Adobe Systems Incorporated
World Headquarters

Study of Facility Management and Operations Best Practices

Research Supporting
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Educating Technicians for Building Automation and Sustainability

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Study of Facility Management and Operations Best Practices

Introduction

This case study is one of several studies conducted on facilities that demonstrate excellence in building operations, maintenance, and management. The study was commissioned by Laney College's Environmental Control Technician Program, as part of its National Science Foundation project *Educating Technicians for Building Automation and Sustainability*.

Best practices, in this context are defined as replicable, proactive strategies and activities that demonstrate excellence in the operations, maintenance, and management of a commercial or institutional facility. Best practices typically meet end-use requirements, improve occupant comfort, reduce energy consumption and meet sustainability goals, improve cost effective operations, and stimulate occupant engagement in energy conscious behavior. Best practices span excellence in technology and design strategies, troubleshooting and problem-solving, proactive organizational management and strategic planning, education and training efforts, and shared leadership. Building technicians play a critical role in each of the best practices highlighted in this study, whether the practices are more technical or more strategic in nature.

The best practices highlighted are not intended as a comprehensive analysis of the operation of each facility. They provide snap-shots of selected areas of excellence that crystallized as particularly significant to the successful operations of each facility. The practices were identified during site visits by a research team from Building Intelligence Group who conducted this research for Laney College.

These case studies demonstrate the critical role building technicians play in all aspects of sustainable building performance. It is our hope that they will inspire educators and practitioners alike in valuing building technicians as key agents of change in facilities and creating education and training opportunities to support technicians in their full professional capacities.

Best practices featured in this case study include:

1. Proactive maintenance
2. Use of energy analytics software across the facility management organization
3. Standardization of processes and reporting
4. Implementation of a sustainability program

Facility Overview

The Adobe Systems Incorporated World Headquarters is located in downtown San Jose, California. Adobe Systems is an international company that develops and sells business, creative and mobile software. The San Jose facility has about 2,500 employees, making Adobe one of the largest employers in downtown San Jose. The three high-rise, 18-story, Class A office buildings are managed by Cushman and Wakefield.

Background

Buildings and Systems

Built in 1996, 1998 and 2004, the towers provide 989,358 square feet of space for offices, conference rooms, data centers, software labs, a cafeteria, fitness center and mechanical rooms. All three of the buildings are certified as LEED EB: O&M Platinum, the highest rating a building can receive under the United States Green

Building Council (USGBC) Leadership in Energy and Environmental Design, Existing Buildings Operations and Maintenance rating system. The three buildings also have earned ENERGY STAR labeling each year since 2003.

Facility Staff

Given the recognition received, sustainability and energy efficiency are clearly core focus areas of the facility management and building operations team. The team works diligently to maintain the LEED EB: O&M and ENERGY STAR ratings at the highest levels.

As stated by George Denise, Global Account Manager at Adobe Systems, the overall mission of the facility management and operations team is "to provide a neat, clean, safe, healthy, productive, sustainable, and uninterruptable work environment at the lowest cost possible." Denise suggests that these items are listed in order of importance. The goal is first to meet the basic needs of the building occupants and to determine how to provide these needs at the lowest cost.

Best Practices

Best Practice #1: Proactive Maintenance

Proactive maintenance is planned work completed to reduce the number of reactive and emergency repairs.

Daily Rounds

At Adobe Systems, proactive maintenance is completed by staff performing both physical and virtual rounds. Physical rounds are completed by walking into each mechanical or electrical space and determining the current operating conditions of equipment. Physical rounds are important to help prevent larger problems and to maintain occupant satisfaction. If large problems are not identified quickly, they can take more time and money to repair.

All building engineers are required to understand and be able to maintain HVAC, plumbing and electrical systems (except high voltage electrical systems). Virtual rounds are completed by observing different operating parameters on the building automation system (BAS) workstation. Both types of rounds provide a different, but complementary, view of building operating conditions. Daily rounds for both HVAC and electrical equipment are completed by one building engineer each day and daily round duties are rotated amongst the building engineers. Completing physical rounds generally consists of determining the operating conditions of different equipment listed on the rounds sheet and looking for abnormal operating conditions, such as leaks, hot equipment and observations of unusual smells or sounds. Data collected during physical rounds is written on a rounds sheet and then stored in a binder. The daily rounds sheets are used when it is necessary to troubleshoot abnormal operating conditions and to provide information for third-party contractors.

Equipment that is inspected during daily physical rounds at Adobe Systems include, but is not limited to, chillers, boilers, fire pumps, the domestic water pressure station and air handling units. Some specific inspection tasks include:

- Reading of generator fuel levels (Figure 1).
- Inspection of chillers, cooling towers boilers, pumps and air handlers (Figure 2).
- Inspection of pumps for vibration or high motor temperatures.
- Comparison of chilled water supply and return temperatures at the chiller to the same temperatures on days with similar outdoor air conditions. Depending on the system, the data can be read from a control panel (Figure 3) or an inflow thermometer. If both are available, comparison of the values from the inflow thermometer and the control panel provide some

insight into calibration of instrumentation.
- Reading of run load amp values of chillers.
- Inspection of air handling unit filters to determine when replacement is necessary.
- Checking the water level in the ground water storage tank.
- Reading electric and natural gas meters.

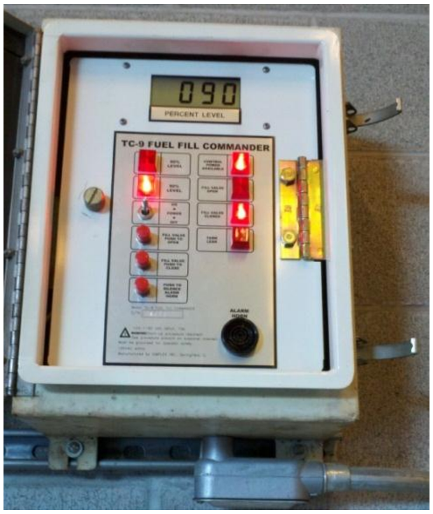


Figure 1: Enclosure with generator fuel indicators

Figure 2: Utility engineer checking pH levels of cooling tower water

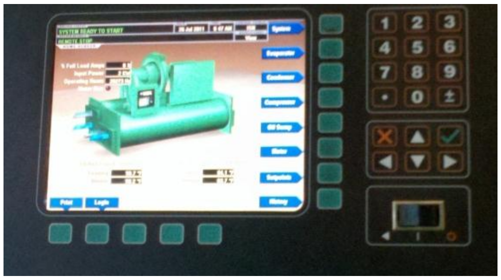


Figure 3: Chiller control panel

Other systems surveyed during daily rounds include the domestic water pressure boosting station (Figures 4) and fire pumps, two systems that are typically found in high-rise buildings. The domestic water pressure station, a series of pumps and tanks, is needed in a high-rise building to ensure that the water pressure within the pipes is great enough for the water to reach the top floors of the building. In addition to inspection, the fire pump is exercised weekly to make sure it will operate properly in the event of a fire. The fire pump motor is continually kept warm to allow for a quick start. In the event of a fire, the fire pump can be started in several ways, including at the control panel and manually by moving two levers (Figure 5).

Figure 4: Domestic water pressure station

Figure 5: Fire pump

Figure 6: Carbon filters used to treat groundwater

Yet another critical system subject to daily rounds is the ground water storage system, a collection of water storage tanks. While this system is not found in all commercial buildings, it is essential where the building extends below the groundwater table. Thus, to prevent groundwater from entering the building, it is necessary to pump it to a storage tank for treatment and then to the city sanitary sewer. Due to local regulations, the water must be treated using carbon filters (Figure 6).

Virtual Rounds

During virtual rounds, data from various systems and equipment is read from the building automation system, or BAS. Different screens are used to review system parameters such as the chilled water temperatures (Figure 7), operating conditions of the uninterruptable power supplies and motor control centers. From a whole building standpoint, daily electrical demand and consumption can be compared over the past several days.

During physical rounds, it is only possible to check for conditions that are seen visually through the exterior cabinet, or detect unusual sounds or smells. However, with the BAS, it is possible to see the energy consumption and temperature of the equipment. This allows potential operating problems to be detected much sooner than through only physical observations. The BAS also allows for data from the UPSs and motor control centers to be viewed at a greater level of detail as compared to the physical observations.

Skills and Knowledge for Proactive Maintenance

Based on the site visits and interviews conducted, building technicians and other members of the facilities team at Adobe Systems' headquarters utilize the following knowledge, skills, and abilities as part of proactive maintenance and the conduct of daily physical and virtual rounds:

- A desire to troubleshoot and fix things.
- Ability to read and record data, such as how to look for patterns in data collected during both physical and virtual rounds.
- Attention to detail to look for changes in operating conditions for different types of HVAC and electrical equipment.
- Communication with many different professionals, including security, building occupants and contractors.
- Ability to make decisions, such as when filters and/or belts need to be replaced, and if parts need to be ordered.
- Ability to read as-built drawings.
- Ability to navigate and use a building automation system.
- Be self-directed and committed to complete tasks.

As a building engineer, it is also important to be an advocate for the building. This requires identifying needs and keeping others informed of parts and tools needed to maintain and repair equipment as well as determining when money is needed for equipment replacement.

Although performing daily physical and virtual rounds is a task completed regularly within many operations and maintenance teams, the benefits of performing daily rounds is significant. If daily rounds were not performed, abnormal equipment operating conditions may occur and go unnoticed. Over time, such conditions could lead to uncomfortable space conditions for building occupants, poor reliability of critical equipment, or catastrophic failures.

Best Practice #2: Use of Energy Analytics Software across the Facility Organization

A common challenge in building operations and facility management today is the availability of data. As the potential to integrate different systems increases, the amount of data available also increases. However, data is only valuable if it can be turned into information that can be used for taking action or making decisions.

Although the ability for building automation systems and facility management software to collect and trend data is not new, there is a growing understanding in the industry that data-driven building operations can reduce cost and energy consumption. The BAS that the Adobe facilities team uses is called the Intelligent Building Interface System, or IBIS. It is an internet-based energy analytics software tool that can be used to monitor and track energy, sustainability and building performance. It can be viewed locally at the facility or anywhere across the globe over an internet connection.

Figure 7: IBIS view of chilled water plant

The original vision for IBIS was to have a system that could respond or provide data to help solve problems quickly. But, the use of IBIS evolved over time, and as new needs were recognized, additional capabilities were added to the system. The system was initially installed to enable automated demand response (ADR). Prior to the installation, the systems installed in the building only supported manual changes to reduce building electrical demand. The second use of IBIS was to support common scheduling of HVAC systems. Common scheduling allowed systems to be turned on and off globally, as opposed to turning equipment on and off at the system or equipment level. The third use of IBIS was to provide a graphical user interface to support faster management decisions. The fourth use of IBIS is to increase the number of automated processes.

Automated demand response (ADR) is a control strategy applied between a building and a utility that enables automatic reduction of building electrical loads. The utility must communicate directly with the building's BAS. Through the use of algorithms, control strategies can change lighting levels, cooling or heating set points, or reduce other equipment loads when there is a high demand on the utility grid. The decision to implement lighting control as an ADR strategy was not primarily economic. Although the electric utility provided incentives for participation in the program, the incentives did not economically justify initial participation. Initially, the lighting ADR application was used to demonstrate commitment to the environment, the potential of a new technology and to help prevent rolling blackouts in the State of California. In order to implement the lighting control ADR strategy using IBIS, it was necessary to rewire the lighting controls. When the buildings were constructed, perimeter and interior lighting zones were often on the same circuit. To prevent interior zones from being too dark and optimizing day lighting during an automated demand response event, the building was rewired to have perimeter and interior zones on separate circuits. After the implementation, the $98,000 capital cost to complete the lighting retrofit resulted in a 30 month payback, equivalent to a 38 percent return on investment.

An intuitive graphical user interface was a key design element of IBIS, allowing large amounts of data to be viewed through a common, easy-to-use interface. The graphical interface is generally “view only”, which means that set points and other operating parameters cannot be changed through IBIS, but only through the BAS. Thus, IBIS is used to view trends (Figure 8) and other operational characteristics that cannot be observed during daily physical rounds.

Figure 8: Trend data comparing energy consumption from the utility to energy generated by fuel cells in the East tower

Trends, like the one shown in Figure 8, are available for many different system parameters originating in a variety of equipment. There are over 30,000 monitored points, including IT branch circuits, uninterruptable power supplies (UPSs), computer room air conditioning (CRAC) units, emergency generators and HVAC sensors and meters. Some of the HVAC sensors and meters installed include water flow meters, supply air temperature sensors, return air temperature sensors, air flow monitoring stations, chilled water temperature sensors and condenser water temperature sensors. To collect this much data, it was not necessary to install many additional meters and sensors after construction. Nearly all of the sensors and meters were installed during construction, in accordance with the initial design. Thus, most of the points are monitored by IBIS and the BAS. IBIS is also integrated with the lighting control system, as well as the building level electric, natural gas and water meters.

To ensure that data read from IBIS is accurate, it is important that the sensors and meters be properly calibrated. At Adobe Systems, a controls contractor calibrates sensors annually. During physical rounds, building operators look for inconsistencies in measurements quarterly and make periodic adjustments as needed. To collect and store large amounts of trend data for long-term analysis, it is important that adequately sized servers provide data storage. At Adobe, one dedicated server is used to store trend data and a second is used to run the IBIS software.

In addition to monitoring and troubleshooting systems, IBIS can be used to resolve occupant issues. Space temperature trend data from conference rooms can be used to troubleshoot comfort complaints. For example, by using trend data for both the supply and return air temperature for a conference room, it was possible to determine that it was more desirable to control the volume of supply air delivered to the conference room based on the return air temperature. Controlling the volume of air based on supply air temperature resulted in too much variation in the room temperature, reducing occupant comfort.

At the management level, data from IBIS can also be used to support high-level energy and operations decisions. For example, Figure 9 displays several screens:

- Upper left: Percentage of total energy consumption, measured in kilowatt-hours for different system types: HVAC, critical systems, systems that consume natural gas

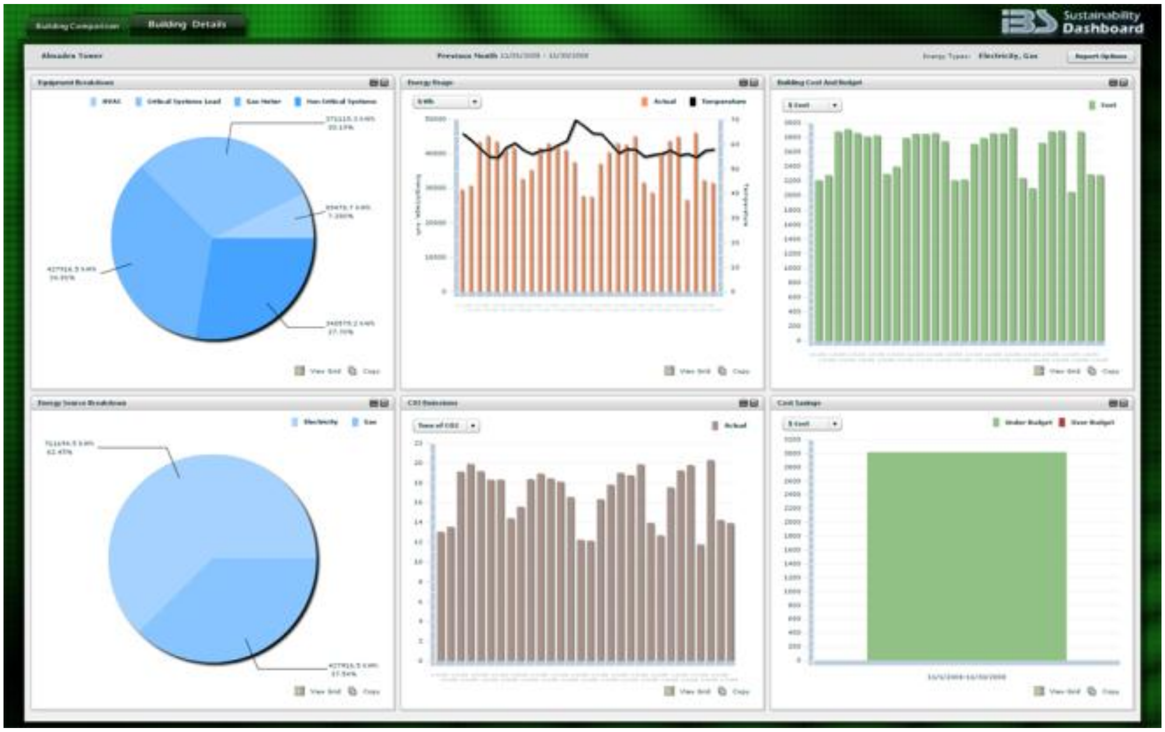


Figure 9: Charts used for energy decision support

and non-critical systems. This data is displayed in real-time from IBIS and can be viewed regularly by members of the facilities team.

- Upper middle: Energy consumed, measured in kilowatt-hours (orange bars) compared to outdoor air temperature (black line) for the last thirty days.
- Upper right: Cost of energy consumption over time for the last thirty days.
- Lower left: Percentage of energy consumption breakdown, comparing electricity and natural gas. This data is displayed in real-time and can be viewed regularly by members of the facilities team.
- Lower middle: Actual carbon dioxide (CO_2) emissions as a result of energy consumption for the last thirty days.
- Lower right: Monthly energy cost savings, where green indicates the cost is within budget. If the bar was red, it would indicate that the monthly cost exceeded the budget.

The charts shown in Figure 9 could be used to determine what systems are consuming the most energy. This information could be then used to prioritize where energy efficiency strategies should be considered. A second use of the charts could be to identify causes for certain operating conditions, compared to weather data. For example, the upper middle chart shows a spike in outdoor air temperature when actual energy consumption is lower than most other days.

The type of chart used can be dependent on the type and time frame that an analysis is being performed. Pie charts can work well when percentages of the total are important. For example, a pie chart was used to help the chief engineer determine that the three-phase power to the uninterruptable power supply (UPS) serving the data centers was not balanced and that the data center had not reached maximum capacity. Looking at the pie chart, it was easy to quickly see that one of the three phases was carrying nearly the full load of the data center. By rebalancing the load, it was possible to provide safer operating conditions, and also prevent additional data center capacity from being installed for two more years. Bar graphs are helpful to compare series of monthly or daily data to each other. For example, the bar graphs (Upper middle, upper right, lower middle), reflect that the energy consumption, and thus carbon dioxide emissions, on weekends is lower than weekdays. For groups of seven days, these three bar graphs show five days (weekdays) of higher consumption with two days (weekends) of lower consumption. This quickly demonstrates that systems and equipment are being turned off on weekends. By comparing weekday and weekend data over a month, it is possible to determine if energy consumption may be starting to trend upwards.

Work orders are automated through IBIS. To do this, it was necessary to integrate IBIS with the computerized maintenance management system (CMMS). A CMMS is a software program that is used to manage work orders, maintenance histories and other maintenance information. The integration between IBIS and the CMMS was completed in-house. To automate a work order requires that a set of rules be written to trigger an event when a certain operating condition occurs. For example, if the chilled water supply temperature is too high, an algorithm could be used to send a work order to a technician to notify him or her that it is necessary to determine the case of the higher than anticipated temperature. Automating work orders can reduce the time it takes for work orders to be dispatched and resolved. When work orders are not automated, it is necessary for either someone to assign a work order to a specific technician or for an alarm to be manually dispatched.

When an alarming strategy is determined, it is always a challenge to balance how many alarm events to use and the priority levels of the alarms to prevent too many alarms from being generated. If too many alarms are not sent out as automated work orders, it can be difficult for technicians to prioritize what work orders are most important. At Adobe Systems, three alarm levels are used:

- Critical alarms for critical HVAC and electrical systems
- Run-time alerts that provide notification that something is running when it should not be
- Energy alerts

Depending on the priority and type of alarm, the alarm may be dispatched through IBIS, the building automation system or a notification may be displayed on the computer screen for some building operators. Critical alarms will be sent out when a possible undesirable operating condition is occurring with critical equipment, such as within the data centers. Depending on priority, alarms are sent out to the chief engineer, building engineer and/or utility engineer via email or sent out as a text message to smart phones in the form of a work order. Non-critical alarms are viewed through the building automation system.

Energy alerts are automated work orders that are sent out when the energy consumption for a specific energy system is higher than expected. When a technician receives the alert, he or she is to use a series of specific action steps provided within the work order to determine the reason for the increase in consumption and complete any follow up items necessary to resolve the work order. To prevent too many alarms from being generated, it is important to carefully set the threshold to prevent alarms from being triggered if the actual energy consumption is not significantly above the anticipated maximum demand.

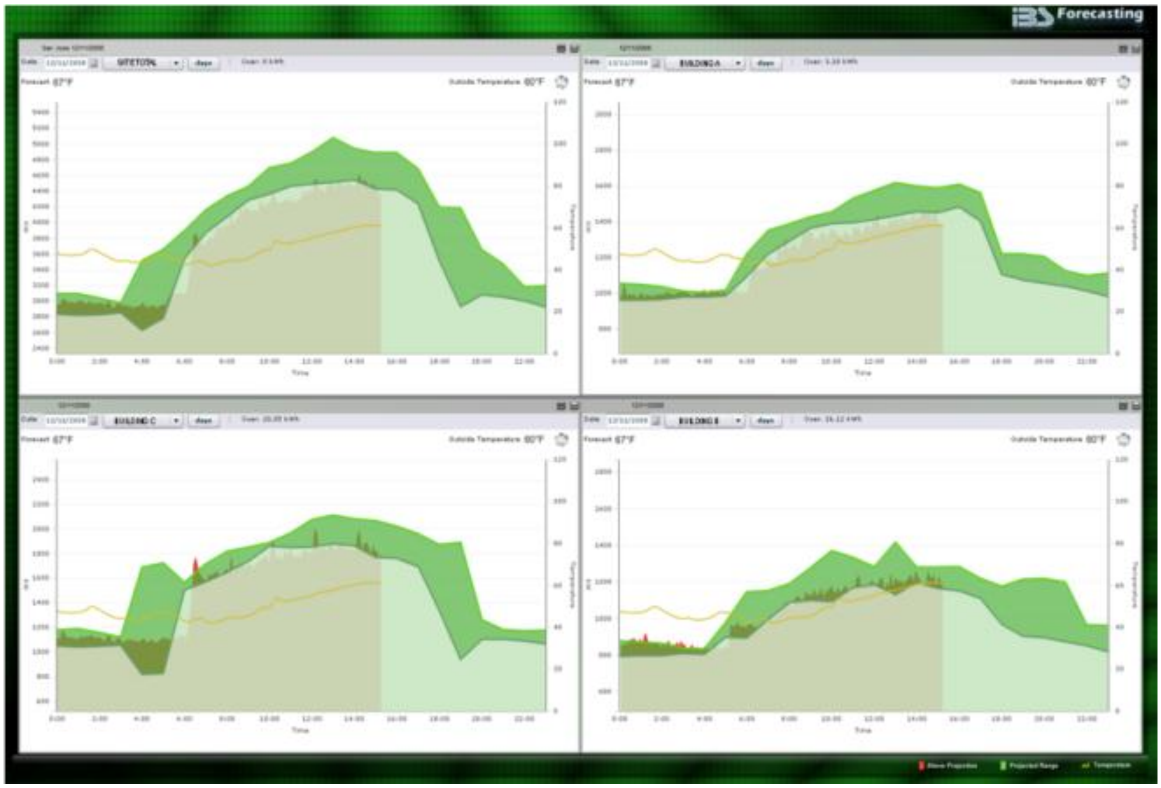


Figure 10: Actual and anticipated electrical demand for the three office towers, individually and combined (upper left)

Analytics can be used to create graphs that compare actual electrical demand against the anticipated electrical demand. Adobe uses an algorithm to compare the last five days of similar weather data, considering temperature, relative humidity and time of year to predict the anticipated electrical demand for the day. The last five days of data can be selected from the last 12 months of data. The dark green band in Figure 10, the demand corridor, indicates the range of anticipated demand. The bottom of the band indicates anticipated minimum consumption, while the top band indicates anticipated maximum demand. Over time, the actual demand for the day is plotted against the anticipated load as a red curve. Within Figure x-11, the lower left and lower right screen captures have small portions of red outside the demand corridor at about 6AM and 2 to 4AM, respectively.

Using these graphs, the building operator can quickly see if or when the demand is higher than anticipated. Using a checklist, the building operator troubleshoots reasons for the high demand. If the demand is higher than the threshold, an energy alert is sent out the technicians.

A current strategic goal at Adobe is to develop algorithms to quantify the cost savings as a result of responding to energy alerts if the increase in consumption would not have been detected over different periods of time, such as a week, month or a year. Use of such data will help to optimize the dispatching of automated energy alerts.

An algorithm was also created to allow ENERGY STAR scores to be calculated in real-time. This allows the score to always be known, instead of receiving an updated score each month or year. The real-time ENERGY STAR scores are displayed in the lobbies for building occupants to see (Figure 11) and can be viewed by members of the facility management team through IBIS.

The use of energy analytics software has many qualitative and quantitative benefits. Qualitatively, the graphical nature of the software reduces the amount of training required to understand how to navigate between the different screens. Technicians can use a mouse to click on different screens to quickly view how different equipment is operating. It is anticipated that the use of IBIS reduces labor costs, increases technician productivity, provides access to information not previously available and improves availability of reports. One example of the quantitative benefits of the data from IBIS is the use of digital water meter data to identify a leak in the irrigation system. By having the meters installed and connected to IBIS, the building operators found a water leak that would not have been caught because the leak only resulted in a small increase in water consumption, compared to the total water consumption of the facility. Having the detailed monitoring data allowed the leak to be detected, saving $12, 000. Although $12,000 is not a large portion of the budget, multiple small savings add up – the identification of ten $12,000 cost reduction opportunities results in $120,000. Some additional cost saving opportunities identified through IBIS to help support "strategic decision-making" are summarized in Table 1.

Table 1: Cost savings identified from the use of IBIS and automated reports

Cost savings measure	Cost ($)	Annual savings ($)	Payback (Years)
Identification of water pump control problem through use of IBIS	$4,364	$4,200	1.0
Lighting re-zoning to support participation in demand response program	$68,000	$28,000	2.4
Installation of real-time digital water meters for cooling towers	$39,422	$12,000	3.3
Installation of weather station	$9,890	$3,000	3.3

Skills and Knowledge for Energy Analytics

Based on the site visits and interviews conducted, building technicians and other members of the facilities team at Adobe Systems' headquarters utilize the following knowledge, skills, and abilities as part of energy analytics:

- Mastery of basic computer skills, including the ability to navigate computer screens.
- Ability to use spreadsheets, including entering data, using formulas, creating graphs and linking spreadsheets.
- Being analytically-minded, questioning operational parameters and why changes have occurred.
- Careful listening and observation, especially with regard to learning from more experienced technicians.

A good understanding of how controls, HVAC and electrical systems work is also important. It is important to recognize that truly understanding building systems requires a lot of experience. There are many different types of systems and different buildings often have different systems and configurations.

"Experience is the key to success in the building operations and facility management business."

Karl Okulove, Global Energy Manager

Best Practice #3: Standardized Processes and Reporting

Facilities operations management reports are distributed monthly. The report contains a summary of the contents of the report, operational highlights, summaries of metrics, and electricity, gas and water usage data. Information contained in the summary presents building data, including the square footage of the facilities, monthly operating expenses, square footage per occupant, operating expenses per square foot and other metrics and site highlights.

Twenty-five monthly key performance indicators, or KPIs, are included. As Adobe Systems is a global company, the KPIs are reported globally, meaning the data for all facilities is aggregated to report a single value. Several of the KPIs are cost metrics: monthly operating expenses, total capital expenses, operating expense per occupant, operating expense per square foot and total copy paper spend. Other KPIs are intended to help understand occupancy patterns: Percent occupancy, total moves, annualized churn rate and customer satisfaction rating. Yet other KPIs quantify maintenance practices: Number of work and preventative maintenance orders, on-time completion rate of work orders and the number of corrective action versus on-demand work orders. The goal for "on-time completion and corrective action" versus "on-demand work orders" is listed following the monthly data to provide a benchmark against which to compare the data. Finally, energy KPIs are listed: average ENERGY STAR score, purchased energy consumption per square foot, and total energy use reported in energy consumption per square foot. Similar to the maintenance KPIs, a benchmark is provided as a meaningful comparison to the monthly data.

Some of the KPIs are also included in the report per building (Figure 12). As shown, the figure includes the size of the building in square feet, the number of occupants (head count), operating costs, operating cost per occupant, percent occupancy, annualized churn rate, total work requests, work requests per occupant, percentage of work orders completed on time and customer service rating. The bottom of the figure provides an average for all of the sites. By comparing the average to specific buildings, it is possible to gauge general performance for metrics that are normalized per occupant.

Since the report for Adobe Systems is created to summarize and compare all Adobe Systems facilities across the world, operational highlights of specific facilities are mentioned. New members of the staff team are mentioned, as well as successes, such as increases in ENERGY STAR scores and the implementation of new programs, such as green cleaning or installation of electric vehicle recharging stations.

Within the KPI section of the report, the electricity, natural gas and water consumption for several different facilities are compared. Figure 13 provides an example of electricity consumption measured in kilowatts per square foot for several different facilities. The three bars to the far right are for the Adobe San Jose buildings. When comparing the energy consumption per unit area for several different buildings, it is important to consider the function of the building and activities occurring in the building before drawing conclusions. For example, the three San Jose high rise buildings have more data centers and software labs than the Boston, Orem and San Francisco buildings. The San Jose east tower (ET) has two data centers, while the other two San Jose buildings only have one data center. The buildings in Boston, Orem and San Francisco are also not high rise buildings.

"Benchmarking helps to note why something is occurring, and provides a starting point to determine why."

George Denise, Global Account Manager

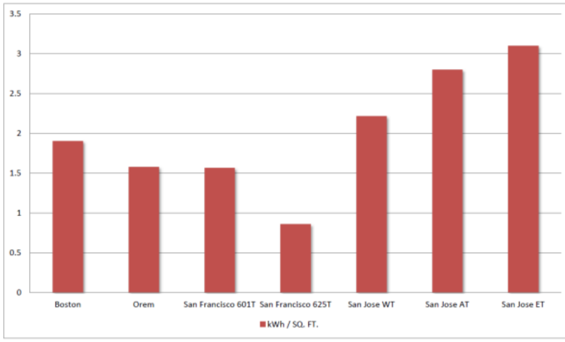


Figure 11: Monthly energy usage for several Adobe Systems facilities

The monthly reports are shared directly with 95 members of the facilities team, including the chief engineer, energy manager, Adobe regional managers and account manager. Having one report helps to reduce the amount of time needed to gather the data and provide a uniform format for everyone to understand the data from a single point of view. It is estimated that a significant amount of employee time is saved when only a single report is generated because multiple managers are not compiling similar reports.

The monthly reports are valuable to both the team members who create the reports and those who use the reports for decision making. When developing a monthly report, it is necessary to collect the data and determine what the data indicates for the given point in time. The conclusions drawn from the report must be defendable: clear reasons as to what the data demonstrates must be known.

One of the main uses of the monthly reports is to set and track goals. For example, initially a goal was set to divert 90 percent of waste generated within the buildings. Now that this goal has been met, a new goal, diverting 98 percent of generated waste, has been set. Setting goals helps to make strategic decisions about what operations and maintenance practices are being performed well and where improvements are needed. Once a goal is met, it is often easier to meet a higher goal because momentum and behavioral changes are already in place to support the practice. A second example of the use of the monthly reports to set and track goals is achieving ENERGY STAR scores. Since all three facilities have earned the ENERGY STAR, the current goal is to have all three facilities have scores of 100, the highest possible score.

If a KPI is lower or higher than previous months, reasons for the low or high value are investigated. The comparison of lower or higher scores depends on the KPI. For example, an ENERGY STAR score would be investigated if it was lower than previous months. However, the total monthly operating expense would be investigated if it were higher. The process starts with discussions between the account manager, site manager and chief engineer. The purpose of the discussions is to determine the reason(s) for the variation. One investigation to lower than anticipated ENERGY STAR scores determined that the boiler efficiency was dropping. Since the local air quality requirements for natural gas boilers were becoming more stringent, the existing burners were replaced with more efficient boiler efficiency, cleaner boiler combustion and an increase in the ENERGY STAR score. A second investigation, at a later date, revealed that the boilers were operating during the summer months. However, it is company policy that boilers are to be turned off in summer. Although manufacturers may suggest that boilers not be turned off for long periods of time, it was found at Adobe that the energy savings resulting from the boilers being off in summer was greater than any operational problems resulting from the boilers being turned off for several months.

Similar to IBIS, the monthly reports are graphical and are written to allow users to find the information they need quickly and support coordinated communication, both of which attribute to increasing organizational efficiency.

Property	Square Feet	Headcount	Operating Costs	Operating Costs / Headcount	Occupancy Percentage	Annualized Churn Rate	Total Work Requests	Worktickets / Headcount	Work Requests Completed On Time (%)	Customer Service Rating
Boston	108,200	130	$ 135,775	$ 1,044.42	42.5%	313.8%	39	0.300	100.0%	3.00
Orem	160,525	782	$ 96,821	$ 123.81	89.3%	160.2%	95	0.121	98.9%	3.00
Ottawa	121,570	324	$ 328,722	$ 1,014.57	81.0%	96.3%	45	0.139	100.0%	3.60
Seattle	181,718	451	$ 536,150	$ 1,188.80	77.9%	79.8%	180	0.399	100.0%	3.42
Arden Hills, Minnesota	19,871	42	$ 4,724	$ 112.48	67.7%	28.6%	N/A	N/A	N/A	N/A
Downers Grove, Illinois	7,981	10	$ 2,915	$ 291.50	47.6%	120.0%	N/A	N/A	N/A	N/A
McLean, Virginia	33,947	129	$ 10,922	$ 84.67	79.6%	27.9%	3	0.023	100.0%	N/A
New York, New York	27,323	86	$ 27,356	$ 318.09	92.5%	181.4%	22	0.256	100.0%	N/A
Total American Field Offices East	96,988	304	$ 56,596	$ 186.17	77.2%	86.8%	26	0.086	100.0%	N/A
Richardson, Texas	7,213	20	$ 5,627	$ 281.35	60.6%	N/A	3	0.150	100.0%	N/A
San Diego, California	39,951	51	$ 7,867	$ 154.25	76.1%	N/A	1	N/A	N/A	N/A
Santa Rosa, California	7,521	11	$ 1,459	$ 132.64	45.8%	N/A	N/A	N/A	N/A	N/A
Total American Field Offices West	54,685	82	$ 14,953	$ 182.35	66.1%	N/A	4	0.049	100.0%	N/A
San Francisco 601T	289,727	835	$ 278,222	$ 333.20	94.9%	N/A	346	0.414	100.0%	3.57
San Francisco 625T	55,853	193	$ 53,508	$ 277.24	73.9%	N/A	80	0.415	100.0%	N/A
Brannan	35,419	147	$ 14,046	$ 95.55	90.2%	N/A	41	0.279	100.0%	N/A
Total San Francisco	380,999	1,175	$ 345,776	$ 294.28	90.1%	61.9%	467	0.397	100.0%	3.57
San Jose WT	364,935	813	$ 346,562	$ 426.27	82.2%	N/A	651	0.801	99.5%	3.67
San Jose AT	250,078	878	$ 305,219	$ 347.63	100.6%	N/A	348	0.396	99.7%	3.78
San Jose ET	300,971	693	$ 438,628	$ 632.94	75.4%	N/A	309	0.446	100.0%	3.85
Total San Jose	915,984	2,384	$1,090,409	$ 457.39	85.7%	85.1%	1,308	0.549	99.7%	3.81
Average	164,831	454	$ 195,346	$ 430.01	76.0%		220	0.307	99.9%	3.53
Total Americas	2,020,669	5,632	$2,605,201	$ 462.57	83.3%	95.0%	2,164	0.384	99.8%	3.66

Figure 12: Metrics from the monthly global report for Adobe Systems at the building level. *[Note: Data is fictitious and for illustration only.]*

Skills and Knowledge for Energy Analytics

Based on the site visits and interviews conducted, building technicians and other members of the facilities team at Adobe Systems' headquarters utilize the following knowledge, skills, and abilities as part of standardized processes and reporting:

- Ability to use spreadsheets to perform data tabulation, analysis and charting.
- Visualization of macro and micro perspectives when making strategic decisions.
- Ability to draw defendable conclusions.
- Understanding of key performance indicators, or KPIs, and how to derive them to support reporting requirements.
- Ability to communicate the rationale behind KPIs and reported information, and reasons for achieving or falling short of performance goals.

Best Practice #4: Implementation of a Sustainability Program

Sustainability is an important part of the mission of Adobe Systems and Cushman and Wakefield. The three towers in San Jose have received the highest USGBC certification, LEED EB: O&M Platinum, and have ENERGY STAR scores of 100, 98 and 92. The highest ENERGY STAR score is 100, on a scale from zero to 100. Buildings with a score of 75 or higher are eligible to receive the ENERGY STAR label. Plaques of these accomplishments are prominently displayed in the main lobby of each building (Figure 14).

Figure 13: LEED and ENERGY STAR plaques

LEED EB: O&M

Leadership in Energy and Environmental Design for Existing Buildings Operations and Maintenance 2009 is a voluntary rating system developed by the U.S. Green Building Council that ranks how green a building is, considering seven categories:

- **Sustainable sites**
- **Water efficiency**
- **Energy and atmosphere**
- **Materials and resources**
- **Indoor environmental quality**
- **Innovation in operations**
- **Regional priority**

To maintain the LEED EB: O&M status and the ENERGY STAR labels annually, Cushman and Wakefield gather documentation monthly that must be submitted for re-certification to the USGBC quarterly and to the U.S. EPA annually. Gathering the data at monthly intervals helps to keep accurate, up to date records. Some of the data needed is collected from IBIS.

Practices instituted at Adobe Systems in support of LEED EB: O&M include:

- Plans for managing cooling tower water treatment, bleed-off and biological control (LEED EB: O&M WEc4.1: Cooling Tower Water Management, Chemical Management)
- A preventive maintenance program to ensure all BAS components are tested and repaired or replaced at the manufacturer's recommended interval; and
- BAS is used to drive decisions about building operations and energy savings (LEED EB: O&M EAc3.1: Performance Measurement – Building Automation).

ENERGY STAR

ENERGY STAR is a voluntary program developed by the U.S. Environmental Protection Agency and the U.S. Department of Energy to help reduce energy consumption through energy efficient products and practices. ENERGY STAR Portfolio Manager is a free, interactive energy management tool that can be used to track energy and water consumption of buildings. Portfolio Manager is used to determine the ENERGY STAR score for a building.

ENERGY STAR scores are tracked monthly as a way to benchmark and maintain energy efficiency. Monthly tracking provides a practical way to determine if energy consumption is slowly increasing or remaining steady, reducing the need for energy audits.

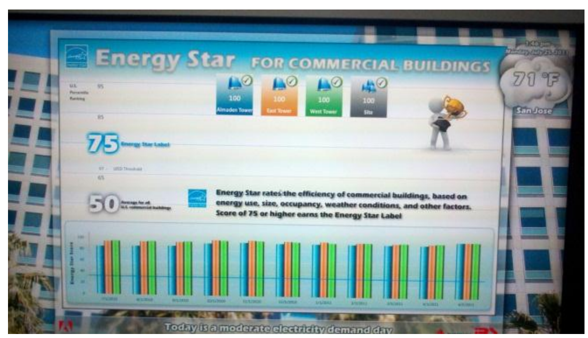


Figure 14: ENERGY STAR scores

Between 2001 and 2011, Cushman and Wakefield completed 77 sustainability projects at the Adobe Systems' headquarters. Spending $2.8 million dollars resulted in a $2 million annual savings, equivalent to a 1.1 year simple payback or 95 percent return on investment with $708,000 in rebates. Some of the benefits include:

- 27 percent electricity usage avoided
- 16 percent natural gas usage avoided

- 53 percent reduction in domestic water use
- 93 percent reduction in irrigation water use
- 98 percent solid waste diversion rate
- 43 percent reduction in carbon dioxide emissions

Projects completed spanned a range of building system upgrades such as installing thermal window film, optimizing the chiller plant control sequences and the implementation of an energy and sustainability checklist. Installing window film resulted in an annual savings of $51,504 with 24 percent return on investment. Optimizing the chiller plant control sequences using an all-variable speed strategy resulted in an annual savings of $297,553, a 49 percent return on investment.

One of the simplest energy conservation projects with a high return on investment was reducing the run-time of the garage exhaust fans. Before the energy conservation project was implemented, the exhaust fans operated 24 hours a day, seven days a week. However, through an analysis of the concentrations of exhaust and other particulates in the air, it was found it was only necessary for the fans to cycle on 15 minutes each hour, except during high traffic times: three hours in the morning and three hours in the evening as employees were coming and leaving the office. The change in the control strategy cost approximately $100 of a building engineer’s time, but resulted in electricity savings of $98,000 annually, yielding a 980 percent return on investment or nearly an immediate payback.

Real-time digital electric meters were installed in the main electric panels for a cost of $39,472. After using the meters for one year to look for energy consumption abnormalities identified by examining graphs of the data, a 42 percent return on investment was realized. It was also found that the graphs made it easier to identify variances in energy consumption.

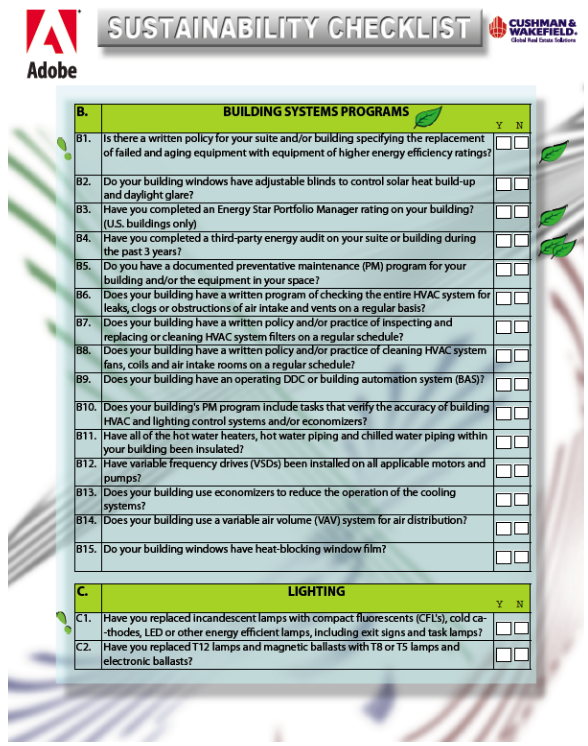
Although the buildings had motion sensors in individual offices for overhead lighting as part of the initial construction, the facilities team determined additional locations where motion and occupancy sensors could be used to further reduce lighting power consumption. Power strips with motion sensors were installed to turn off plug loads, except uninterruptable power supplies (UPSs), when occupants are not in their offices. Motion sensors were installed in break rooms, hallways, restrooms and meeting rooms. Motion sensors, connected to relays, were connected to the variable air volume (VAV) boxes in the conference rooms so that the rooms were only being heated or cooled during use. Since code requirements do not allow lights in stairwells to be turned off using motion sensors, the lamps and ballasts initially installed were replaced with dimmable lamps and ballasts to allow motion sensors to dim stairwell lighting to the minimum level to meet code requirements for safety when the stairwells are not occupied. A similar strategy was also used with the parking garage lighting. Initially, the parking garage lighting was on 24 hours a day, seven days per week. However, to optimize energy efficiency while maintaining safe conditions, lighting levels were adjusted.

ENERGY STAR ratings of 75 or higher have been achieved since 2003 for the three Adobe towers.

The sustainability checklist (Figure 15) is a 92 item list of possible items to improve sustainable operations. The list was generated through in-house ideas and research about what other facilities are doing. The checklist also allows Adobe to compare the number of sustainable operations practices implemented at each Adobe facility worldwide through quarterly reports. The quarterly report includes three lists: sustainability and energy, total cost savings and pending projects. Pending projects include projects that are currently being implemented, or are being planned or evaluated. At the time the case study was written, the San Jose facility had completed 88 of the items on the checklist.

Reaching sustainability goals requires a well-established process. At Adobe, the following high-level steps were completed to reach past goals:

1. Benchmark buildings using ENERGY STAR Portfolio Manager
2. Conduct an energy audit to determine strategies to reduce energy consumption
3. Implement low-cost, no-cost energy efficiency strategies recommended from the energy audit
4. Once the ENERGY STAR Score is 75 or greater, apply for an ENERGY STAR certification
5. Hire a LEED Accredited Professional (LEED AP) to guide the in-house team through the LEED-EB:O&M process to assist with a gap analysis to determine where actions are needed to achieve LEED credits.
6. Select a team of contractors and in-house team members to help implement the items determined through the gap analysis
7. Register to apply for LEED certification and start completing tasks necessary to earn LEED points
8. Meet weekly to review progress and discuss challenges
9. Apply for LEED certification


Adobe
SUSTAINABILITY CHECKLIST
CUSHMAN & WAKEFIELD. Global Real Estate Solutions

B.	BUILDING SYSTEMS PROGRAMS	Y	N
B1.	Is there a written policy for your suite and/or building specifying the replacement of failed and aging equipment with equipment of higher energy efficiency ratings?	☐	☐
B2.	Do your building windows have adjustable blinds to control solar heat build-up and daylight glare?	☐	☐
B3.	Have you completed an Energy Star Portfolio Manager rating on your building? (U.S. buildings only)	☐	☐
B4.	Have you completed a third-party energy audit on your suite or building during the past 3 years?	☐	☐
B5.	Do you have a documented preventative maintenance (PM) program for your building and/or the equipment in your space?	☐	☐
B6.	Does your building have a written program of checking the entire HVAC system for leaks, clogs or obstructions of air intake and vents on a regular basis?	☐	☐
B7.	Does your building have a written policy and/or practice of inspecting and replacing or cleaning HVAC system filters on a regular schedule?	☐	☐
B8.	Does your building have a written policy and/or practice of cleaning HVAC system fans, coils and air intake rooms on a regular schedule?	☐	☐
B9.	Does your building have an operating DDC or building automation system (BAS)?	☐	☐
B10.	Does your building's PM program include tasks that verify the accuracy of building HVAC and lighting control systems and/or economizers?	☐	☐
B11.	Have all of the hot water heaters, hot water piping and chilled water piping within your building been insulated?	☐	☐
B12.	Have variable frequency drives (VSDs) been installed on all applicable motors and pumps?	☐	☐
B13.	Does your building use economizers to reduce the operation of the cooling systems?	☐	☐
B14.	Does your building use a variable air volume (VAV) system for air distribution?	☐	☐
B15.	Do your building windows have heat-blocking window film?	☐	☐

C.	LIGHTING	Y	N
C1.	Have you replaced incandescent lamps with compact fluorescents (CFL's), cold ca--thodes, LED or other energy efficient lamps, including exit signs and task lamps?	☐	☐
C2.	Have you replaced T12 lamps and magnetic ballasts with T8 or T5 lamps and electronic ballasts?	☐	☐

Figure 15: Sustainability checklist (page excerpt)

As Adobe reviewed the LEED points, many of the practices Adobe was already using supported reaching LEED goals. Adobe already followed site erosion control plans, had an indoor air quality management and hazardous materials minimization plan in place, and supported the use of alternative transportation.

The evaluation of green technologies is also part of the Adobe sustainability program. When technologies are evaluated, many decision criteria are considered, including cost, environmental impact and opportunity to be recognized as a technology leader. When facility management teams choose to install new technologies, such as fuel cells, federal and state incentives are often available to reduce the capital cost. Adobe has evaluated solar, wind spires and fuel cells.

It was determined that solar was not a viable technology because the roof design of the towers did not support an effective layout of the panels. Both wind spires and fuel cells were installed.

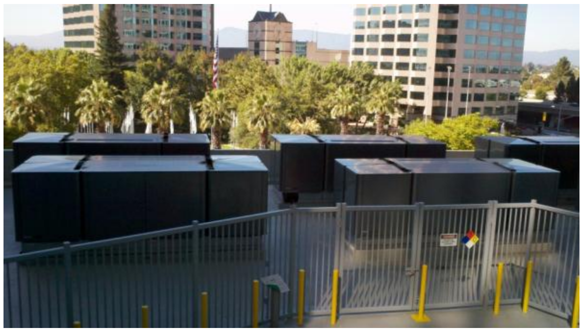


Figure 16: Fuel cells on roof at Adobe Systems

The fuel cells work through a chemical reaction within a ceramic material, an electrolyte, coated with special coatings to create an anode and a cathode. The natural gas passes over the anode and air passes over the cathode. As this occurs, oxygen ions react with the natural gas inside the fuel cell to produce electricity.

The Adobe Systems headquarters also has 20 wind spires. These 1.2 kilowatt wind spires can generate 2,400 kilowatt hours of electricity annually with wind speeds of 25 miles per hour. Although wind spires are more commonly installed in the ground, there was not enough space on the site for a typical installation. Since Adobe Systems is committed to supporting new technologies, including wind technologies, the wind spires were installed on the sixth floor decks. As a result, the buildings prominently display a renewable technology, demonstrating Adobe Systems' commitment to sustainability.

Skills and Knowledge for Energy Analytics

Based on the site visits and interviews conducted, building technicians and other members of the facilities team at Adobe Systems' headquarters utilize the following knowledge, skills, and abilities as part of implementing a sustainability program:

- Ability to develop concepts and solutions to address requirements of programs such as LEED and ENERGY STAR.
- Quantitative skills, such as the ability to use spreadsheets to analyze data and the ability to develop and compare solutions.
- Understanding of HVAC and electrical systems.
- Understanding of renewable energy technologies and systems.

Conclusion

The Adobe Systems Incorporated World Headquarters in San Jose, CA includes three high-rise office towers that include offices, conference rooms, data centers, software labs, a cafeteria and a fitness center, managed by Cushman and Wakefield. As Adobe Systems and Cushman and Wakefield strive to be leaders in energy efficiency and sustainability, the best practices described above are a key part of continually achieving this goal.

As the eyes, ears, and hands of the facilities and operations team, technicians play a critical role in the application of and ongoing improvement of such best practices. The practices featured in this case study are summarized by the table below that concludes this document, where the skills and knowledge attributes associated with each best practice are listed. It is the intent and hope of this work that other facilities management and operations teams will benefit from the the combined experience of Adobe Systems and Cushman and Wakefield, that educational institutions will incorporate the seeds of these skills and knowledge attributes in their programs, and that the technicians themselves will strive to develop the skills and knowledge as they work towards a future of sustainable and high performance buildings.

Acknowledgements

Thanks to the Cushman & Wakefield team at the Adobe Systems Incorporated facility, including George Denise Sr. CFM, CPM, FMA, RPA, LEED AP, Global Account Manager; Karl Okulove CFM, LEED AP, Global Energy Manager; Charles Stathis, LEED AP; Director of Engineering; Lakshimi (Meera) Ramanathan, LEED AP, Global Sustainability Manager; Bert Lankins, Utility Engineer; and Carl Gerlach, Chief Engineer.

Resources

USGBC LEED EB

http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221

ENERGY STAR

http://www.energystar.gov/index.cfm?c=business.bus_index

Adobe Systems Incorporated World Headquarters: Summary of Best Practices

Best Practice		Skills and Knowledge Attributes Identified in this Study that Apply to Technicians and other Key Facilities Personnel
1	**Proactive Maintenance**	A desire to troubleshoot and fix things.
		Ability to read and record data, such as how to look for patterns in data collected during both physical and virtual rounds.
		Attention to detail to look for changes in operating conditions for different types of HVAC and electrical equipment.
		Communication with many different professionals, including security, building occupants and contractors.
		Ability to make decisions, such as when filters and/or belts need to be replaced, and if parts need to be ordered.
		Ability to read as-built drawings.
		Ability to navigate and use a building automation system.
		Be self-directed and committed to complete tasks.
2	**Use of Energy Analytics Software across the Facility Organization**	Mastery of basic computer skills, including the ability to navigate computer screens.
		Ability to use spreadsheets, including entering data, using formulas, creating graphs and linking spreadsheets.
		Being analytically-minded, questioning operational parameters and why changes have occurred.
		A good understanding of how controls, HVAC and electrical systems work.
		Careful listening and observation, especially with regard to learning from more experienced technicians.
3	**Standardized Processes and Reporting**	Ability to use spreadsheets to perform data tabulation, analysis and charting.
		Visualization of macro and micro perspectives when making strategic decisions.
		Ability to draw defendable conclusions.
		Understanding of key performance indicators, or KPIs, and how to derive them to support reporting requirements.
		Ability to communicate the rationale behind KPIs and reported information, and reasons for achieving or falling short of performance goals.
4	**Implementation of a Sustainability Program**	Ability to develop concepts and solutions to address requirements of programs such as LEED and ENERGY STAR.
		Quantitative skills, such as the ability to use spreadsheets to analyze data and the ability to develop and compare solutions.
		Understanding of HVAC and electrical systems.
		Understanding of renewable energy technologies and systems.