade)

- Lighting savings 36% (office), 30% (school)
- 5-9% whole building savings (office, school)



Impact – Phase 1 Systems Savings Over LED/Component Based Upgrades



Lighting Energy Savings relative to Baseline	63.1%	84.8%	93.3%	81.3%
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“Energy Cost Savings of Systems-Based Building Retrofits: A Study of Three Integrated Lighting Systems in Comparison with Component Based Retrofits” (Regnier, 2018)

Progress – Systems Industry Study, Results

- 12,000+ retrofit projects included
- Utility projects
 - <15% of their projects had high energy savings
 - Widget approach used in (80-90%+) of projects
 - Lighting predominant in all cases
- FEMP/GSA projects
 - ~25% of their projects had high energy savings
 - System retrofits used in:
 - >25% of low energy saving projects used system retrofits
 - >30% for high energy saving projects
- ESCO projects
 - >40% of their projects had high energy savings
 - System retrofits used in:
 - >50% of low energy saving projects used systems retrofits
 - >60% for high energy saving projects



Progress – Cohort #2 Systems Development



Utility partners:

- Identified ~24 EEMs and system packages of interest
 - System packages include EE and grid services
- Provide input on regional info – baselines, rate structures
- Will prioritize packages for development
- Simulations by RMI to analyze system package performance for each utility
- Two or more systems to be selected for further development and validation in FY19/20

Stakeholder Engagement

Systems Industry Study



SMUD



NAVIGANT



CLEAResult[®]

Systems Development

Utility Cohorts #1 and 2



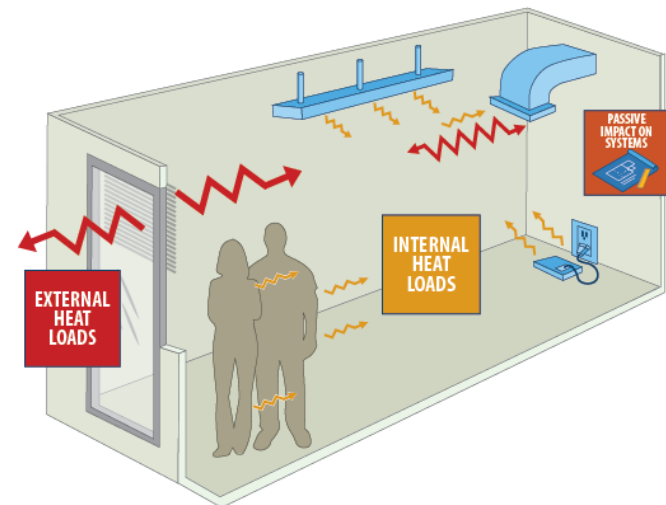
Industry Outreach and Engagement



Remaining Project Work

Next Steps

- Complete industry systems study, peer review & publish
- Second Utility Cohort - Systems Selection, Development and Validation
 - Model individual EEMs and system packages
 - Prioritization for development and validation by utilities
 - Develop system specification
 - Develop FLEXLAB test plan and execute
 - Completion of program manual documentation
- Continued outreach to industry partners, include A/E/C community



Thank You

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REFERENCE SLIDES

Impact – Integrated Systems Package 1

BTO program goals include reducing existing buildings EUI by 30% by 2025. Three integrated systems packages validate significant annual energy savings ([cbs.lbl.gov/beyond-widgets-for-utilities](https://www.cbs.lbl.gov/beyond-widgets-for-utilities))



Workstation specific lighting with daylight dimming

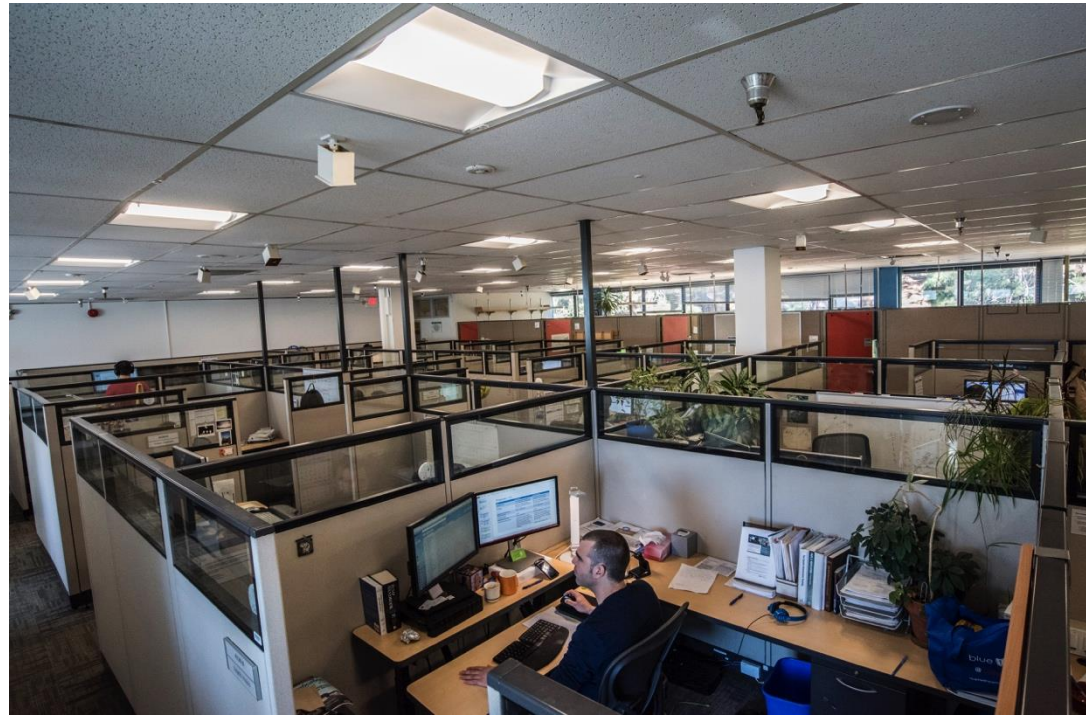
- 82% lighting savings
- 6-15% whole building savings (med – large office)



Impact – Integrated Systems Package 2

Task/ambient lighting combined with plug load occupancy controls

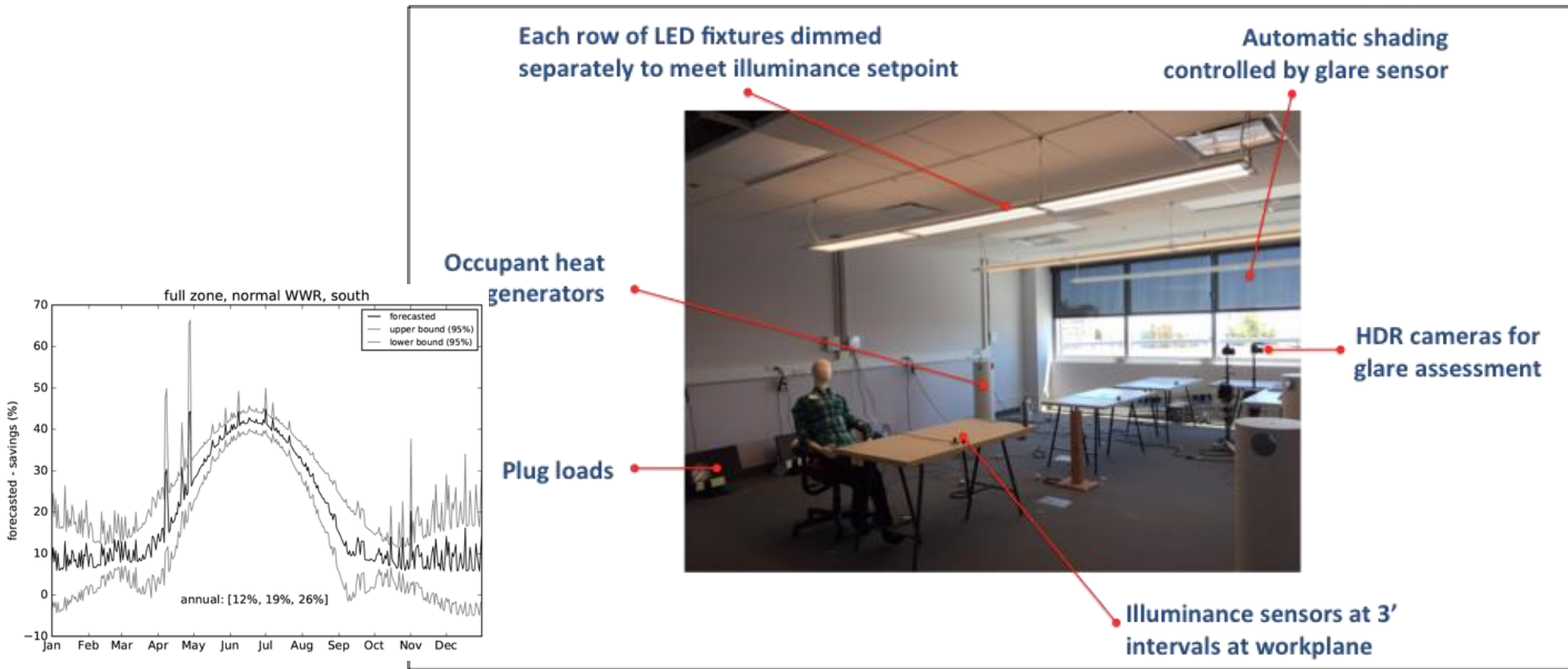
- 30-41% lighting and plug load savings (office)
- 12-20% whole building savings (small – large office)



Impact – Integrated Systems Package 3

Automated shading combined with daylight dimming
(excludes fixture upgrade)

- 36% lighting savings (office), 30% lighting savings (school)
- 5-9% whole building savings (office, school)



Project Budget

Project Budget: Project started as a 3-year competitive lab call award, FY15-17, and was continued with additional funds in FY18 onwards

Variances: N/A.

Cost to Date: 2.6M

Additional Funding: Cost share from utilities – in-kind, equipment purchases and cash, 850k total.

Budget History

FY15– FY 2018 (past)		FY 2019 (current)		FY 2020 – TBD (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
2.4M	650k	1M	200k	TBD	TBD

Project Plan and Schedule

Project Schedule												
Project Start: October 1 2014	Completed Work											
Projected End: September 30 2020	Active Task (in progress work)											
	◆ Milestone/Deliverable (Originally Planned)											
	◆ Milestone/Deliverable (Actual)											
	FY2018				FY2019				FY2020			
Task	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Past Work												
Q4 Milestone: Industry Report on Market Trends				◆	◆							
Q1 Milestone: Confirm Utility Partners						◆						
Q1 Milestone: Identify / Assess Candidate EEMs						◆						
Q2 Milestone: Prioritize Systems Packages							◆					
Current/Future Work												
Q3 Milestone: FLEXLAB Test Plans								◆				
Q3 Milestone: Draft System Specifications								◆				
Q2 Milestone: FLEXLAB Testing											◆	
Q3 Milestone: Final System Program Package												◆
Q4 Milestone: Handoff to Utility Program(s)												◆