Yardi Pulse Building Optimization

Saving 10% to 30% of Building HVAC Energy Consumption with Payback Under 1.5 Years

What is Pulse Building Optimization?

Yardi Pulse Building Optimization is an intelligent energy optimization platform for heating, ventilation and air conditioning (HVAC) systems that changes the way large commercial facilities consume energy while increasing occupant comfort. Our optimization algorithms significantly reduce HVAC energy consumption by sending temperature, pressure and speed set point adjustment signals to the existing HVAC fans, pumps and chillers every 30 seconds. Yardi Pulse is the only completely integrated software that delivers advanced HVAC intelligence to the Building Automation System (BAS). It works in conjunction with the following Yardi Pulse functions:

- **Pulse Building Optimization** simultaneously optimizes chiller plant and air handling, delivering up to 30% HVAC energy savings. Building Optimization ensures that the facility uses just the right amount of energy to satisfy heating and cooling loads without compromising occupant comfort.
- **Pulse Fault Detection** identifies costly faults in real time to catch hard-to-find energy waste and maintain operational excellence and building performance. Pulse Fault Detection ensures that all equipment operates at peak performance all the time.

Features and Benefits

- **Comfortable occupants**. Building Optimization improves the tenant experience by increasing comfort. Implementations often reduce comfort-related complaints (comfort calls) by up to 90%.
- **Energy savings**. Building Optimization typically reduces HVAC system energy consumption by 10% to 30% by systematically optimizing the air side and the central plant in a building's HVAC system. Large direct expansion (DX) roof-top units also see substantial savings.
- **Operator-friendly user interface**. Building operators can quickly monitor the performance of Building Optimization and adjust key set points. Many operators find Pulse an easier and more powerful tool for monitoring HVAC than their existing BAS.
- **Real-time tuning**. Self-tuning accounts for system, weather, occupancy and operational/mechanical variations. This ensures continuous commissioning and persistent savings over time.
- **Analytics**. Building Optimization displays HVAC and site data at regular intervals, which allows users to monitor trends in their site's energy usage.

Pulse Building Optimization brings intelligent, efficient operation to commercial comfort systems. Before Pulse, the basic operation of large-scale commercial HVAC systems had not changed in decades. Even with more efficient motors, pumps and drives and the addition of digital controls, HVAC systems being installed in 2018 operate much like they did in 1972. Pulse brings advanced algorithms in the form of machine intelligence to HVAC operations.

Summary of Recent Pulse Building Optimization Results

The buildings included in this summary differ in size, age, mechanical equipment types, location and more. Each building had the following five standard Pulse Building Optimization measures installed:

- Chilled water (CHW) loop differential pressure optimization
- CHW supply temperature optimization
- Duct static pressure optimization
- Supply air temperature optimization
- Condenser water supply temperature optimization

Table 1 below summarizes the savings for each project[1].

	CASE STUDY 1	CASE STUDY 2	CASE STUDY 3	CASE STUDY 4	CASE STUDY 5
BUILDING	480,000-sq. ft. R&D facility in Brea, CA	500,000-sq. ft. office building in Washington, DC	550,000-sq. ft. office building in Irvine, CA	65,000-sq. ft. office building in Santa Barbara, CA	1,900,000-sq. ft. office building in New York City
UPFRONT INVESTMENT	$131,637	$102,000	$62,500	$23,291	$159,270
ESTIMATED 5-YR ROI	169%	133%	20%	N/A	99%
PAYBACK PERIOD	1 year	1.2 years	Immediate	Immediate	1.2 years
ESTIMATED 5-YR IRR	101%	79%	N/A	N/a	74%
UTILITY INCENTIVE	$0	$0	$65,402	$34,635	$0
ANNUAL ENERGY SAVINGS	$175,598	$113,100	$35,585	$55,686	$189,880
HVAC ENERGY SAVINGS	9% (whole building)	9% (whole building)	13%	28% (whole building)	11%
SAVINGS PER SQ.FT	$0.37	$0.23	$0.06	$0.86	$0.10

Because most of these buildings were designed with efficiency in mind, decreasing energy costs was not the only concern. The building owners were also committed to enhancing tenant comfort by ensuring indoor temperatures remained consistent and comfortable. Building Optimization allows them to achieve both goals.

Case Study 1

The Building

This is a 480,000-sq. ft., research and development facility in Brea, CA. The facility has three 385-ton and two 495-ton water-cooled McQuay chillers in the north and south plant, respectively. The north plant has three BAC cooling towers (CTs), and the south plant has two. All CT fans have variable-frequency drives (VFDs). The six chilled water pumps (CHWPs) and six condenser water pumps (CDWPs) all have VFDs. The north side has 12 air handler units (AHUs) with a combined fan size of 450 HP. The south side has ten AHUs with a combined fan size of 330 HP.

The Financials

With an initial investment of $131,637, the return on investment was 169%. The project achieved simple payback in 0.96 years and a 101% internal rate of return (IRR) over five years.

$131K	$0	169%	1 YR
UPFRONT INVESTMENT	UTILITY INCENTIVE	ROI	SIMPLE PAYBACK

101% IRR OVER 5 YEARS

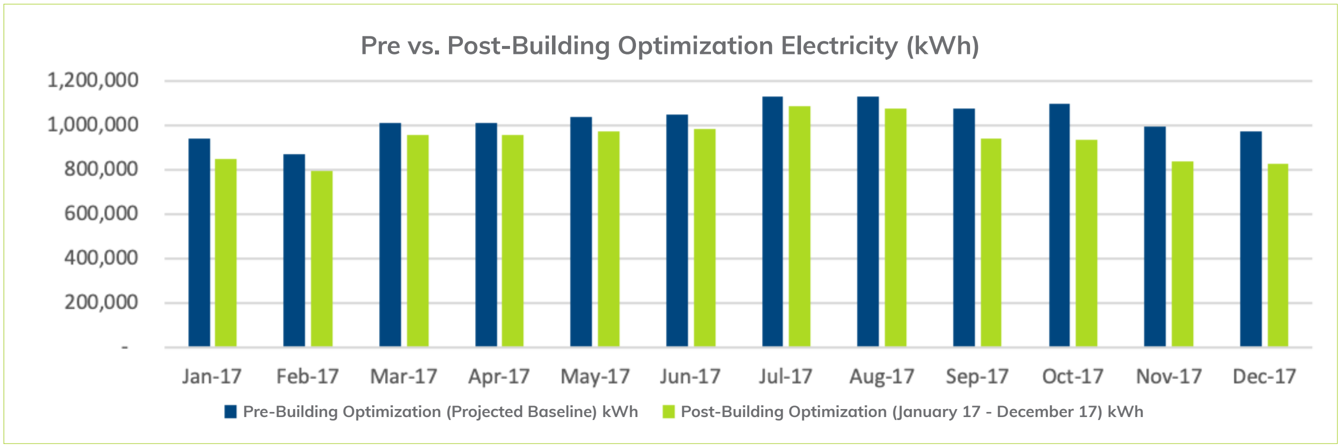
The Savings

Pulse Building Optimization was installed at the site in December 2016, and during 2017, it reduced the site's total projected energy consumption by 9% and saved over 1 million kWh.

1,097,486 KWH = **$175,598** TOTAL

Figure 1 summarizes the monthly electricity consumption in kWh, using a projected electricity baseline as the pre-Building Optimization case and actual 2017 data as the post-Building Optimization case case.

Figure 1: Pre- vs. Post-Building Optimization Electricity Consumption (kWh)



Case Study 2

The Building

This 500,000-sq. ft., 12-story office building in Washington, DC was completed in the early 1990s. The site held an ENERGY STAR® designation for efficiency and conservation prior to the Building Optimization installation and recently received BOMA's "The Outstanding Building of the Year" (TOBY) award. In addition to office space, the building includes a 10,000-sq. ft. gym and a few retail spaces. Typical operating hours are 7 AM to 8 PM Monday through Friday and 9 AM to 4 PM on weekends.

The facility has one 300-ton and two 800-ton, variable-speed centrifugal chillers. The chilled water system is primary only. The condensed water system includes two induced-draft CTs with two 75-HP, variable-speed fans each. Some 24x7 CHW load exists for data centers and critical spaces. The facility has four 100-HP, variable-speed chilled water pumps, as well as one 25-HP and three 100-HP, variable-speed condenser water pumps. The building's core space is served by VAV boxes and the perimeter, by fan-powered boxes (FPBs) with electric reheat coils. The AHUs serving the VAV boxes and FPBs have CHW coils and variable-speed supply and return fans with outside air economizers.

The Financials

With an initial upfront investment of $102,000, the return on investment was 133%. Simple payback was achieved in 1.2 years and a 79% internal rate of return (IRR) over five years.

$102K	$0	133%	1.2 YRS
UPFRONT INVESTMENT	UTILITY INCENTIVE	ROI	SIMPLE PAYBACK

79% IRR OVER 5 YEARS

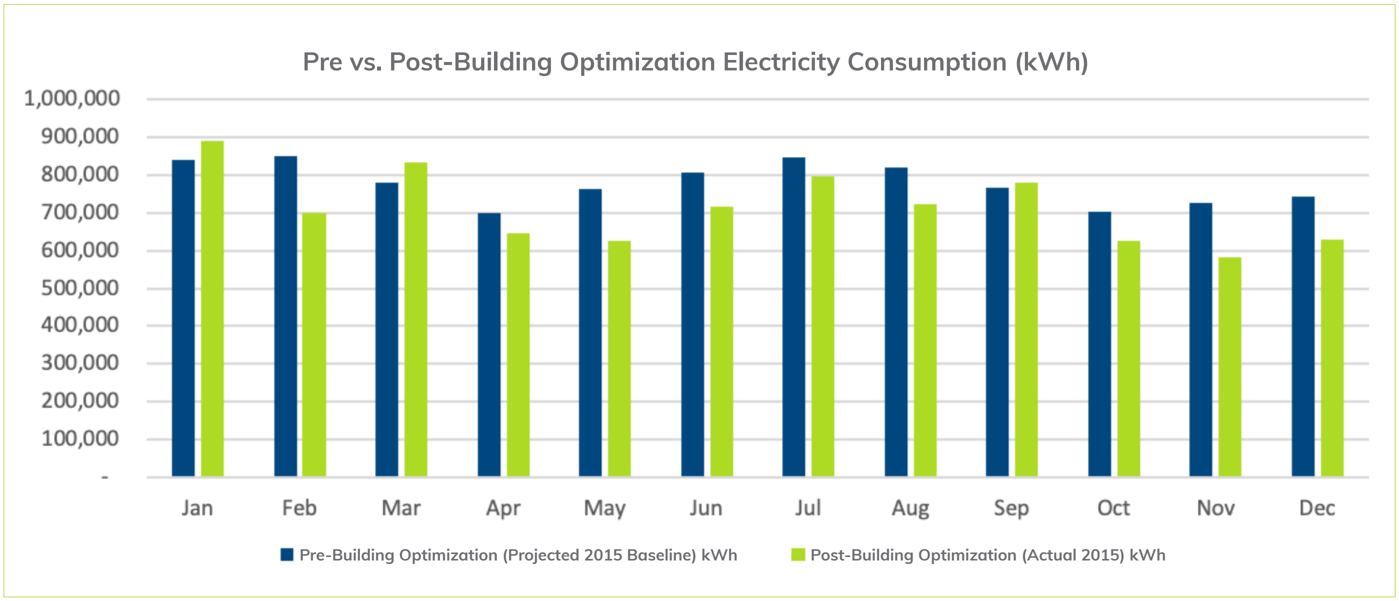
The Savings

Pulse Building Optimization was installed at the site in December 2014. In 2015, the building reported a total reduction in energy consumption at the site by 9% or $113,100.

797,344	=	$113,100
KWH		TOTAL

Figure 2 summarizes the monthly electricity consumption in kWh, using a projected electricity baseline as the pre-Building Optimization case and actual 2015 data as the post-Building Optimization case.

Figure 2: Pre- vs. Post-Building Optimization Electricity Consumption (kWh)



Case Study 3

The Building

This 550,000-sq. ft., office building in Irvine, California, was built in the late 2000s and holds ENERGY STAR as well as LEED Gold certifications. The typical operating hours are 8 AM to 6 PM Monday through Friday. The facility has two 1,000-ton, variable-speed York centrifugal chillers. A third pony chiller was added after the Building Optimization installation to handle after-hour and smaller loads. The CHW system is primary with bypass only. The condenser water system includes two 1,000-ton, induced-draft CTs with 75-HP, variable-speed fans. There is some 24x7 CHW load for data centers and critical spaces. The facility has two 100-HP, variable-speed CHWPs and two 75-HP, constant-speed CDWPs. A smaller 30-HP, variable-speed CHWP was added to serve the third chiller. VFDs were also added on the CDWPs. A VAV with a hot water reheat system serves each floor. The AHUs have CHW coils as well as variable-speed supply and return fans with outside air economizers. A dedicated AHU serves the lobby.

The Financials

The utility incentives of $65,402 covered more than 100% of the upfront installation cost of $62,500.

$62K	$65K	20%	0 YRS
UPFRONT INVESTMENT	UTILITY INCENTIVE	ROI	SIMPLE PAYBACK

INCETIVES COVERED INVESTMENT

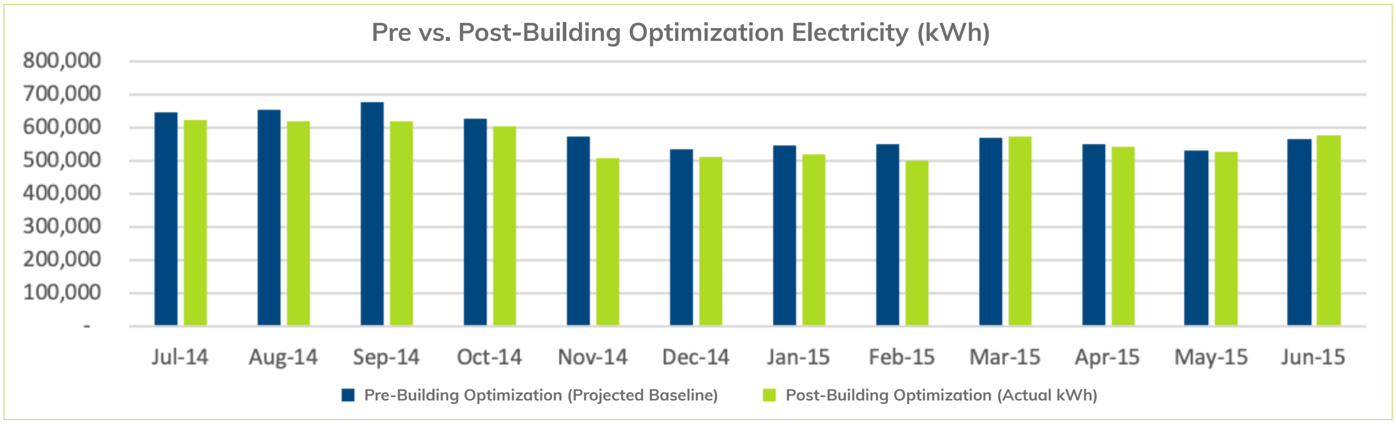
The Savings

Pulse Building Optimization was installed at the site in June 2014. From July 2014 to June 2015, the building saved more than $35,000. The Building Optimization installation reduced the projected HVAC energy consumption at the site by 13% and projected total energy consumption by 4%.

301,571 KWH = **$35,585** TOTAL

Figure 3 summarizes the monthly electricity consumption in kWh, using a projected electricity baseline as the pre-Building Optimization case and actual savings period data as the post-Building Optimization case case.

Figure 3: Pre- vs. Post-Building Optimization Electricity Consumption (kWh)



Case Study 4

The Building

This 65,000-sq. ft., two-story office building in Santa Barbara, California, was built in the early 1970s. The typical operating hours are 2 AM to 6:30 PM Monday through Friday. The facility has two 75-ton TRANE DX units without heating. The fans have variable-speed drives. Eight smaller York DX rooftop units range from 3 to 7.5 tons. The facility also has two gas-fired boilers and two hot water pumps (HWPs). A 30-ton Liebert unit serves the data center.

The Financials

On this project, the utility incentives of $34,635 more than covered the installation investment of $23,291.

$23K	$34K	100%	0 YRS
UPFRONT INVESTMENT	UTILITY INCENTIVE	ROI	SIMPLE PAYBACK

INCETIVES COVERED INVESTMENT

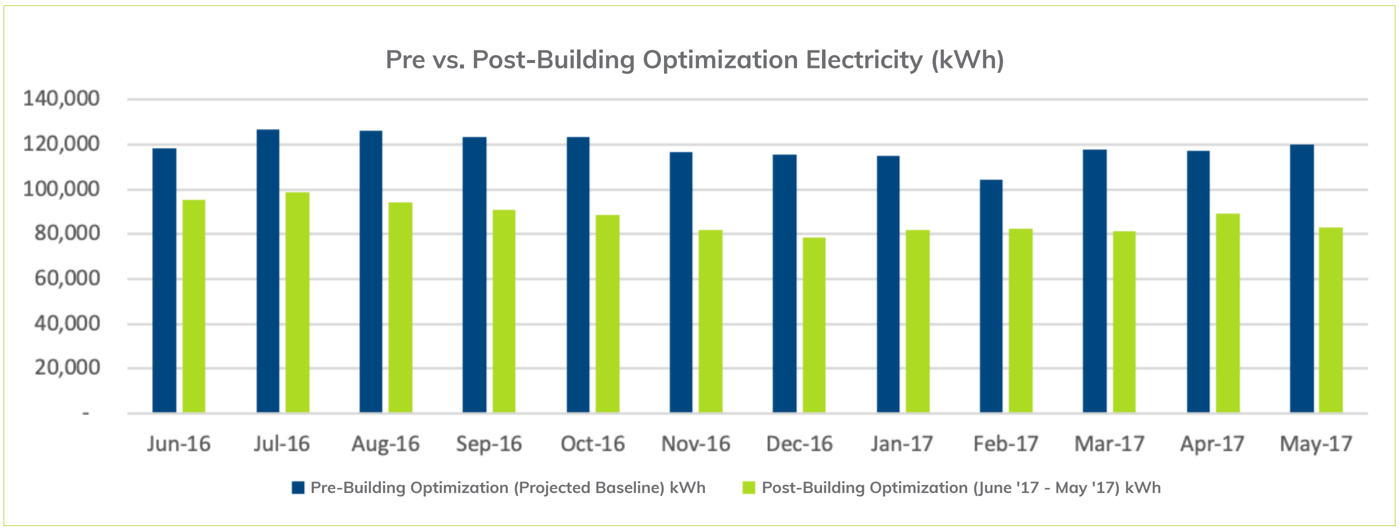
The Savings

Pulse Building Optimization was installed at the site in June 2016. The property reported annual energy savings totaling $55,686 for gas and electric from June 2016 through May 2017. The Building Optimization installation reduced the projected total energy consumption at the site by 28%.

378,890 KWH + **3,438** THERMS = **$55,686** TOTAL

Figure 4 summarizes the monthly electricity consumption in kWh, using a projected electricity baseline as the pre-Building Optimization case and actual savings period data as the post-Building Optimization case.

Figure 4: Pre- vs. Post-Building Optimization Electricity Consumption (kWh)



Case Study 5

The Building

This 1.9-million sq. ft., 56-story office building in New York City was built in the early 1970s. The typical operating hours are 6 AM to 7 PM Monday through Friday.

The facility has two 2,350-ton, water-cooled York steam turbine chillers as well as one 1,300-ton and one 600-ton York electric centrifugal chiller. Both electric chillers have VFDs. The steam chillers run during peak hours, and the electric chillers run during off-peak periods. The CHW system is primary/secondary with variable-speed pumps. The condenser water system includes four 100-HP and two 60-HP, induced-draft operational cooling towers with VFD supply fans. Variable-volume (VAV) air handling units (AHU) serve the building's interior spaces. These AHUs have multiple steam pre-heat coils, CHW coils and variable-speed supply and return fans with outside air economizers. Induction units with a two-pipe secondary loop system serve the perimeter.

The Financials

With an initial investment of $159,270, the return on investment was 99%. The property achieved simple payback in 1.2 years and a 74% internal rate of return (IRR) over five years.

$159K	$0	99%	1.2 YRS
UPFRONT INVESTMENT	UTILITY INCENTIVE	ROI	SIMPLE PAYBACK

74% IRR OVER 5 YEARS

The Savings

674,756	+	2,444	=	$189,852
KWH		THERMS		TOTAL

Pulse Building Optimization was installed at the site in November 2016. The three quarterly on/off tests conducted at the site were used to calculate annualized savings for 2017. The property reported annual energy savings totaling $189,852 for steam and electric. The Building Optimization installation reduced the projected total HVAC energy consumption at the site by 11%.

Figure 5 summarizes the monthly gas consumption in therms, using a projected gas baseline as the pre-Building Optimization case and the actual savings period data as the post-Building Optimization case.

Figure 5: Pre- vs. Post-Building Optimization Gas Consumption (Therms)

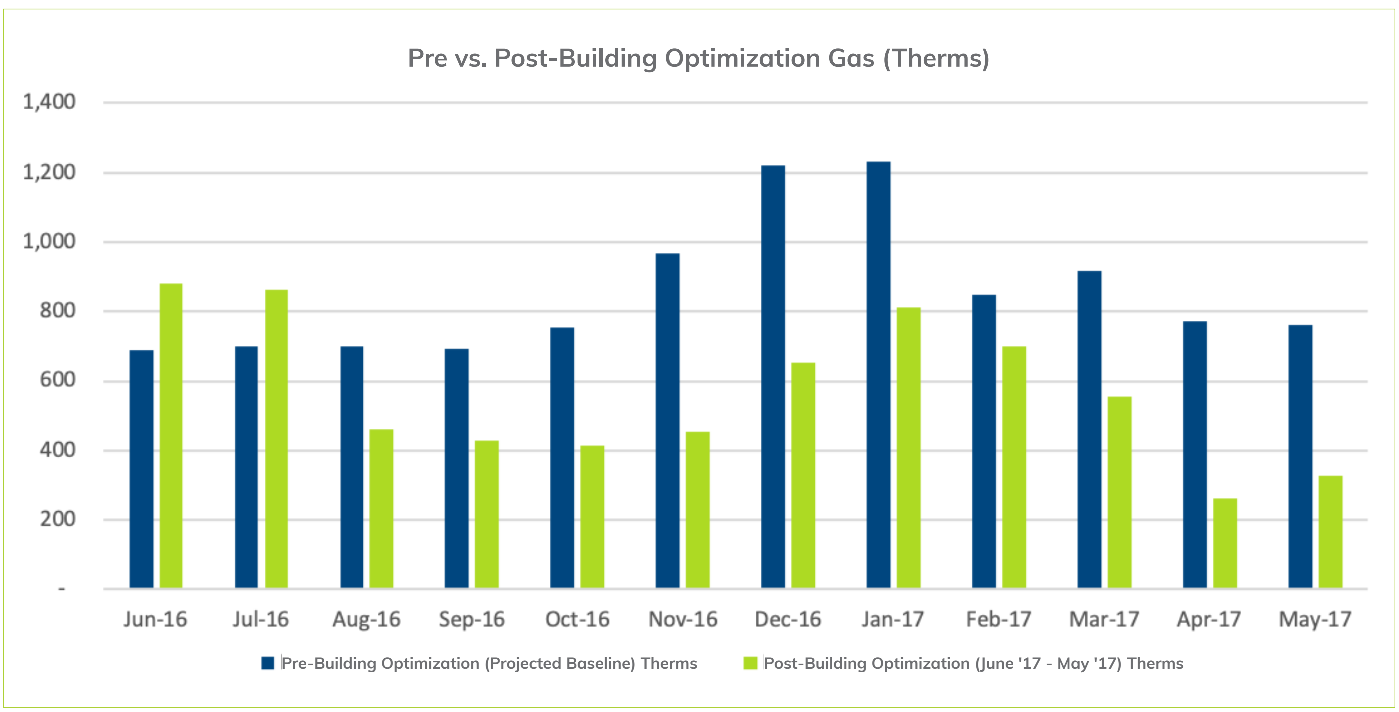


Figure 6 summarizes the monthly electricity consumption in kWh using a projected electricity baseline as the pre-Building Optimization case and actual savings period data as the post-Building Optimization case.

Figure 6: Pre- vs. Post-Building Optimization Electricity Consumption (kWh)

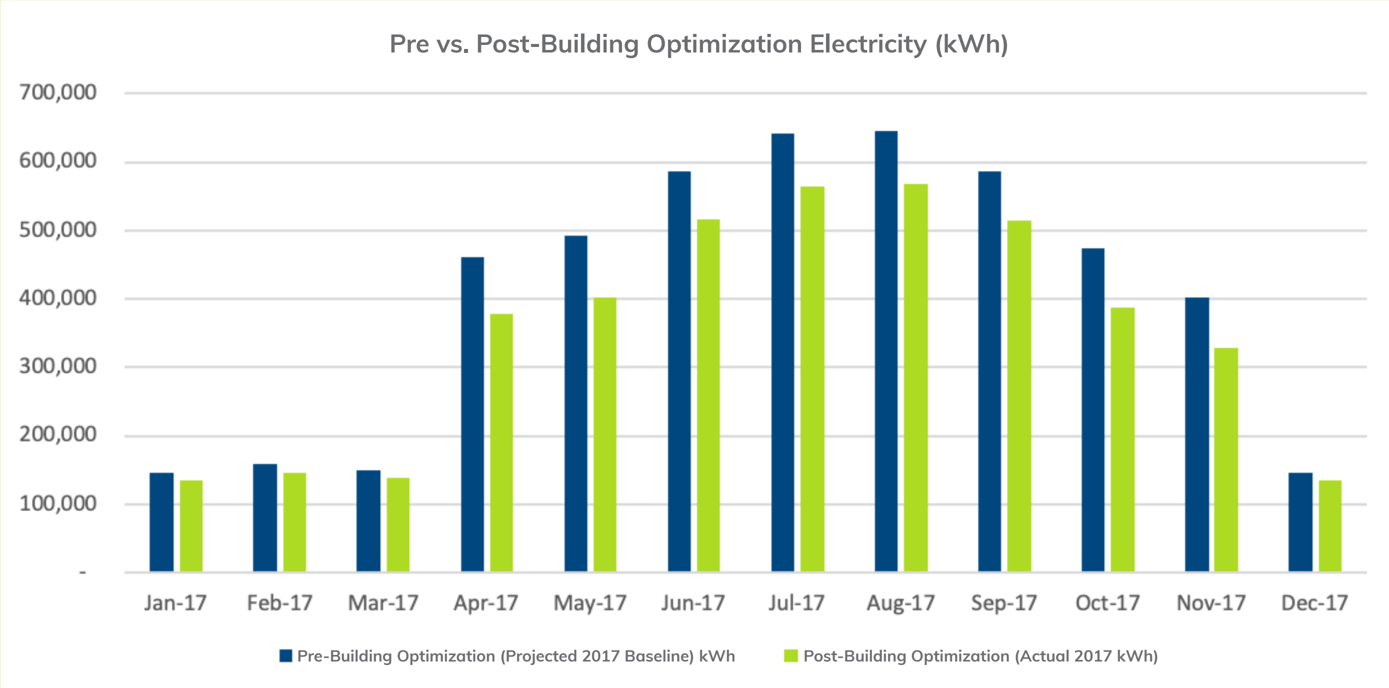
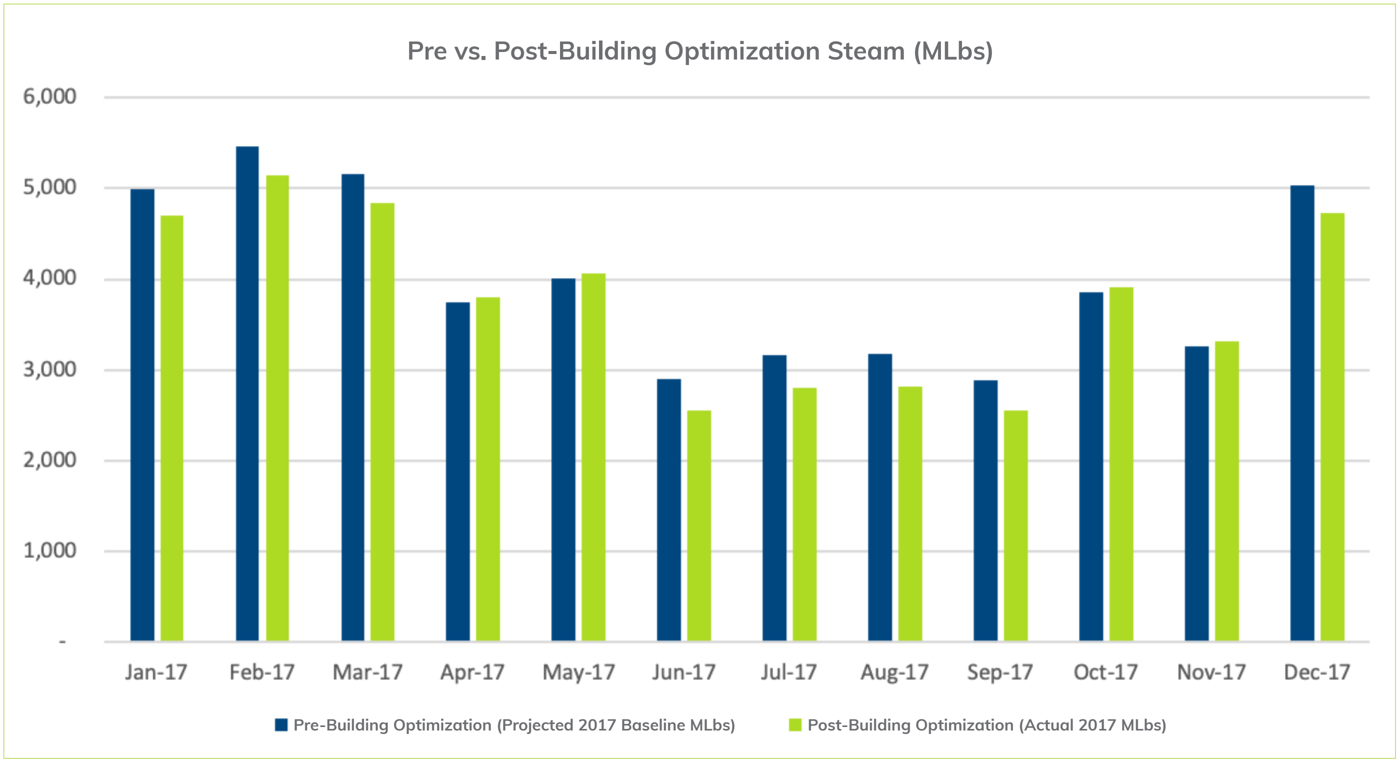


Figure 7 summarizes the monthly steam energy consumption in MLbs, using a projected steam baseline as the pre-Building Optimization case and the actual savings period data as the post-Building Optimization case.

Figure 7: Pre- vs. Post-Building Optimization Steam Consumption (MLbs)



Methods

M&V Methods

The International Performance Measurement & Verification Protocol (IPMVP) is used to calculate savings. Depending on the amount of data available at the site, several IPMVP options are available:

- **IPMVP Option B: Retrofit Isolation All Parameter Measurement (HVAC Only)**. This option is used when HVAC data for the baseline period and savings period can be isolated from the entire facility.
- **IPMVP Option C: Whole Facility**. This option is used when HVAC data for the baseline period and savings period cannot be isolated from the entire facility.
- **IPMVP Option C: Whole Facility with Building Optimization On/Off Test**. We include an on/off test with Option C if baseline period HVAC data is not available, but the client needs to verify HVAC savings from Pulse Building Optimization. We turn Building Optimization off for one/two week(s), then back on for one/two week(s) and compare the weather normalized (if applicable) trended data for both cases. The difference shows the effect Building Optimization has on the site.

The case studies in this document used the following IPMVP options:

- **Case Study 1**: Option C
- **Case Study 2**: Option C
- **Case Study 3**: Option C (with Building Optimization on/off test)
- **Case Study 4**: Option C
- **Case Study 5**: Option C (with Building Optimization on/off test)

Calculating Energy Savings

Because the weather between the baseline period and the savings period can vary substantially, we perform weather normalization to better reflect the savings achieved with Building Optimization. For example, if the savings period was much warmer than the baseline period, the savings period would use a lot more energy to cool the building relative to the baseline period. In that case, any savings calculated without weather correction would not be indicative of the building's true performance. The baseline period data is weather-normalized to mimic the savings period's weather conditions, as if the baseline period's usage had happened during the savings period's weather. This is achieved by performing a regression analysis using localized cooling degree days (CDDs) and heating degree days (HDDs) with the baseline period data. The weather-normalized baseline period data is then used as the pre-Building Optimization projected baseline when calculating savings.

Energy and cost savings are defined as follows:

- Energy savings = projected baseline – actual savings period data
- Cost savings = energy savings * energy rate

Conclusion

Yardi Pulse Building Optimization helps large commercial facilities use up to 30% less HVAC energy while increasing tenant comfort by up to 90%. Building Optimization can improve a building's LEED score and increase eligibility for other energy certifications. The Yardi Pulse platform optimizes how the HVAC system uses energy through energy efficiency optimization and fault detection and diagnostics.

The five case studies summarized in this paper represent a variety of Building Optimization installations. Each building saw a payback period of less than 1.5 years and savings of 10% to 30%. Some projects received utility incentives to help cover initial investment costs. In two cases, the utility incentive covered the entire upfront investment, resulting in immediate payback for the client.

Sustained energy savings, such as those produced by Building Optimization, can result in significant increases in the value of a building. On average, these five buildings save $0.36 per square foot in energy costs with Building Optimization. Assuming a 6% cap rate, the value of the five evaluated buildings was increased by $5.97 per square foot on average, or a total of $12 million.

Contact us to discuss the Yardi Pulse solution that's right for you.

Yardi.com/buildingoptimization | sales@yardi.com or (800) 866-1144

SOURCES

[1] All financial calculations presented in this document include implementation, incentives and annual Pulse Building Optimization service costs.