Making Integrated Systems Easy via Packaging and Standardization

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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...

...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
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*
Illustrative examples

Tenant fit-out ISP
- lighting upgrade + lighting controls + plug loads + sub metering + VAV controls

Real Estate Lifecycle
- Purchase & Sale
- Tenant Fit out
- Refinancing
- Renovation
- Equipment Replacement

RTU replacement ISP
- High eff RTU + heat recovery + demand controlled vent + ongoing Cx
LBNL project: ISPs optimized for real estate lifecycle

Sponsor: Demonstrations 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

- Payback is (almost always) still important
- Packaging and standardization are valuable
- Get in the specs
- Timing is critical
- Lease and ownership structure (and term) matter
- Organizational priorities and practices vary widely
- The key influencer is ... not obvious

Number of interviewees
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
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

Each row of LED fixtures dimmed separately to meet illuminance setpoint

Automatic shading controlled by glare sensor

Occupant heat generators

Plug loads

HDR cameras for glare assessment

Illuminance sensors at 3’ intervals at workplane
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
Sample FLEXLAB Results

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

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