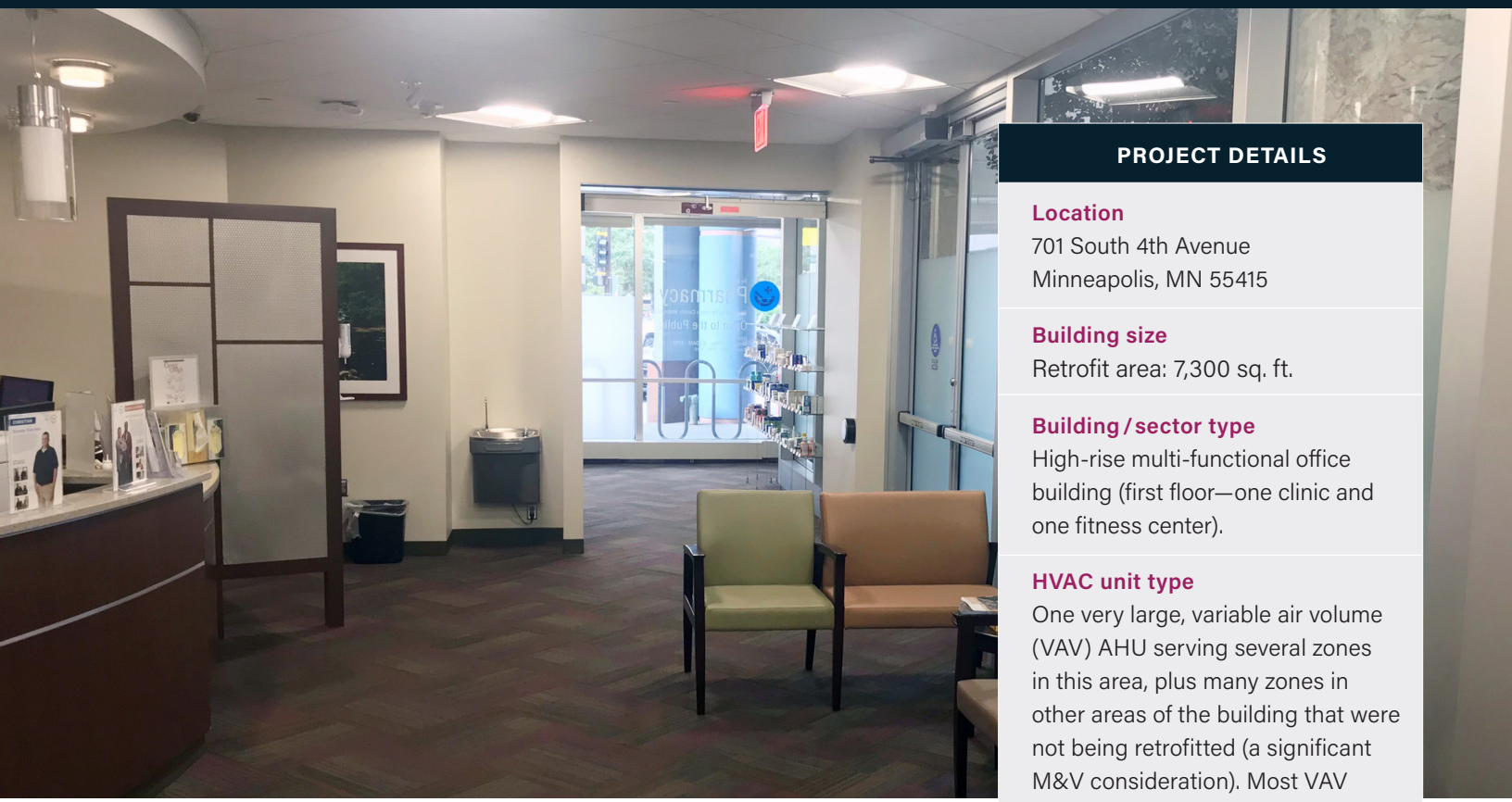
slipstream

INTEGRATED CONTROLS PILOT PROGRAM | **CASE STUDY**



Hennepin County 701 Building

PROJECT BACKGROUND

Hennepin County, the most populated county in Minnesota, operates a massive portfolio of buildings covering most building types. They also have a goal of reducing greenhouse gas emissions from their operations by 25% by 2025. As a result, they have undertaken significant energy retrofits over the past decade, with much effort focused on lighting retrofit. They recently investigated broader uses of smart building controls and were subsequently introduced to Slipstream's integrated controls pilot. The County saw value in testing the integration of these

PROJECT DETAILS

Location
701 South 4th Avenue
Minneapolis, MN 55415

Building size
Retrofit area: 7,300 sq. ft.

Building / sector type
High-rise multi-functional office building (first floor—one clinic and one fitness center).

HVAC unit type
One very large, variable air volume (VAV) AHU serving several zones in this area, plus many zones in other areas of the building that were not being retrofitted (a significant M&V consideration). Most VAV boxes are hot water (HW) reheat boxes. Building has a HW and chilled water system for heating and cooling the AHU.

BAS system type
Automatrix system with JACE

Occupancy description
Fitness area is 24/7 with highly variable occupancy. Outpatient Clinic has regular occupancy 6 a.m.–6 p.m. Monday–Friday.

Incentives
DOE incentive: $21,315
Xcel Energy incentive: $8,700

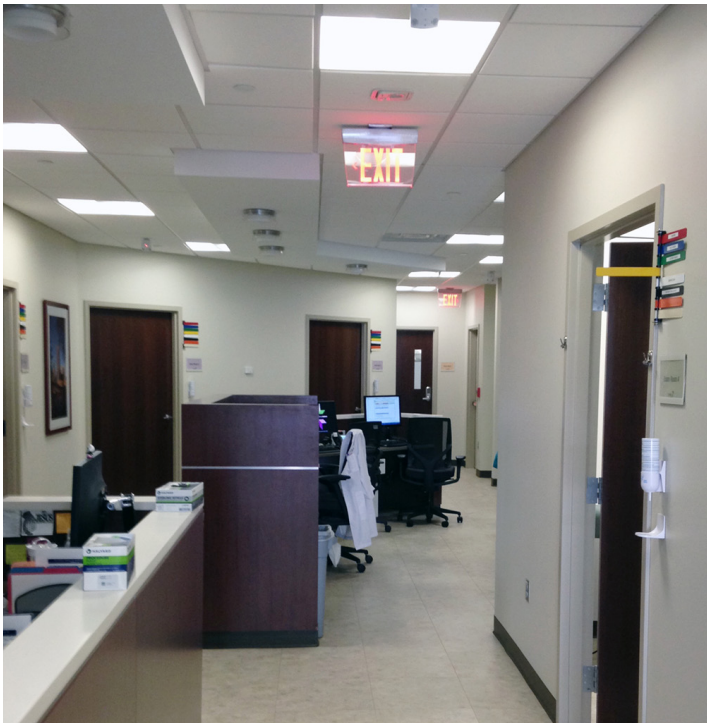
PROJECT PARTNERS

CREE LIGHTING
A COMPANY OF IDEAL INDUSTRIES, INC.

legrand®

Pacific Northwest
NATIONAL LABORATORY

Xcel Energy®



Lighting quality was improved in nurses areas.

Specific industry requirements needed to be met for pharmacy lighting.

different building systems and decided to apply the approach to one floor of a large building in downtown Minneapolis.

PROJECT SUMMARY

The project studied the impacts and trade-offs from integrating LED lighting with luminaire-level lighting controls with plug load controls, and zone HVAC controls. Slipstream conducted field measurement of the demonstration to evaluate the energy savings potential from reducing lighting, plug load, and HVAC system operation when spaces are unoccupied. Slipstream also assessed the ease of installation and documented occupant feedback of the new technologies compared to the baseline systems.

PROJECT DETAILS

The project retrofitted two separate spaces with an integrated controls system, both served by a common VAV system, covering a total of 7,300 square feet. One space was an outpatient clinic. In this space the different exam rooms, nurses' stations, pharmacy, and reception area all had highly variable occupancy, making it an excellent candidate for control of lighting, HVAC services, and a few select outlets. The other space on the floor is a fitness center that serves a building amenity. The center was open 24/7 to serve varying needs of building occupants, so lighting, HVAC, and plug loads all operated all day even though there are significant periods when no one was using the center. The system allows all three systems to shut down during those times. The project required coordination between the County,

ENERGY SAVING CONTROL STRATEGIES
SmartCast lighting and all its associated energy-saving controls and features
Plug load controls in office spaces
Plug load controls on common area equipment like printers and chargers
Plug load controls on the fitness center exercise equipment
Thermostat setback based on occupancy
VAV box shut off based on occupancy
SAT reset
Static pressure reset based on VAV box position (which is based on occupancy)

the building's property management firm (which also managed the fitness center), clinic staff, lighting control vendor, and contractor. It was truly an integrated effort, and this did lead to some challenges.

The backbone of the new hardware for the retrofit was a luminaire-level lighting control system provided by Cree—their SmartCast platform. This system incorporates dimming control, photosensing, and occupancy sensing all onboard each individual fixture. The existing fixtures were replaced with SmartCast on a one-for-one basis. Sensors communicate wirelessly with each other, creating a flexible, granular mesh network of sensing throughout the building from just replacing the fixtures themselves. This network is accurate enough to be used for individual outlet control, HVAC zone control, and of course lighting control. In addition to the new lighting fixtures and onboard controls, the other hardware component installed were the wirelessly-controlled outlets.

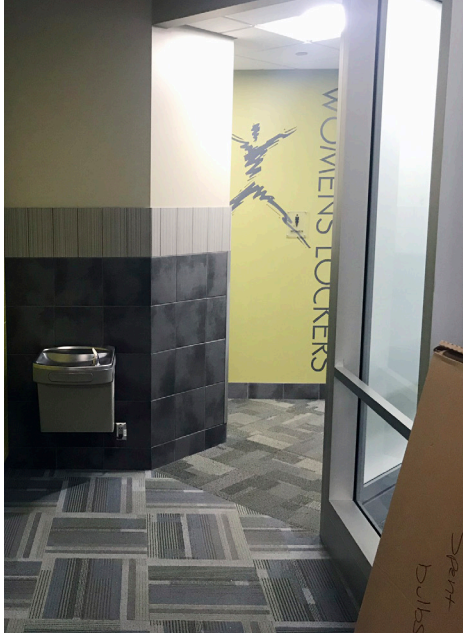
Being a controls-focused project, the project was not complete once this hardware was installed. Commissioning of the controls was an important step:

- The lighting and plug load controls were commissioned by the vendor, Cree, as a service included with the purchase of the fixtures.
- New HVAC sequences were implemented by the building's designated controls contractor that took advantage of the occupancy data from the lighting network.
- Building operators and occupants were trained on use of the lighting controls and outlet controls.

LESSONS LEARNED

The concept of integrating controls across systems is relatively new, and lessons were learned along the way:

- The lighting control implementation and commissioning were relatively simple for the County and their electrician, with help from Cree's in-field representatives.
- The integration across systems was not quite plug and play. Cree learned several lessons about configuring their system to communicate readily with the HVAC system. Most notably, the importance of having up-to-date and compatible firmware on all devices.
- Lighting in the pharmacy on this site did present challenges in finding an LED solution that could achieve enough illumination with only one-for-one retrofit.
- Mapping control points between lighting and HVAC involves coordination between multiple parties; the lighting and HVAC zones should be planned in advance.
- The fitness center had some unique decorative fixtures that were harder to integrate into the Cree platform. The solution in the end was to use a tubular LED retrofit coupled to an independent Cree control module, demonstrating that there are options when a SmartCast-branded fixture did not meet project requirements.
- In order to tune light levels, just enough high-end trim was implemented for the task in each space. This was done with photometric calculations in many spaces,



(Top) **The fitness center is infrequently used, making controls effective.** *(Middle)* **Locker rooms were included in both lighting and HVAC control.** *(Above)* **The building's VAV system utilizes the sensing to turn down individual zones when nobody is present.**

Controls are particularly impactful in the pharmacy, where light levels (and therefore base energy usage) are higher.

but these calculations were lacking in some cases, requiring field measurements of illuminance as commissioning progressed.

- Occupants need to be informed of both the purpose of the lighting controls and how they operate in order for them to persist.
- In retrospect someone on the building owner's staff should have been trained as commissioning was taking place so that once it's done, there is someone local who knows how to make necessary adjustments.
- At this site the retrofit only covered one floor of a large office tower. The partial nature of the retrofit did not affect lighting, plug load, or zone HVAC control savings, but the ability to impact overall HVAC energy performance at the *system* level was hindered. Many potential AHU-level control improvements were omitted or constrained because the HVAC systems served many floors that did not include the new zone controls.

PAYBACK INFORMATION

The impacts table describes the savings, cost, and resulting payback for this project. This site demonstrated that the economics of integrated controls are challenging for small retrofits. The cost of integration and HVAC improvements remain fixed while the savings are significantly smaller. Payback would improve if a much bigger portion of the building were retrofit.

IMPACTS	
Lighting savings	1.5 kWh/sq. ft.
Plug load savings	0.1 kWh/sq. ft.
HVAC savings	1.4 kWh/sq. ft. 0.13 therms/sq. ft.
Total cost savings	$0.42/sq. ft.
Cost (after incentives)	$10.6/sq. ft.
Payback	25.4 years
Payback, mature product*	11.1 years

*Based on system costs in more mature markets, and excluding plug load controls.

FOR MORE INFORMATION

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ACKNOWLEDGMENT: "This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Building Technologies Office, Commercial Buildings Integration Program, Award Number DE-EE0001890."