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LAWRENCE BERKELEY NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

Making Integrated Systems Easy via Packaging and Standardization

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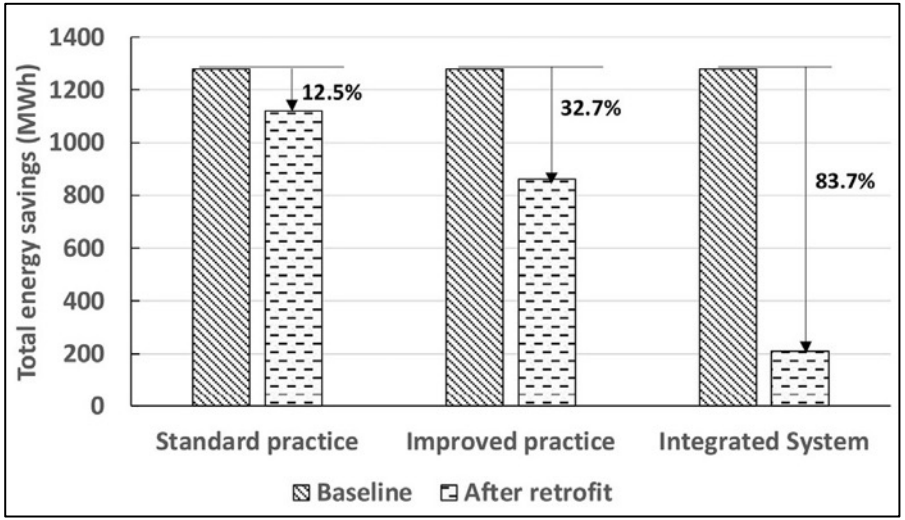
Premise

Deep energy savings are needed in new *and existing buildings* to achieve net zero goals.

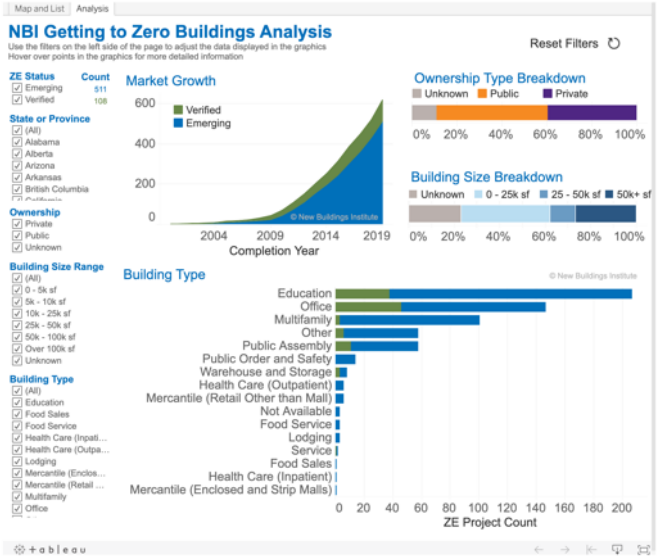
Deep energy savings *require* integrated systems approaches.



Source: Regnier et al., Energy and Buildings, 2017

The solution has a problem

We (mostly) know how to do this…



Source: New Buildings Institute

...but:

- retrofits are often **too disruptive** because they are **not aligned with the real estate life-cycle**;
- require **significant engineering expertise** to implement and operate,
- utility incentives often entail **overly cumbersome M&V**;
- lingering concerns with **savings uncertainty and persistence**.

It's not easy to implement deep retrofits → ***Hinders scale adoption needed to meet climate goals***

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A strategy to scale integrated systems

1. Integrated systems **packages** (ISPs) to de-risk technologies and reduce transaction costs through packaging, standardization and streamlining.
2. Embed ISPs in routine **real estate life cycle events**, to reduce disruption and increase cost-effectiveness.

Vision:
Integrated systems become the low-risk 'default' option for routine real-estate life cycle events

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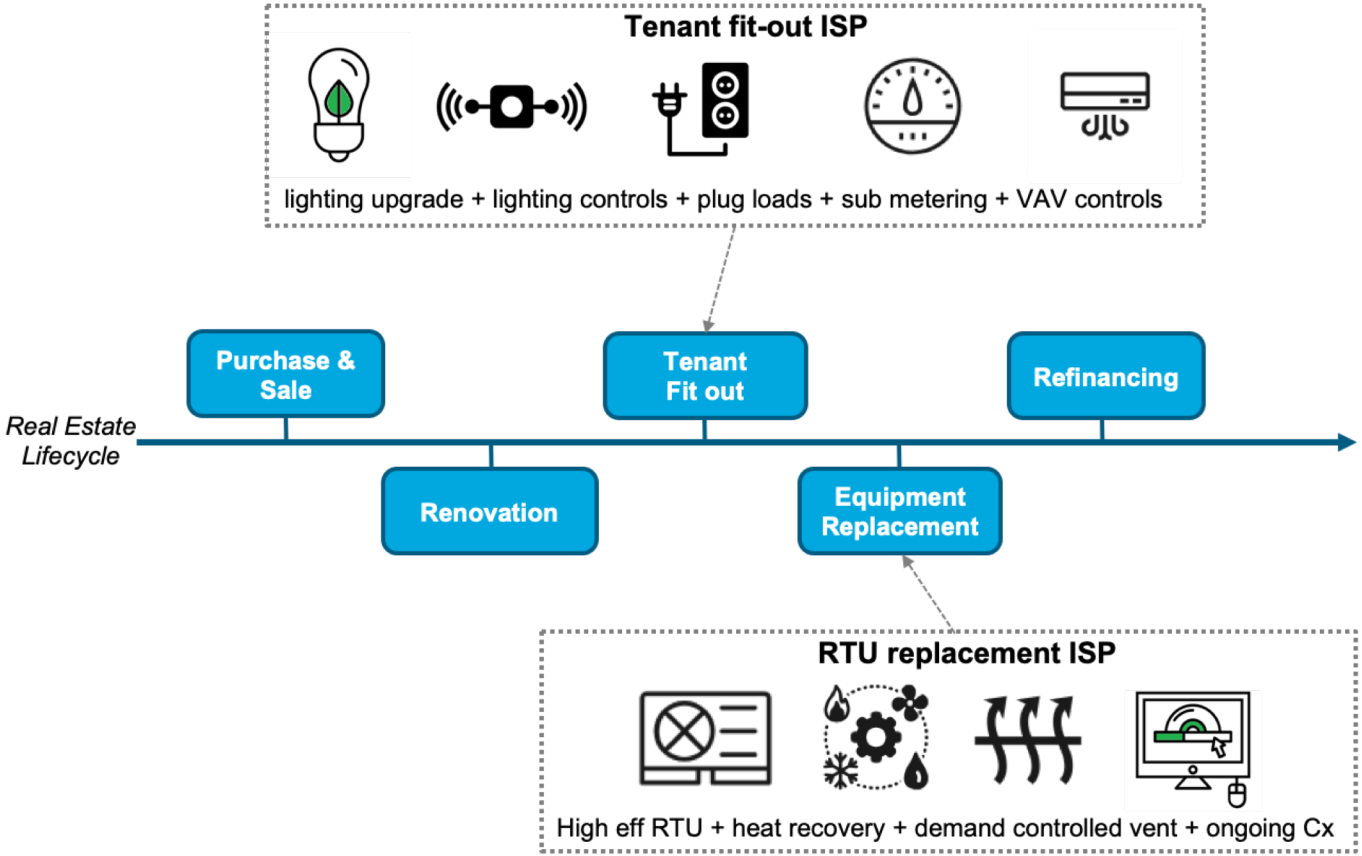
Illustrative examples

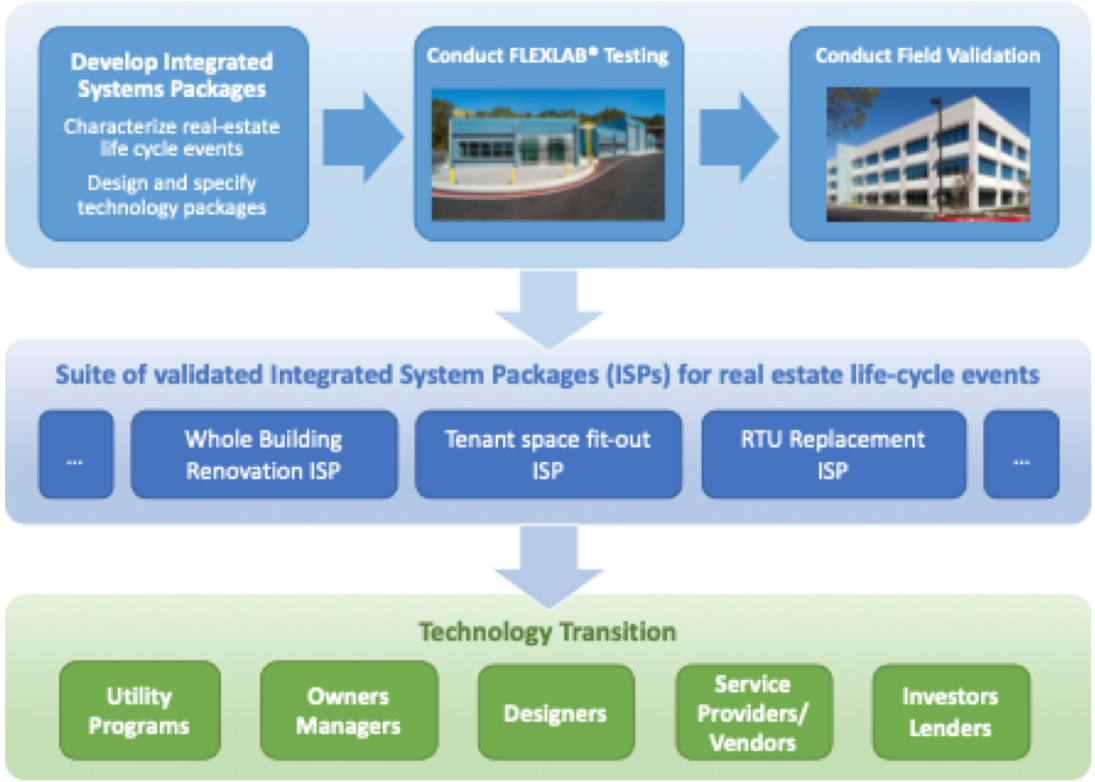


LBNL project: ISPs optimized for real estate lifecycle

Sponsor:

Demonstration partner:

Research Team:

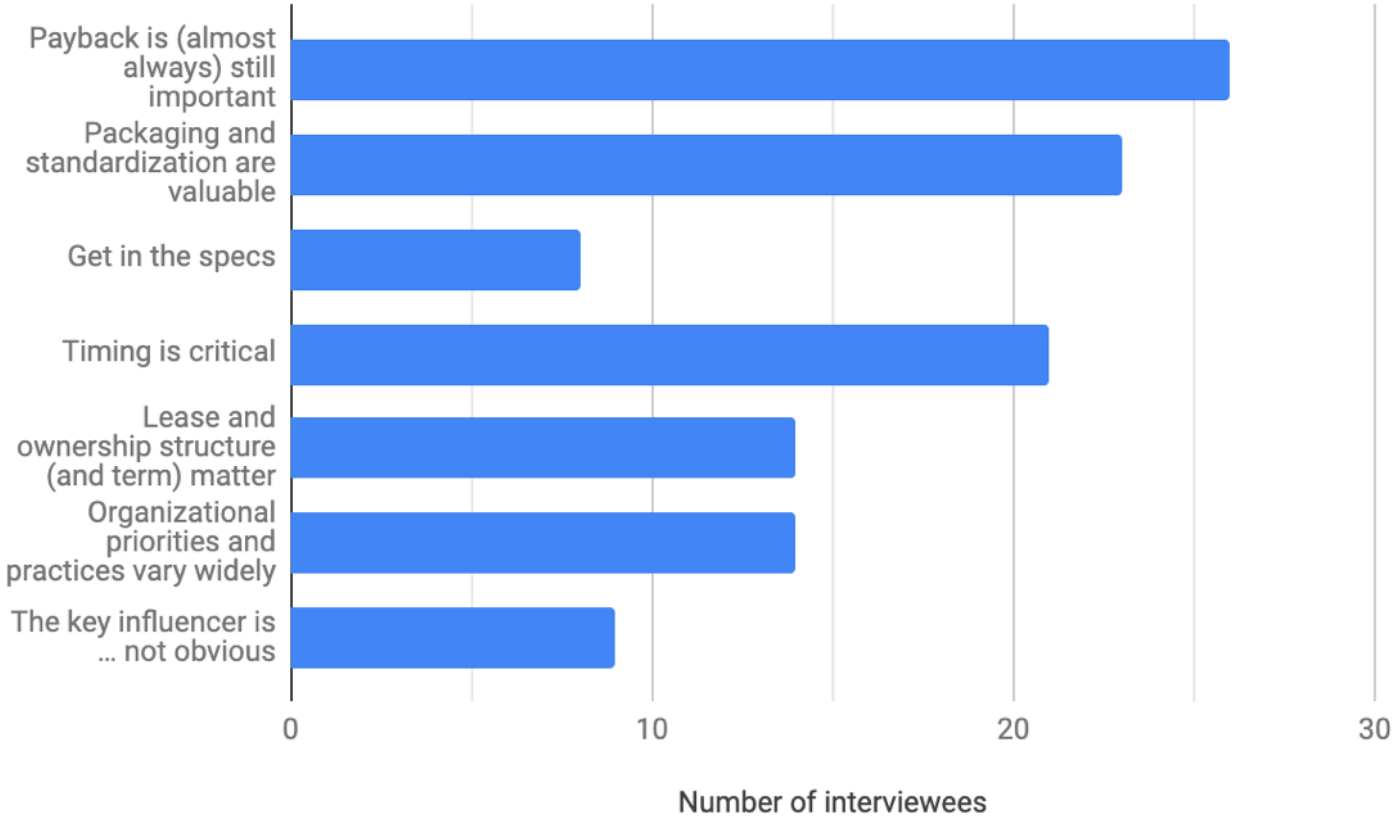


Who we talked to

- *Owners*
- *Operators*
- *Tenants*
- *Investors*
- *Developers*
- *A/E*
- *Project managers*
- *Lease lawyers*

- Two large real estate investment firms
- Two well known tech firms
- Large bank
- Large asset management firm

Stakeholder perspectives: seven themes



Integrated Systems Packages: Development and Validation

FLEXLAB: Test Facility for Systems Integration

- Laboratory testing for integrated building systems under realistic operating conditions
    - Systems integration at end use, whole building & grid interaction levels
    - HVAC, lighting, windows, envelope, plug loads, controls, PV, storage
- Energy efficiency; IAQ ; thermal & visual comfort ; installation and Cx

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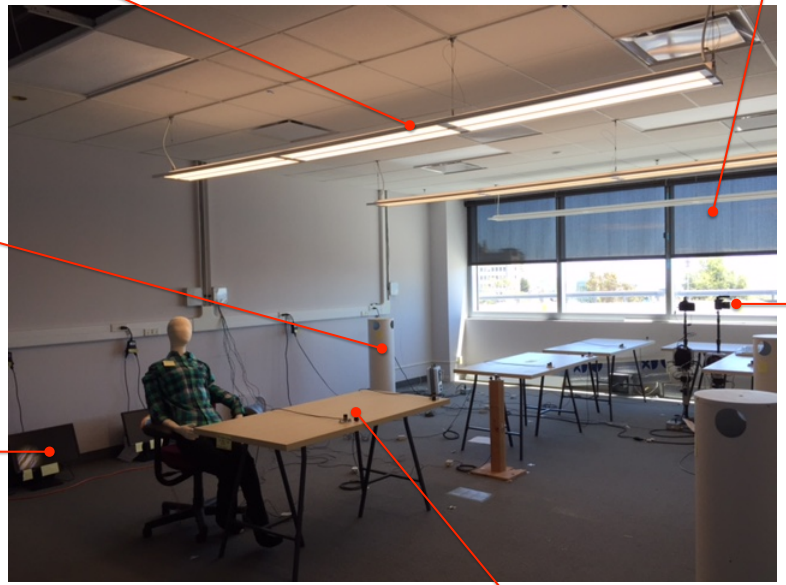
ISP for Tenant Fitout

Lighting | Shading | HVAC controls | Ceiling Fans | plug load controls

Automated Shading & Daylight Dimming System

ISP developed for potential utility incentive program

ComEd
An Exelon Company



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Parametric testing

- Orientation: South, West
- Window-to-Wall Ratio: 0.40, 0.30
- Depth of daylit zone: 25ft, 15ft, 10ft
- Lighting type: T-8, LED

Partitioning for lower zone depth

Paneling for lower window-to-wall ratio

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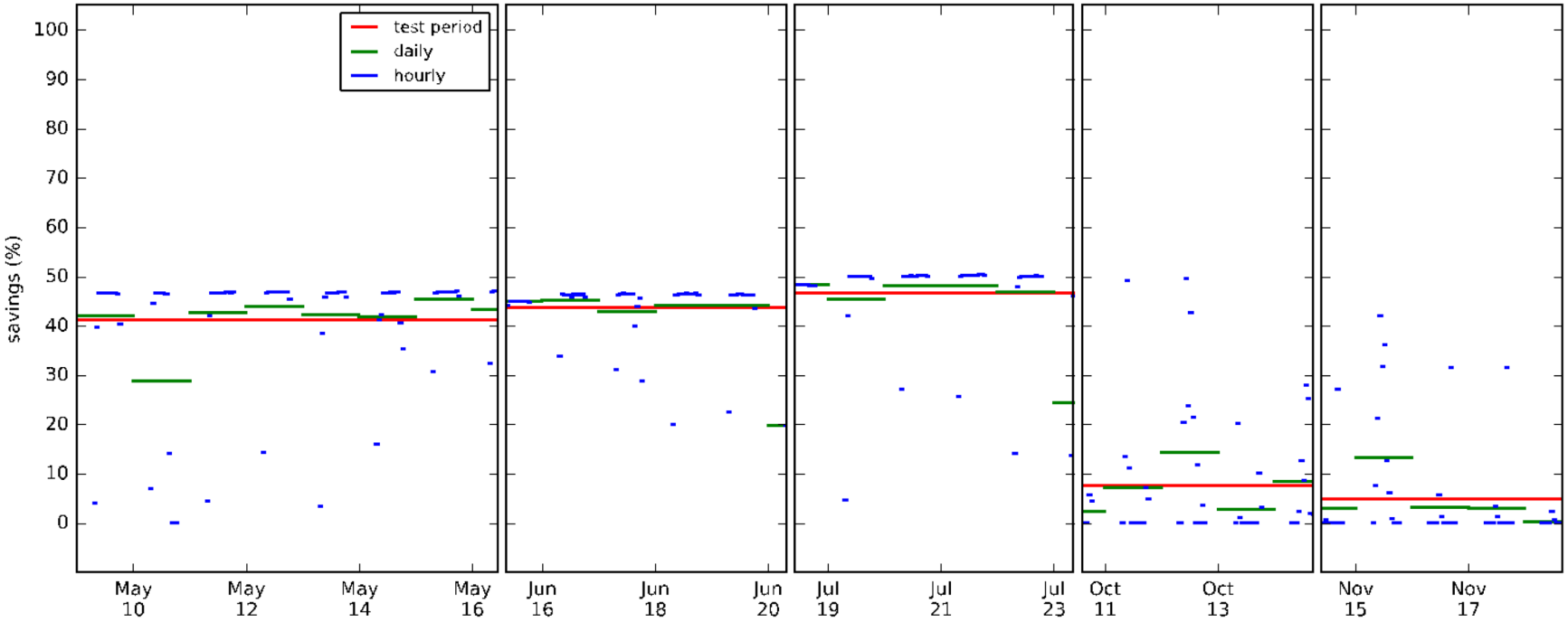
Sample FLEXLAB Results



Lighting energy savings for configuration 1S
(Full zone, South, Normal WWR)

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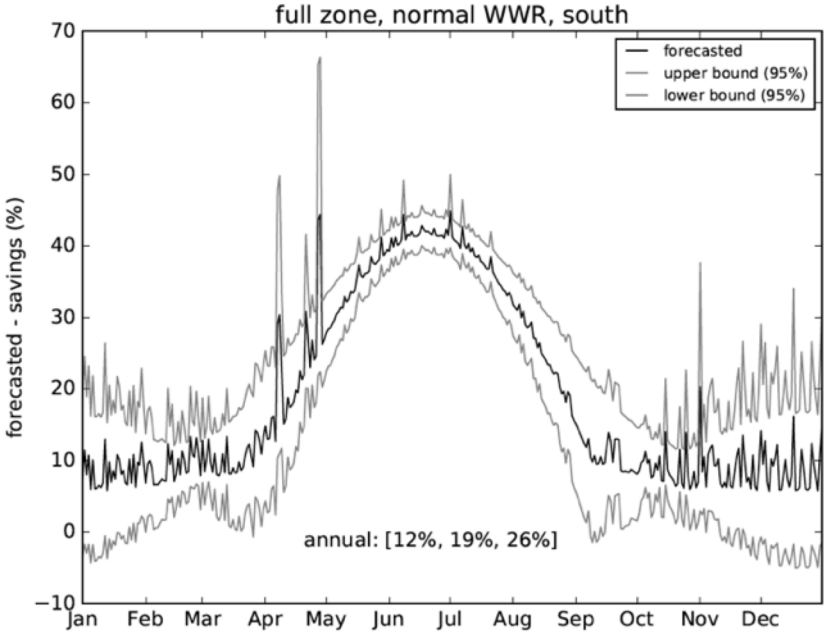
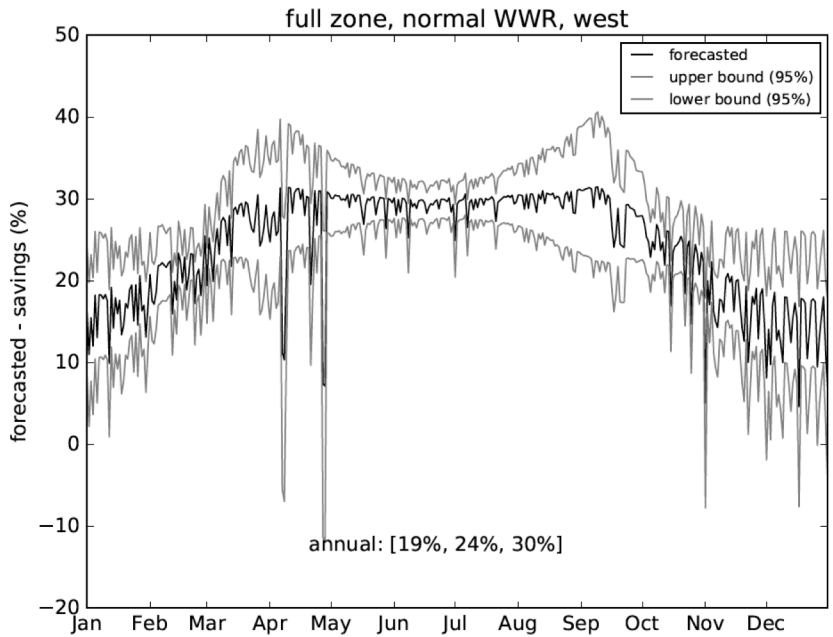
Annual Energy Savings



Annual lighting savings for configuration 1S
(25ft deep zone, south orientation)



Annual lighting savings for configuration 1W
(25ft daylight zone, west orientation)

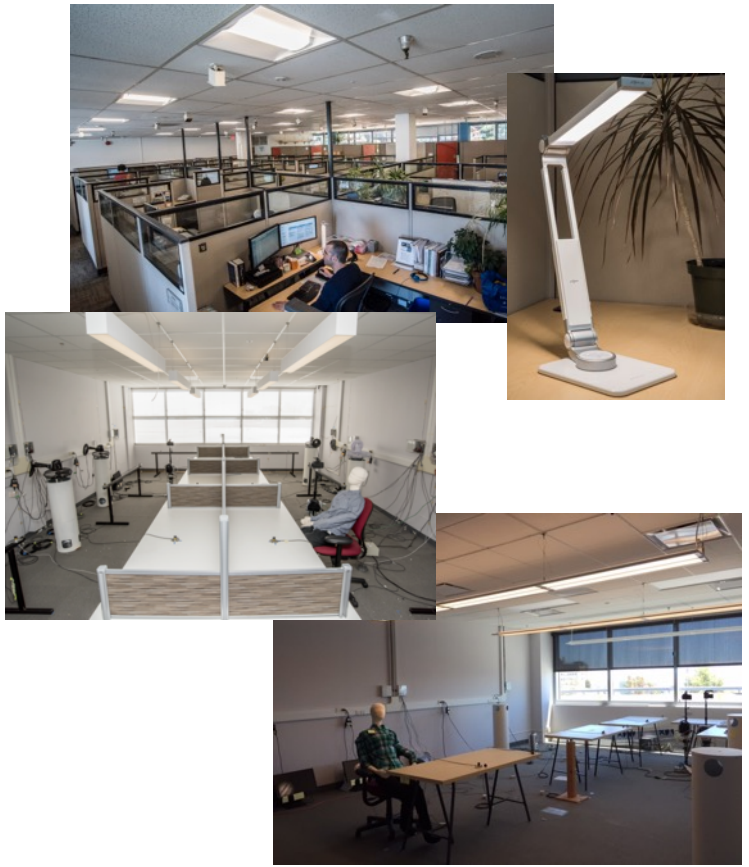
South - mean of 19% annual lighting savings
West - mean of 24% annual lighting savings

ISPs for Utility Programs

Integrated task/ambient lighting with plug load occupancy-based controls
(interior core application)
*12-28% whole building savings**

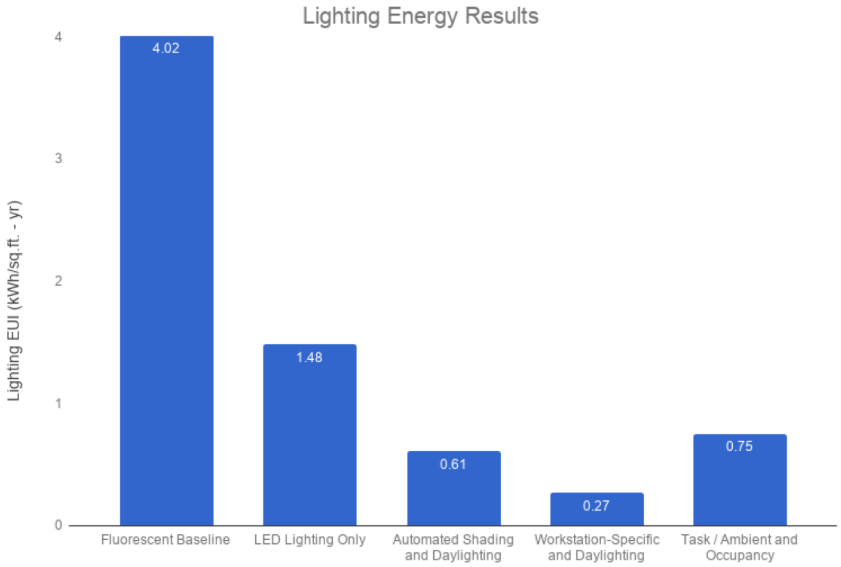
Integrated workstation-specific lighting with daylight dimming
(south perimeter application)
*5-8% whole building savings**

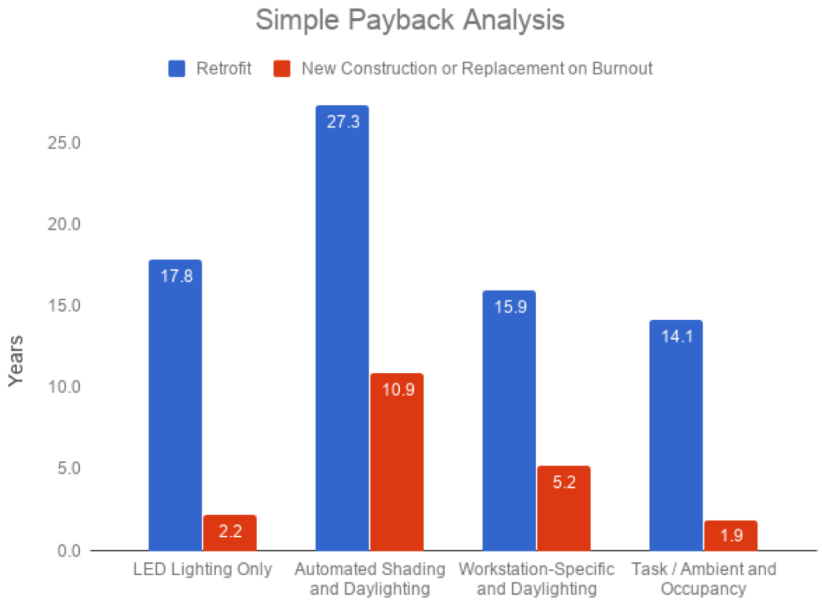
Automated shading integrated with daylight dimming lighting control
(south perimeter application)
*3-5% whole building savings**



*Whole building savings are estimated for application in medium and large commercial office buildings

Systems can be cost-effective





Comparison of three systems based retrofits vs. lighting upgrade.

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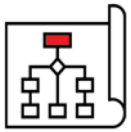
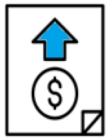
Resources for stakeholders

1 *Resource sets for design and delivery chain*


Applicability guides


Benefit-cost calculators


Design and installation Specifications


functional test protocols


maintenance guidelines

2 *Laboratory and field validation results*


Energy performance


Cost-benefit


Transaction costs

Building owners/managers and tenants

- Develop scope of work and procure products/services for real estate events.

Design professionals, service providers, vendors

- Offer value-added “upsell” offerings to building owners and operators.
- Ease the sales cycle and reduce customer acquisition costs.

Efficiency programs

- Offer incentives based on field validation results.
- Reduce the level of effort to deploy these technologies via custom incentive programs.

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Thank you

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