



## 9-Story Office Building Center City Philadelphia, Pennsylvania

BUILDING BACKGROUND

Building Usage  
Office

Occupants  
600

Size  
338,000 sq ft

Operating Hours  
8:00 am - 6:00 pm  
Monday - Friday

Stories  
Nine

Year Built  
1989 & Modified 2002

Start Year for Energy Management  
2007

Energy Efficiency Typology  
Retro-Commissioning

### retrofit at a glance

- .....Building Control System
- .....Demand Base Load Shedding
- .....HVAC Scheduling
- .....Condenser Pump Improvements
- .....Revised Lighting Plans
- .....Motion Sensors
- .....Lighting Technology Upgrade

## Overview & Scope

The building is a 338,000 SF Class A office building in downtown Philadelphia. The original structure was completed in 1989 and a 220,000 SF wing was added in 2002. Eighty percent of the building is occupied office space. The remaining area houses a multilevel parking structure, a full service cafeteria, and other meeting and activity spaces.

The building's individual floor-by-floor heating, ventilation, and air conditioning (HVAC) units have been designed to accommodate variable air volume (VAV) temperature controls. Supplementary heat is provided by a zoned perimeter hot water radiation system. In the winter months, the system is fueled by either natural gas or #2 heating oil. As necessary, the boilers that heat the water for the system can be switched to operate with fuel from the 5,000 gallon fuel-oil tank installed beneath the building.

The building's electrical systems have been sized to support a high-density computer fit-out, while a building automation system (BAS), last upgraded in 2000, controls all systems within the building. Six passenger elevators serve all office and common space for approximately 600 occupants. The building also has one dedicated freight elevator and one hydraulic elevator for the parking garage.

Utility expenses account for 25 percent of the facility's overall building budget, of which 80 percent is electricity expenses. Due to budget cuts and anticipated energy cost hikes, the building owner decided to study and undertake measures to reduce energy consumption in the building.

## Project Details

In 2008, building management engaged the services of a building system engineering firm to perform an evaluation of current building operations and develop strategies for energy reduction. HVAC, electrical, plumbing, and miscellaneous systems were considered when developing energy savings opportunities. Management set a goal of attacking "low hanging fruit" in energy savings projects and selected eight strategies that have the highest energy savings return on investment. By using in-house labor, several projects could be undertaken with minimal up-front cost.

## Energy Management Approach

**Building Control System** - Building management purchased a software program by Verdiem that allows for remote management of PCs throughout the building. The program allows management to monitor energy settings as well as power down computers at the end of the day to reduce plug load.

**Demand Based Load Shedding** - The building automation system (BAS) allows building management to monitor energy consumption and remotely deactivate systems in order to reduce the load. During peak consumption periods, common strategies to shed demand include adjusting building temperature and shutting down individual elevators.

**Strategic Scheduling of HVAC Start Ups** - Building management has set up strategic HVAC start ups to prevent the system from running needlessly. The system is scheduled so that ideal building temperature is reached when occupants begin arriving in the morning and the system is shut off at the end of business hours in the evening.

**VFDs for Condenser Water Pumps**- The only project that required the use of an outside consultant was the installation of variable-frequency drives (VFDs) on condenser water pumps. Although the project incurred outside labor cost, it also generated high level of energy savings.

## Lighting

**Revise Lighting Layout** - A lighting study of the building determined that many spaces were over-lit. Unnecessary fixtures were removed throughout the building to reduce energy consumption.

**Parking Garage Lighting Upgrade** - Parking garage lighting was upgraded with more energy efficient fixtures.

**Motion Sensors** - Building management installed motion sensors in private offices, meeting rooms, and supply rooms throughout the building. Motion sensors ensure lights will be turned off when a room is not in use.

**Emergency Lighting Fixture Improvements** - A survey of existing emergency fixtures showed that current levels exceeded the minimum requirement of the Philadelphia building code. Management removed unnecessary emergency fixtures throughout the building to reduce the 24-hour lighting load.

## Project Outcome

The total cost of the projects was \$43,000, about \$0.13 per square foot. These projects cost a mere 2 percent of the facility's operating budget, and when completed are estimated to save \$64,000 annually, yielding a 149% return on investment. If all projects had been implemented at once, they would have a payback period of 8 months. These savings, however, are realized gradually because the investments have been made incrementally over the past few years. The building has realized a 2 percent annual reduction in energy usage and cost since implementation began, including the reduction of peak-loads. These improvements led the building to be awarded the ENERGY STAR label for 2008 and 2009.

## Lessons Learned

In order to reduce energy consumption and expenditure, the management team can begin by identifying and eliminating areas where there is a waste of energy. By reviewing existing lighting fixtures, strategically managing the HVAC and other building systems, building management can realize a high level of savings with minimal cost.

Energy efficiency measures need not be expensive, and many improvements can be made with no additional cost. From the management team's perspective, it is strategic to undertake projects that will yield a relatively high level of savings, with little up-front labor and fixture costs.

## Economic Analysis

	COST	ESTIMATED ANNUAL SAVINGS	SIMPLE PAYBACK
Lighting Motion Sensors	\$16,000	\$5,000	3.2 years
Verdiem Software	\$7,000	\$10,000	8.4 months
Reduce Emergency Light Fixtures	\$0	\$10,000	immediate
Revise Lighting Layout	\$0	\$10,000	immediate
Demand Based Load Shedding	\$0	\$6,000	immediate
Strategic Scheduling of HVAC Start Ups	\$0	\$2,000	immediate
Energy Efficient Lighting Fixtures	\$2,000	\$1,000	2 years
VFDs for Condenser Water Pumps	\$18,000	\$20,000	10.8 months
<b>Total</b>	<b>\$43,000</b>	<b>\$64,000</b>	<b>8 months</b>