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Getting Control of Comfort and Energy:

The Benefits of Upgrading to Automated Shades
and Advanced Lighting in Commercial Buildings

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Introduction

Interior lighting and window shading innovations have advanced leaps and bounds in the past two decades. Each innovation offers benefits to existing buildings, ranging from improved occupant comfort and wellbeing to significant energy savings.

Advanced lighting systems alone can improve overall lighting energy performance in a typical office by up to 40%. When packaged with window shading and advanced controls, the whole building savings can be over 20%.

Given today's evolving work environment, it's an ideal time to consider upgrading lighting and/or shading systems. Post-pandemic workplaces will look different.¹ Building owners and managers who commit to making their interior spaces more attractive will be better positioned to maintain and attract new tenant leases in the years ahead.

While comfort in buildings is highly subjective, research indicates one way to increase occupant satisfaction is to give occupants more control over their space.² Daylight, views to the outside, and thermal comfort all contribute to increased wellbeing, and are attributed to better productivity, fewer sick days, shorter hospital stays, higher test scores, and a multitude of other tangible benefits.³

This guide provides building owners, facility managers, and interior designers reasons to consider automated window shades, advanced lighting, and network-level control upgrades to improve thermal and visual comfort, deliver occupant control, capture energy savings, and future proof their buildings. It covers the multiple benefits of combining these technologies into one retrofit package and provides tips for success in the retrofit process.

Future Proof Your Building

Offices will continue to serve an important role in a post COVID-19 world, even if people go to them only 2-3 days per week. Tenants' needs are expected to change. Companies will likely seek more square footage per occupant, eliminate the open office environment, enhance ventilation and building controls, and alter circulation to allow for physical distancing.

Energy-efficient upgrades made in tandem with other improvements can shield buildings against rising utility bills, help them become important tools for reducing carbon emissions, offer healthier spaces for returning occupants, and improve the asset's value. As an added benefit, occupants will remain more comfortable and healthier, reducing sick time costs, employee turnover, and attracting new talent.³

¹ Read more about changing occupant preferences: www.gensler.com/research-insight/blog/insights-from-genslers-u-s-work-from-home-survey-2020

² ASHRAE Standard 55—which defines thermal comfort requirements in buildings, is evolving to account for the variability in occupant preferences: <https://cbe.berkeley.edu/centerline/comfort-classifications-encourage-occupant-control/>

³ Several studies have linked indoor environmental conditions to occupant wellbeing. One such study is: *Effects of realistic office daylighting and electric lighting conditions on visual comfort, alertness, and mood*: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.868.8868&rep=rep1&type=pdf>

Bring in the Sun on Your Terms

Benefits of Automated Shades

Window treatments, which help counteract direct sunlight, glare, heat, and lack of privacy, are very common in commercial buildings. They come in many different forms, ranging from traditional blinds with strings to automated fabric shades. Automated fabric shades are attractive in office settings because they can be programmed to raise and lower according to sunlight patterns without relying on individual occupant behavior.

They allow building owners to maximize daylight, which in turn reduces the need for lighting. And because the fabric is partially transparent, the covering allows filtered sunlight to brighten a space while allowing views to the outdoors. Most automated shades even have an override option, which allows individuals to remotely make adjustments to the shade position if they so choose.

Split window control systems, the latest innovation in automated window coverings, maximize the benefits of natural light. Split systems seek to harness the direct sunlight coming into the upper portion of a window and redirect it toward the ceiling. This redirected light diffuses deeper into the space near the ceiling without glare. The lower part of the window covering appears and functions like a fabric shade.

Many building owners install automatic shades for aesthetic reasons, programming them to rest at different positions during and after office hours. Shades can also be programmed to provide full window coverage for security reasons, which in turn helps maintain building temperature after hours.



The Rollease Acmeda Illuminate Product has upper louvers that allow daylight integration with electric lighting while the lower independent shade can be adjusted for occupant or operator preferences.
Credit: TRC Companies

Luminaire Level Lighting Control (LLLC)– Precision Dimming

Modern lighting systems, dominated by LED technology, are far more energy-efficient than previous systems. They are also more customizable and controllable. Over 80% of commercial buildings were built before the year 2000 and only 1 in 4 built prior to 2008 have undergone a lighting upgrade.⁴

Lighting control at the luminaire, known as Luminaire Level Lighting Control (LLLC), has emerged as a top energy efficiency strategy for office buildings. In contrast to older systems, which control a zone of lights with one wall switch or central ceiling-mounted sensors, LLLC works by automatically dimming or shutting off individual fixtures based on the conditions around each fixture. This allows for more consistent and tunable lighting levels to suit occupants' lighting needs based on the type of space (e.g. hallways, conference rooms, laboratories, etc.). By eliminating excess lighting, the building owner can realize significant energy savings while improving conditions for occupants.

Combining Shades and Lighting Controls– the Ultimate Partnership

By combining automated window shades and lighting upgrades into one retrofit project, building owners can save money during both the design and installation phase as well as long-term operations. The two technologies complement each other, in that automated shading ensures maximum daylight which in turn reduces the need for artificial lighting.

The Illuminate automated shade product from Rollease Acmeda can be powered by solar photovoltaics and an internal battery, thereby eliminating the need for expensive, disruptive, and labor-intensive wiring in retrofit scenarios.



⁴ According to CBECS Rev 2016 data:
<https://www.eia.gov/consumption/commercial/data/2012/bc/cfm/b1.php>

Benefits of Packaged Shades and Lighting Controls

Automated shades offer benefits to the three parties involved in and impacted by the quality of the systems in the building: owners, occupants and operators, as seen in Figure 1.

Integration

The greatest operational benefit of automated shade systems is the potential to integrate them with other building systems. For example, an integrated system could raise and lower shades, adjust ventilation rates, and dim lighting through a shared system occupancy sensor. With help from a centralized building automation or energy information system (BAS or EIS), a building manager has the ability to see and set key performance indicators for a variety of building systems—shading, lighting, ventilation, etc.—and more easily identify system performance issues. Integrated smart technologies are part of today’s built environments, regardless of the age of the building.

Advanced lighting systems, particularly LEDs, also offer substantial operational savings. The lifespan of LEDs is significantly longer than traditional fluorescent lighting that is still in place in the majority of existing commercial buildings. The reduced maintenance from changing lamps out gives more time back to building operators and managers to focus on other areas of the building.

Retrofitting building lighting and shading presents a good opportunity to retro-commission the HVAC controls to update the sequences and assure the system is optimized and getting the most out of the new technologies. The LLLC controls can communicate with the HVAC to modify temperatures and ventilation rates based on occupancy data from the lighting system.

Occupant Health

Both visual and thermal comfort are important for occupant wellbeing and productivity. Poor lighting and glare can impact the visual system and cause headaches and neck pain, while access to daylight and views of outside can have an opposite effect, improving people’s moods and productivity.⁵

Figure 1: Benefits of automated lighting and shading systems

Owners
Modernized building
Reduced operating costs
Higher tenant satisfaction
Occupants
Personalized control
Thermal comfort
Elimination of glare
Maintained views
Operators
Centralized data and control
Reduced maintenance of lamp change outs
Reduced comfort complaints

“A unique value for this project was that you could set the order of operations based on position of the sun, security needs, and occupant lighting preferences.”

-Marti Hoffer, Lumenomics

⁵ <https://hbr.org/2018/09/the-1-office-perk-natural-light>

Uncomfortably warm or cool environments impact occupant behavior, can reduce productivity, and can negatively impact people’s moods.⁶ Window shades are known to be an effective tool at improving thermal comfort for occupants working near windows.

Modern fabric shades are the ideal window treatment because they are able to cut glare while providing occupants with views to the outside, as seen in the photo to the right.

Additionally, in a post-COVID-19 world, with increased awareness of communicable diseases and the potential transfer via surfaces, building owners, managers and occupants will appreciate the touchless controls of automated shades.

Energy Savings

LED lighting upgrades combined with automated shading, daylight harvesting, and advanced lighting controls can result in huge energy savings, according to a recent California Energy Commission demonstration project, *Leading in LA*.⁷ Table 1 below provides an overview of energy savings from lab testing of the lighting and shades for the *Leading in LA* demonstration project.

Table 1. Laboratory energy savings per test case and season (% relative to baseline)

Savings Type	Baseline Comparison	SEASON		
		Summer	Fall	Winter
Lighting Energy	Existing Building	76%	73%	62%
Cooling Load		36%	28%	n/a
Lighting Energy	Title 24 Building	62%	57%	50%
Cooling Load		19%	15%	26%

Not only did the advanced lighting and shading improvements save energy by reducing lighting requirements, they created a noticeable reduction in cooling demand, particularly in the summer. That’s because LED lights generate way less heat than fluorescent bulbs.

At two Los Angeles area demonstration sites, retrofit packages of automated shading, daylight harvesting, LED lighting, and advanced lighting controls show significant energy savings. Lighting energy use after installation of the retrofit packages is down **35%** and **42%** and the whole building (site) energy use for the full package at these sites was reduced **25%** and **15%**.

⁶ <https://www.dlrgroup.com/media/articles/sethi-thermal-comfort-design/>

⁷ See Resources section for project website



The lower shade has a 3% openness that provides views and outdoor connection while shielding the occupant from glare and heat. Credit: New Buildings Institute

“[LEDs] takes the burden of lightbulb exchanges off the city. This decreased maintenance has associated energy savings, monetary savings, and it doesn’t compromise comfort which is a big element.”

–Phil Neff, City of Santa Ana

Table 2: Measured Energy Savings Compared to Pre-Retrofit

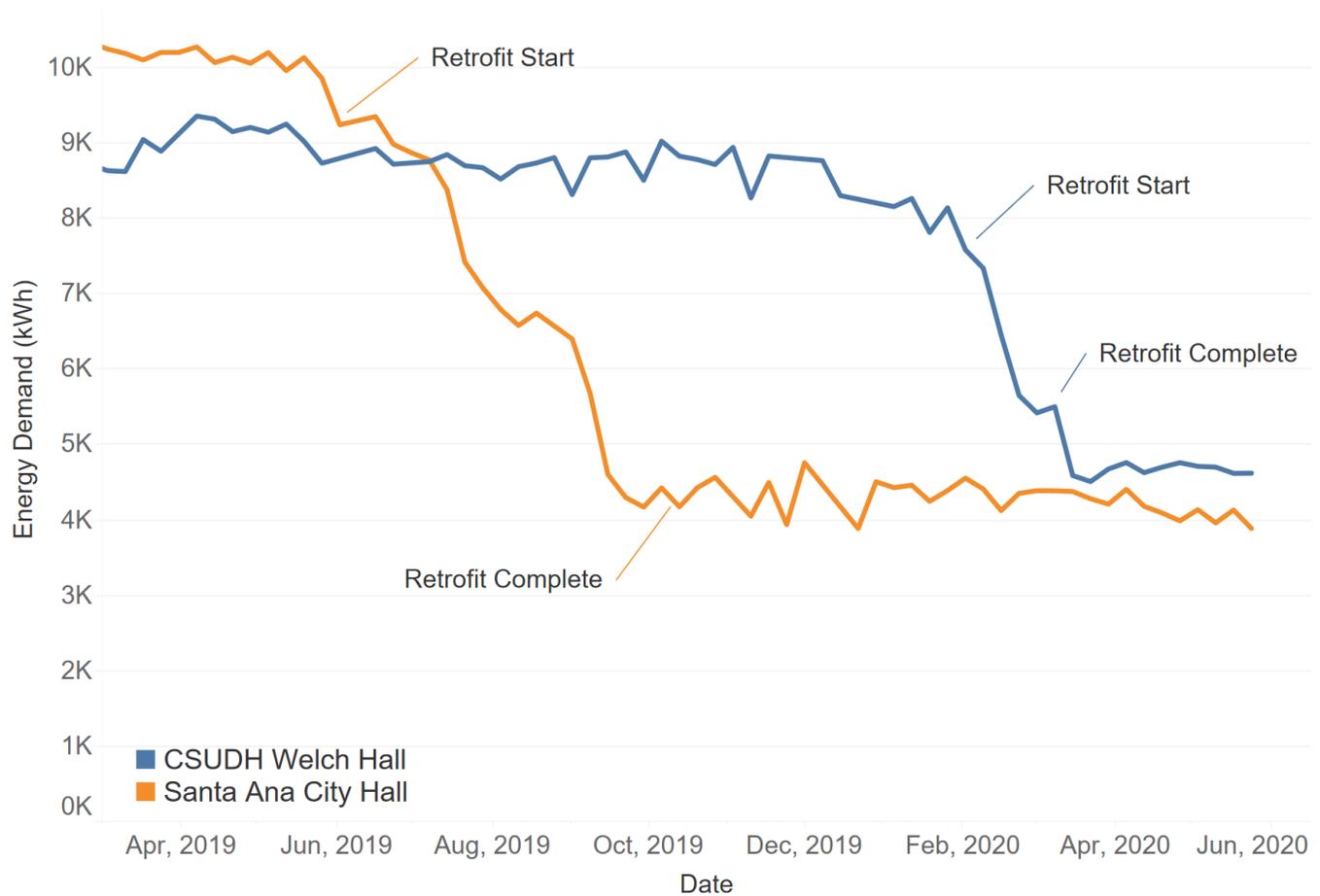
Location	Site Energy	Lighting Energy
CSUDH Welch Hall	26%	35%
Santa Ana City Hall	15% ¹	42%

¹ Steam energy data was not available so whole building energy savings may be larger

“It saves on capital expenditure and energy savings which is especially important when there is little budget to pursue projects like this.”

-Christy Kindig, City of Santa Ana

Figure 2: Lighting energy use prior to and after retrofit lighting package installation at two demonstration sites



Getting Started: How to Implement Automatic Shades and LLC in Your Project

Often, the best time to upgrade lighting and shading systems is when a building is already undergoing improvements. “Trigger points” include tenant improvement projects, lighting upgrades, HVAC replacement, or when existing shades/blinds (or lack thereof) are making occupants uncomfortable. Proactively planning for and implementing automated shading and LLC can help avoid inefficient like-for-like replacements when unexpected repairs are needed. In addition, as building performance standards and California Title 24 energy code upgrades are required, adding automated shades to a building requires minimal additional occupant disruption and will amplify the lighting energy savings of the upgraded lighting system.

Keys to Success

Consider the following five keys to success when undergoing shading and LLC upgrade:

1

UNDERSTAND YOUR BUILDING'S NEEDS AND SHORTCOMINGS.

Working with your building managers, and if needed, outside consultants, complete a thermal and visual comfort assessment of your building. As part of this assessment, survey occupants to better understand their pain points related to lighting and shading, and their overall wellbeing. This information can serve as a baseline by which to measure the success of your retrofit project. If occupants and other stakeholders understand the benefits of the new lighting and shading system, managers will typically have fewer complaints during the adjustment period. Occupants are typically excited by the opportunity to customize lighting in the space and enjoy more natural light in their environment.

2

ASSESS LIFECYCLE BENEFITS AND RETURN ON INVESTMENT.

Automated shading systems and lighting upgrades can offer significant energy savings. At two demonstration sites, the lighting energy use dropped by 36% and 42% after a lighting retrofit with networked lighting controls and automated interior shades. The non-energy benefits of natural light in space are well documented albeit challenging to quantify in dollars, including occupant wellbeing and real estate value.

Energy efficiency programs and incentives may be available in your area to support your automated shading. For example, in Southern California shading may be incented if documented in combination with the lighting and submitted as a custom measure (see link in resources).

3

HIRE A SINGLE PROJECT MANAGER TO DELIVER THE PROJECT

From the outset, hire a single project manager to oversee the procurement, installation, commissioning, and training of staff. Most shading and lighting retrofits, especially when combined into one project, will require multiple contractors and subcontractors. Designating a single point of contact who is responsible for the successful delivery of the project will not only improve outcomes, but will also reduce work for the building owner. Owners may also consider working with a service provider that pays the upfront costs and is paid back via guaranteed energy cost savings and/or a monthly service fee.

5

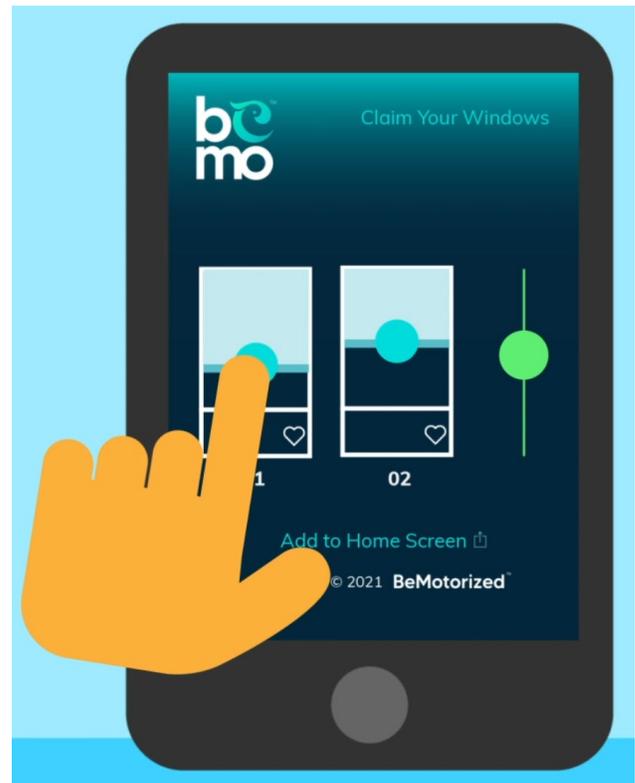
COMBINE WITH OTHER IMPROVEMENT PROJECTS.

As mentioned earlier, there are multiple benefits to combining automated shades and advanced LED lighting control system upgrades into one retrofit project. Syncing up system retrofits and real estate transactions throughout the lifecycle of the building help reduce implementation costs, minimize building disruption, and reduce the time required to manage a large retrofit project. Training for building managers and IT staff, along with occupant education, is also minimized.

4

MANAGE EXPECTATIONS AND GET BUY-IN FROM OCCUPANTS

First and foremost, meet with the building managers to get them on board with the upcoming improvements. Explain the reasoning behind upcoming changes, the expected benefits, how the changes might impact their work load, and the timeline. Ensure occupants are briefed about the changes as well, and that they understand how to override shading and/or lighting controls to match their own preferences. Designate someone from the IT department as the point person for ensuring the networking required to wirelessly control shades will not interfere with other networked systems.



Occupants can control individual or groups of shades in their space via smartphone app or web browser.

Credit: The Energy Coalition

Checklist for Success

- ✓ Focus on occupant improvements, what needs are not being met by the building?
- ✓ Engage a single entity to provide turnkey design, installation, commissioning, and long term system support for the system.
- ✓ Get stakeholders at the table early, including the IT department, facilities managers, and key occupants and staff. Communicate the benefits of the new systems to generate buy-in from occupants.
- ✓ When conducting a cost-benefit analysis of system upgrades include occupant health benefits such as improved comfort, well-being, and productivity. Pursue energy efficiency incentives to support the project.
- ✓ Maximize your savings by bundling HVAC retro-commissioning, lighting upgrades, advanced lighting controls, and other advanced technology solutions.

Resources

[Leading in Los Angeles Project Page](#)

[Luminaire level lighting control technology application guide](#)

[Department of Energy Energy Efficient Window Attachments](#)

[Santa Ana City Hall Retrofit Case Study Project Video](#)

[CSU Dominguez Hills Welch Hall Retrofit Case Study and Project Video](#)

[Installer Guide for Automated Shades and Advanced Networked Lighting](#)

[Southern California Edison's Energy Efficiency Express and Customized Solution Programs](#)⁸

The Continental Association of Building Automation (CABA)
[2018 Impacts of Automated Shading in Building Projects](#)

⁸ Other California utilities also offer efficiency programs and incentives for commercial building retrofits. Check your local utility website.

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EPIC invests in scientific and technological research to accelerate the transformation of the electricity sector to meet the state's energy and climate goals.



SCE funding for research on these technologies is aligned with their [Going \[carbon\] Neutral Pathway 2019](#) goals and steps.



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