FLEXLAB®
IMPROVING BUILDING ENERGY EFFICIENCY RETROFITS WITH INTEGRATED SYSTEM PACKAGES

Overcoming barriers to system-based energy retrofit approaches and scaling adoption of integrated systems throughout the real estate life cycle

THE CHALLENGE

Speeding the implementation and scale of integrated systems packages in commercial buildings

Achieving deep energy efficiency at scale in existing buildings is essential for realizing zero energy goals in the building sector. Systems-based approaches are much more effective doing so than component-based retrofits, but they typically rely on significant engineering expertise to design, install, and operate and are often disruptive to building occupants and activities when not aligned with the real estate life cycle. Simplifying and streamlining the implementation of integrated system packages (ISPs) is essential to enable wider adoption. The ISPs are designed to leverage key building life cycle "events" (tenant fit-out, rooftop unit replacement and whole building renovation) as intervention points to enhance energy efficiency in real estate portfolios. Each ISP includes a set of efficiency measures that are commercially proven and amenable to standardization.

THE SOLUTION

Researchers at the U.S. Department of Energy's FLEXLAB® facility at Lawrence Berkeley National Laboratory conducted laboratory testing of a promising ISP designed for tenant fit-out. This package includes "core" retrofit measures as well as optional, or "core-plus" measures for additional savings. The project evaluated technology integration, installation and commissioning procedures, energy and demand savings, thermal and visual comfort, measurement and verification approaches, and associated savings uncertainty. By evaluating the energy and indoor environmental quality (IEQ) performance of the ISP under a wide range of controlled conditions, the goal was to "de-risk" the package and make it more acceptable to site owners, managers, and occupants.

> **"FLEXLAB® was invaluable in verifying the savings for integrated systems packages. It is challenging to conduct true side-by-side comparisons in actual buildings and FLEXLAB testing afforded us the unique opportunity to obtain measured energy performance and quantify the impacts of different package components. We appreciate having all this great data!"**
>
> **Duane Kubischta,** Engineering Manager, kW Engineering

THE BOTTOM LINE

The ISP studied provided deep energy savings.

Because ISPs improve efficiency in a variety of building systems at the same time, deep energy savings are possible. In addition, the ability to retrofit multiple systems at once with a package tailored to common real estate life cycle events offers building owners and operators the opportunity to achieve more cost-effective savings in a streamlined, shorter timeframe than it would otherwise take to implement them.

THE EXPERIMENT

- Testing was conducted in two FLEXLAB® test cells with identical open office layouts, enabling side-by-side comparison of the integrated system performance under real-world conditions.
- Three cell configurations were tested: south- and west-facing perimeter zones (with windows), and an interior zone (no windows).Performance of the core and core-plus-optional packages was evaluated in each configuration.
- To evaluate energy savings, researchers monitored and analyzed electric power and thermal loads in both cells. For thermal and visual comfort, indoor temperature, air velocity, mean radiant temperature, illuminance, and daylight glare probability were also monitored continuously.
- To assess the operation of ASHRAE Guideline 36 HVAC control sequences, numerous parameters were logged, including heating and cooling set points, interior space temperature, heating and cooling control valve positions, outside air damper position, supply air temperature, and supply air fan speed.

THE RESULTS

- Lighting energy savings of 70 to 80% were achieved during the test periods, with daylight-based dimming providing just over 10% lighting energy savings in the perimeter zone.
- HVAC daily cumulative load data for the test periods showed cooling load savings between 35 and 65%.
- Data indicated that the ISP was successful in maintaining or improving IEQ relative to the baseline, in terms of task illuminance, daylight glare probability, and mean radiant temperature.

Lighting	Core	Option
LED Fixtures	✓	
Occupancy-based controls	✓	
Daylight dimming controls	✓	
Network lighting controls system		✓

HVAC	Core	Option
ASHRAE Guideline 36 Controls Trim & respond for supply air temp and duct static pressure, demand-controlled ventilation, intermittent ventilation, VAV box retuning	✓	
Ceiling fans w/2.2C (4F) cooling setback		✓

Other	Core	Option
Automated interior Shades		✓
Plug load controls		✓
Metering & monitoring	✓	

flexlab.lbl.gov
flexlab.lbl.gov/publications/energy-efficiency-and-real-estate
flexlab.lbl.gov/publications/package-deals-deep-savings-scaling
buildings.lbl.gov/cbs/isp

Energy Technologies Area
BERKELEY LAB