

Energy Efficiency Opportunities: Big Box Retail and Supermarkets

BY

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PREFACE

The growth of shopping at so-called “big box” retailers, which derive their profits from high sales volumes, has increased as value-conscious and time-challenged shoppers try to get the best deals in the least amount of time possible. But shoppers are often subjected to harsh indoor environments—vast (90,000- to 200,000-sq ft), windowless, rectangular single-story buildings with merchandise piled to neck-craning heights, leaving many shoppers with a mundane experience of an environment that has all the charm of a slab of concrete.

It doesn't have to be this way. There are many ways to improve the aesthetics and overall “feel” of these stores, ranging from more daylighting to better air distribution, open plazas, waterfalls and improved shelf space organization and traffic flow.

In this report, we'll show you how to plan and implement energy efficiency improvements, and provide examples of big box retailers and supermarkets who have successfully executed similar programs. If you would like help pursuing such improvements, please email one of the authors.

The paper is published by the Center for Energy and Climate Solutions (CECS), a one-stop shop for helping companies and states design high-leverage strategies for reducing greenhouse gas emissions. The Center is a division of the Global Environment & Technology Foundation (GETF), a nonprofit dedicated to building the infrastructure for sustainable development. GETF facilitates the demonstration of new technologies and ways of doing business and helps make these ideas accessible and replicable throughout a number of sectors. We look for innovative technologies and partnerships that can significantly contribute to this goal.

Since its inception in 1998, the Center has developed best practices and high quality case studies on corporate greenhouse gas mitigation and energy efficiency. These were published in the 1999 book *Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions*. Since 1999, CECS has worked with the World Wildlife Fund to create the Climate Savers program, which encourages major companies to make GHG commitments. Climate Savers companies include IBM, Johnson & Johnson, Polaroid, The Collins Companies, and Nike.

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EXECUTIVE SUMMARY

According to the U.S. Environmental Protection Agency, the retail industry spends \$13 billion every year on energy.¹ With the strategies and technologies described in this paper, the industry could save as much as \$3 billion a year.

As mega-stores continue to gain economic traction, it becomes important to evaluate the impact of energy usage, from lighting to heating, cooling and refrigeration. The “big box” retail stores are not usually considered energy intensive on square foot basis, but because of their large size and long run hours they often run up sizable energy bills. Implementing the appropriate energy efficiency technology can reduce energy consumed, with rapid payback of all costs associated with the improvements. Done correctly, energy efficiency may be a more cost effective way to increase productivity and quality than any other potential investment. But, many businesses are unaware of the remarkable gains in energy efficient technologies and practices.

Here are some examples of successful lighting and energy management efforts at big box retailers and supermarkets discussed in the report:

- Few supermarkets in the U.S. have saved as much energy through advanced energy monitoring systems and lighting retrofits as Shaw’s Supermarkets has. Shaw’s new energy monitoring systems reduce electricity use by 23 million kWh a year. Shaw’s estimates that it is saving roughly 20 million kWh per year as a result of the lighting retrofits. An added benefit, Shaw’s energy monitoring systems and lighting retrofits combined reduce CO₂ emissions by more than 30,000 tons per year. This is similar to a cut in oil consumption of nearly 60,000 bbl per year or the removal of more than 4,000 typical passenger cars from the road.
- By reducing interior lighting, installing energy efficient T8 low-mercury fluorescent lamps and electronic ballasts, Wal-Mart has achieved an annual savings of about 250 million kWh per year – enough power to supply more than 20,000 homes.
- A cross-sectional field study by The Heschong Mahone Group (HMG) statistically demonstrated that diffusing sky-lights improve retail sales by 40 percent compared to retail stores without daylight, a significant measure of organizational productivity. The analysis included 108 retail stores where two-thirds of the stores had skylighting and one-third did not. If a typical non-skylit store were averaging sales of \$2.00/sq ft, then its sales might be expected to increase to between \$2.61 and \$2.98/sq ft with the addition of a skylighting system.

Big box retailers and grocers can vastly improve their energy usage, and the overall appeal factor of their stores, by simply applying a combination of the expert resources available, such as the Energy Star program, a little creativity and old-fashioned common sense. The equipment is cost effective and readily available, and usually results in a payback of two- to three-years. In this report, we’ll show you how to plan and implement energy efficiency improvements, and provide examples of big box retailers and supermarkets who have successfully executed such programs.

Energy Efficiency Opportunity: Big Box Retail and Supermarkets

The growth of shopping at so-called big box retailers such as Wal-Mart, Sam's Club, Target, Home Depot, Price Club or Circuit City that derive their profits from high sales volumes has increased steadily as value-conscious and time-challenged shoppers try to get the best deals in the least amount of time possible. And getting the best deal has always been the goal, for buyer and seller alike. But a clean, comfortable and healthy shopping environment—something we take for granted today—wasn't always so and isn't what it could become.

Back in the 1920s, department stores were the big box retailers of the day. In 1924, the J.L. Hudson department store in Detroit wanted to keep their popular bargain basement sale days going during the summer months, but the frantic pace of shopping in the heat caused many customers to faint! Installation of a centrifugal chiller system in the basement put an end to the fainting and created a more hospitable shopping environment. Soon after, the system was expanded to serve the first three floors, and eventually the entire store.

In 1929, Macy's New York installed a similar air conditioning system in its Herald Square flagship store, using it as a drawing card for patrons who wanted to shop in comfort. Macy's even ran a tongue-in-cheek advertisement informing the public that though tempted by the cool temperatures inside, they couldn't spend the night in the store.

These two stores serve as examples of how energy technology can be applied to improve the shopping experience. Moreover, they serve as reminders that for some time, storeowners have recognized that a more comfortable indoor environment equates to happier customers, who ideally spend more of their time, and money, in the store. Humans, after all, function much better when proper amounts of daylight and fresh air are present.

So why then, some 80 years later, are shoppers often subjected to harsh indoor environments inside most big box stores? Shoppers are greeted by vast (90,000- to 200,000-sq ft), windowless, rectangular single-story buildings with merchandise piled to neck-craning heights. As that euphoric feeling of possibility and prosperity fade, shoppers are left with a mundane experience of an environment that has all the charm of a slab of concrete. Yet we know it doesn't have to be this way. Certainly there are many ways to improve the aesthetics and overall feel of these stores, ranging from more daylighting to better air distribution, open plazas, waterfalls and improved shelf space organization and traffic flow.

Such was the case with the June, 1993 opening of a Wal-Mart prototype store in Lawrence, Kansas. Called the Eco-Mart, the building was an experimental foray into sustainable design by the nation's largest retailer. A major goal of the project was to design for energy efficiency. The building has a glazed arch at the entrance for daylighting, an efficient lighting system, a heating and cooling system that utilizes ice storage and a new type of light monitor (advanced skylights) developed specifically for this project.²

Wal-Mart's building costs are extremely low, and a store typically pays for its own construction costs in a few months. The Eco-Mart cost about 20 percent more than Wal-Mart's normal construction cost per square foot. But, as a result of a cost savings measure, an unintentional experiment took place where only half the store used the light monitors, Wal-Mart learned that sales-per-square foot were significantly higher for those departments located in the daylit half of the store. This sales rate was also higher compared to the same departments in other stores. Additionally, employees in the non-daylit half of the store argued that their departments should be moved to the daylit side. And these

lessons were applied during California's energy crisis of 2000-2001, as we'll examine later in this report.

According to an article in Shopping Center World (Sep 1, 2001), as the trend toward social interaction at retail centers evolves, architects are designing more varieties of common areas that draw shoppers and keep them on-site longer. Waterscapes, landscapes, pedestrian pathways, sitting nodes, performance areas, and other amenities are all part of a retail architect's repertoire today.³

Big box stores generally operate as stand-alone facilities, but more commonly are in a new type of shopping center called a "power center" or "value mall." Most power centers have some common characteristics: large rectangular single-story buildings, a reliance on auto-borne traffic with acres of parking and limited mass transit service, and a no-frills site plan with little unique community character, mixed-use and pedestrian amenities. Power centers generally bring together various branches of the "big box" family—for example, a discount department store, a warehouse club, a world-class-sized supermarket and the smaller discount outlet stores. And, the lines are blurring; general merchandise chains now sell groceries and supermarkets now sell more general merchandise.

The U.S. suburbs proved a fertile breeding ground for big-box retailers and power centers in the 1980s and 1990s.⁴ Wal-Mart, Best Buy, Lowe's and a bevy of other category killers mushroomed in middle markets and outlying suburbs, nourished by rich demographics and enough green fields to support super-sized, one-level stores and expansive parking lots.

But recent declines in outward growth for many major markets are prompting big boxers to rethink site selection for new stores. Built-up urban locations now offer an enticing number of young professionals and empty nesters in an under-stored environment. But big boxers have to adjust their formats and think creatively to corner these consumers.

As these mega stores continue to gain economic traction, it becomes important to evaluate the impact of energy usage, from lighting to heating, cooling and refrigeration. The big box retail stores are not usually considered energy intensive, on square foot basis, but because of their large size and long run hours they often run up sizable energy bills. Implementing the appropriate energy efficiency technology can reduce energy consumed, with rapid payback of all costs associated with the improvements. Done correctly, energy efficiency may be a more cost effective way to increase productivity and quality than any other potential investment. But many businesses are unaware of the remarkable gains in energy efficient technologies and practices. One survey found that small businesses thought energy efficiency required turning down heat or turning off lights, which were not considered acceptable options, "because a cold, under-lit store would discourage customers."⁵

For this example, energy savings is defined as bottom-line savings: pairing \$5,000 a month from operating costs goes straight to profitability. Depending on profit margins, that \$5,000 could be better than a \$100,000 increase in monthly sales, which entails increased costs for materials, labor, production and overhead. And, best of all, energy savings are permanent, whereas a boost in sales might not be.⁶

When comparing (or benchmarking) the energy costs for big box facilities it is important to consider the wide regional variations, which affect energy costs. The cost of electric energy, for example, varies from a low of about \$0.05/kWh to a high in excess of \$0.15/kWh. This wide spread can greatly affect a particular facility's energy cost. So let's take a look at some of the methods and technologies available to big box retailers *now*:

Lighting usually represents 30 to 50 percent of energy use and is usually the best opportunity to improve efficiency, while increasing quality and productivity, in most facilities. Lighting energy can generally be reduced by 40 to 80 percent by installing more efficient lighting fixtures, improved lighting controls and taking advantage of daylight where available. Paybacks for lighting projects are usually quick because of the long run hours, much of it during the utility's peak periods. Also, the newest lighting technology almost always provides higher quality lighting, which benefits both workers and customers.



Photo by Sportlite, Inc.

A supermarket with metal halide lighting

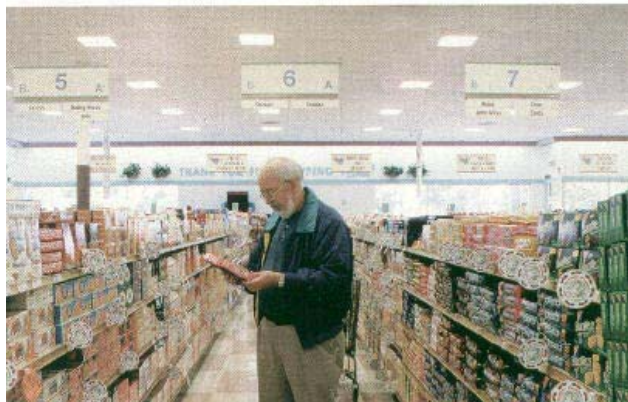


Photo by Sportlite, Inc.

The same store with high intensity fluorescent lighting.

Many retail locations still use metal halide, high-pressure sodium or mercury vapor lighting. This type of lighting is less efficient, more expensive to operate, less flexible (no instant-on/re-strike) and overall, not as appealing to the eye.

Fluorescent lighting has improved dramatically over the past decade. High intensity fluorescent (HIF) lighting, on the other hand, provides a brighter, more natural light and is more energy efficient. HIF lights also allow for instant-on/re-strike.

The U.S. Environmental Protection Agency's "Green Lights" program helps businesses reduce energy use by providing the most current information about which energy-efficient lighting technologies work best for a particular application.

Climate Control is very dependent on climate region. Whole-system engineering aimed at minimizing the need for mechanical cooling is the key to efficient climate control. This can be achieved by reducing unwanted heat gain, harnessing natural ventilation and cooling techniques, expanding occupants' comfort envelope and properly sizing and controlling heating and cooling equipment.

In northern locations, **heating** represents the second largest energy use, particularly in large facilities, which condition vast amounts of fresh air entering the building. Heating energy can be reduced as much as 50 percent by installing more efficient heating systems and controls, by installing heat recovery equipment and by limiting the quantity of outside air entering the facility.

In warmer climates, **air conditioning** replaces heating as the second largest energy use in big box facilities. It also can be reduced considerably by lessening heat loads, installing more efficient cooling equipment, installing free cooling systems, using heat recovery, and controlling outside air that must be cooled and de-humidified. Humidity also is an important factor because much of the air conditioning in humid cities such as New Orleans and Miami is required to control humidity. A city like Phoenix, however, has more cooling degree days but much less latent load to contend with. Also, regions with dry heat can often utilize less costly evaporative cooling methods.

Refrigeration is unique to facilities that sell food and beverages, which must be maintained at cold or freezing temperatures. As big box retailers increasingly provide cold chain merchandise, and as supermarkets become more like big box retailers, this becomes increasingly important. The refrigeration load can be reduced with more efficient refrigeration equipment and improved controls. For example, Micro Thermo, Inc. offers supermarket and big box food merchandisers a complete monitoring system for all refrigerated cases, integrating compressor racks, rooftop units, air handlers, fan coils, zone control units and lighting panels in an interoperable environment. This helps store managers devise better strategies for effective energy management while helping them to reduce operating costs through better management of their refrigeration, HVAC and lighting equipment. In colder regions the refrigeration systems operate more efficiently and can even provide "free heat" for the facility.

The net result of these wide variations in energy costs and climate is a very wide spread in energy intensity expressed as dollars, kWh (or BTU) per square foot. Also, for the same reasons, the cost effectiveness of various energy efficiency upgrades can also vary enormously. This fact, combined with widely varying utility rebates (from 75 percent of project cost down to nothing), can produce paybacks ranging from less than one year to more than ten years for the exact same upgrade measure at different locations.

Retail Stores

According to the U.S. Environmental Protection Agency, the retail industry spends \$13 billion every year on energy. Although not as large in area as distribution centers, the big box retail stores more than make up for it in energy consumption. Lighting levels are normally high in order to attract customers to the products. Good quality lighting is highly desirable, especially a high color rendition index (CRI) light source that brings out colors. Customer comfort is also important so more extensive heating, cooling and ventilating systems are the norm compared to the distribution centers.

The following list summarizes the best measures for improving energy efficiency in big box retailers, and can be applied to large distribution centers, as well:

- ❑ Replace any metal halide, high-pressure sodium or mercury vapor lighting with more efficient, high intensity fluorescent (HIF). In addition to energy savings, the HIF has better color and allows instant-on/re-strike.
- ❑ Use daylighting where possible. Consider skylights in the ceiling and glazing with light shelves around the perimeter.
- ❑ Limit outside air entering the facility during cold and hot weather. Consider installing *demand controlled ventilation* that adjusts outside air according to the number of customers and employees, rather than assumed occupancy, which is how most HVAC systems are designed. This often results in over-ventilation, wasting both money and energy.
- ❑ Install variable speed drives on pumps and fans with long run hours and variable loads.
- ❑ Install more energy efficient heating equipment.
- ❑ Install more efficient cooling equipment. Use enthalpy based economizer cooling whenever possible. In dry regions consider evaporative cooling.
- ❑ Install energy management systems in all stores for scheduling and controlling HVAC and lighting. Be sure it has remote access capability.

Some examples of successful retail and big box lighting and energy management implementations include BJ's Wholesale Club, Costco and Wal-Mart:

BJ's Wholesale Club

After retrofitting the perimeter fluorescent lights to T8 lamps at 14 stores, BJ's Wholesale Club installed the new pulse-start metal halide technology for the main sales area lighting. After a successful test installation at its Framingham, Massachusetts site, BJ's contracted to retrofit 85 more stores in 1999-2000.⁷

The retrofit consisted of converting 400-watt metal halides to a 350-watt pulse start system, which reduced the wattage per fixture from 455-watts to 375-watts. In total, more than 30,000 fixtures have been retrofitted at BJ's Clubs. The pulse-start metal halides are brighter, start faster, and have a reduced color shift over the life of the lamp compared to the 400-watt metal halides.

Costco Wholesale Corporation

Energy efficiency measures don't always have to be complex or costly to implement. According to the California Technology, Trade and Commerce Agency (CTTCA), wholesale giant Costco has received positive feedback from its member shoppers after implementing energy-saving procedures.

Costco Wholesale Corporation, a membership warehouse club with 90 locations in California and a total of 350 worldwide, has adopted Emergency Conservation Management Guidelines that are being implemented nationwide and are currently in effect in California. It has also taken steps to ensure that its buildings are energy-efficient, and that new structures are built to meet or exceed conservation standards.⁸ Costco has:

- Installed skylights in its stores to reduce lighting loads.
- Implemented an energy management system that automatically regulates its energy needs throughout its stores.
- Reduced indoor lighting by two-thirds during the day in response to the energy challenge.
- Lowered thermostats for heat from 68 to 63 degrees, and for cooling from 72 to 78 degrees.

Wal-Mart

With innovative thinking and a proactive approach to energy efficiency, Wal-Mart is proving that conservation and business success go hand in hand. The retail giant has voluntarily reduced interior lighting in all of its California locations without skylights. That step and others have helped Wal-Mart reduce its monthly pull on California's electricity grid by enough energy to power 5,000 homes.⁹ Wal-Mart has:

- Reduced interior lighting in all California stores without skylights by turning off every third fixture.
- Included a daylighting system on all recently constructed buildings. This system uses a combination of light sensors and skylights to maximize the use of natural light.
- Installed T8 low-mercury fluorescent lamps and electronic ballasts (the most efficient lighting system on the market) at new stores. These lighting systems are 30 percent more efficient than required by California code.
- Since the mid-1990s, all Wal-Marts built in California have white membrane roofs. The high solar reflectivity of this membrane results in lowering the cooling load by about 8 percent.

Nationwide, there are nearly 600 Wal-Mart Supercenters, SAM'S Clubs and Neighborhood Markets featuring the daylighting system. This results in an annual savings of about 250 million kWh per year — enough power to supply more than 20,000 homes. Six Wal-Mart and SAM'S Club stores in California are outfitted with this system. Recently, Wal-Mart voluntarily reduced interior lighting in all California stores without skylights by turning off every third fixture. This change alone is estimated to save 25 million kWh a day.¹⁰

California Energy Commissioner Robert Pernell recently applauded Wal-Mart's conservation measures. "By using energy-efficient lights and heating and cooling units, by incorporating the use of daylight where possible, by simply covering their California stores with white roofs that reflect the heat and reduce cooling costs, Wal-Mart is proving that retailers can be energy efficient, good neighbors."

Retail Grocery Stores

There are more than 125,000 grocery stores and supermarkets in the United States, accounting for some \$500 billion in annual sales. Twenty-five percent of these retailers – the 30,000-plus supermarkets included in the total – account for more than 75 percent of total sales. Today, food retailers of all kinds are faced with the pressure to improve profit margins, cope with escalating

energy prices, and manage facilities with high energy intensity. These are significant factors that make strategic energy performance key to superior financial performance for food retailers. Even slight improvements in energy performance can have immediate and dramatic impact on the profitability of food retailers. That's why the Food Marketing Institute (FMI) has partnered with Energy Star to provide members with this guideline to developing an Energy Performance Program.¹¹

So how does a food retailer get started? According to FMI, the first step in developing an energy performance program is to conduct a high level review of the organization's energy performance and present the potential opportunities to senior management to gain their approval to move forward. A recognizable ongoing commitment to energy performance from top management will drive the creation of an environment for energy efficiency and cost savings. This is at least a seven-step process, as discussed on FMI's Web site:

I. Data Gathering

A key activity to undertake to understand overall performance and gauge potential opportunities is to collect and analyze one to three years of energy data. As we'll see in the Shaw's Supermarkets example later in this report, collect monthly energy data and graph over time to learn about trends in both cost and usage. Graphing demand and consumption can demonstrate seasonal trends, unusual spikes, weather sensitive loads, base loads and other savings opportunities.

FMI says, "If your organization does not have systems in place to track energy, consider using Energy Star's Portfolio Manager, an on-line tool for developing, tracking, and evaluating an organization's approach to reducing energy costs over time.

A second important step is to assess the potential impact on the organization in terms of cost savings. For example, it should be reasonable to think that a focus on energy management can easily save 10- to 30-percent annually in energy costs. How will this level of achievement impact the financial performance of the organization? During this step it also is important to investigate the extent and success of past energy improvement efforts, what has worked or not worked, and what opportunities may still be available under the current economic and business conditions.

To assist in understanding what the potential impact can be to your organization, Energy Star also offers a free financial value calculator that demonstrates the value of energy investment opportunities using the key financial metrics asked for by senior management.

FMI encourages their members to work with senior management to decide on the level of resources required to move forward and conduct a preliminary assessment.

II. Preliminary Assessment

For the next step, FMI advises to conduct a preliminary assessment to identify the areas of potential focus. There are five strategic areas in which an organization can implement initiatives to make improvements in energy performance and reduce costs. Each of these five areas should be reviewed to determine how they impact the organization:

1. Information—improved understanding of how energy is used and how it impacts the organization's costs
2. Technology—improved utilization of technology for both upgrading existing stores and designing new stores
3. Purchasing—improved purchasing practices for both energy and equipment
4. Education and Awareness—improved education and awareness for employees, customers, suppliers and senior executives
5. Operations and Maintenance—improved operating and maintenance practices

For each of these five areas, assess what opportunities exist and the expected costs and benefits for each. Then consider how each of the following questions might be answered for each of these areas:

- What are our current energy management practices? Describe and understand your organization's current practices, commitment, strengths and weaknesses.
- What energy management activities are considered industry standard and world-class? What activities are standard practice in the industry and what are the leaders doing to raise the bar?
- What is right for the organization? Based on the organization's business strategy, where does it need to be in terms of organizational practices and/or capital investment?
- What will it cost in terms of resources, personnel, and investment to get to where the company wants to be? Perform a high-level analysis of expected costs and benefits.

Finally, summarize the findings and expected costs and benefits for each action item identified for each of the five strategic areas and present them to senior management. Consider using the terms or metrics that are commonly used in the organization. Relate expected savings in terms of an equivalent sales increase, improved inventory turnover, or other financial metrics used by the company.

Securing on-going senior management commitment will be key to developing a successful energy performance program. Be sure to address the need for active management support such as making energy improvement status reports as part of regular senior management meeting agenda. If possible, identify an executive officer of your organization to champion the program.

With the preliminary assessment complete and management support established, the next step will be to develop the Energy Management Policy Statement, Strategies and Goals.

III. Statement, Strategies and Goals

The Energy Management Policy Statement and Strategy should clearly communicate the organization's commitment to energy performance and support the organization's overall business strategy and objectives. This statement can be as short as one sentence and used repeatedly

throughout the organization on communication tools, employee bulletins and newsletters. Energy management strategies should clearly demonstrate how energy management supports the organization's overall business strategy and objectives.

The key to developing goals and objectives is to identify specific and measurable goals that provide a means to track and gauge success of the energy performance program. Goals and objectives should be designed to be achievable yet provide the opportunity for greatest impact to the organization. Often, successful programs include incentives and rewards tied directly to the achievement of the energy management plans and goals.

The next step will be to conduct a feasibility study for the potential projects identified in the preliminary assessment. Often this step begins with an in-depth energy audit of the store and review of operating practices. Before embarking on the on-site audit, take time to conduct a pre-site review.

Once the pre-site review is complete, conduct an efficient and effective on-site survey with minimal disruption to customers and store associates. For more information on energy auditing and sample auditing worksheets, contact the U.S. Department of Energy's Energy Efficiency and Renewable Energy Network or the Washington State University Total Efficiency Network.

IV. Feasibility Study

Now it is time to conduct a feasibility study. A feasibility study is a detailed engineering and financial impact study for each of the potential projects identified in the energy audit. This analysis should address the parameters that an organization uses in its capital funding and investment decision strategy.

If the organization does not have expertise or resources in-house, consider outside assistance from companies such as engineering firms or energy service providers that provide a wide range of services from energy auditing to detailed analysis and design.

The feasibility study is also important because it establishes baselines for each project that can be later used in your program to measure savings and success.

V. Implementation Plan

The next step is to develop an implementation plan for all projects and activities that meet financial investment criteria and are approved by management. The plan should be organized in a format that is easy for everyone to understand and that can be used as a working document that can be updated and referred to throughout the course of the program.

There are four primary objectives to be accomplished while developing the implementation plan:

1. Dedicate resources and assign responsibilities;
2. Meet schedules and minimize impact on business operations;
3. Manage resources and budget; and,
4. Track milestones and success.

The implementation plan should be designed to assist everyone in the organization to focus and prioritize efforts on the activities that contribute toward achieving success. A Summary Action Plan is a good starting point to organize efforts and activities and is a building block to developing a full implementation plan.

VI. Energy Performance Program Evaluation

Sustained success of the Energy Performance Program requires establishing a system to collect and evaluate success. Organize efforts around two key activities:

1. *Track and organize data* – Develop a data tracking system to collect and organize data for analysis and meaningful management reports. The continued success of the program depends on establishing a system to collect and organize data to measure the success of projects. Relevant data in understandable formats is important when evaluating and modifying the program and in maintaining sustainable gains in energy performance.
2. *Measure and verify* – Undertake efforts to measure and verify the success for all of the projects and practices that are implemented. Be sure to pick the appropriate form of verification. In some cases measuring success may require investment in sub-metering and other equipment used to monitor the performance of new equipment. In other cases all that may be required are simple forms for the staff to complete or even just verbal feedback from staff that is affected by the program.

VII. Communicate Accomplishments

Collecting and tracking program results also provides a means to communicate accomplishments to staff and management. Often energy costs are considered uncontrollable and a “cost of business.” Communicating the successes of the energy performance program will help educate everyone that energy costs are manageable and that everyone in the organization can play an important role in making the energy performance program an ongoing success.

Case Study: Shaw’s Supermarkets

The retail grocery business is highly energy intensive. Grocery stores are huge spaces that must be heated, cooled and lighted around the clock. The storage and display of frozen and refrigerated foods creates large cooling loads, even in winter.

The management of Shaw’s Supermarkets, owners of a 135-year old chain of grocery stores throughout New England, worked hard with utilities and others to improve its energy efficiency throughout the 1990s.



Few supermarkets in the U.S. have saved as much energy through advanced energy monitoring systems as Shaw’s.¹² In 1997, after successfully implementing a refrigerant leakage reduction program, the company began to work with its leak detection system provider to develop an energy sub-metering and monitoring program that would use the same communications hardware and reporting mechanisms. Prior to this effort, the only way to find out about energy waste was by to

identify trends on monthly bills. Because energy department staff reviewed a “whole house” bill, it was difficult to pinpoint exactly where the electrical inefficiencies were. It also was difficult to enlist the help of maintenance staff, since store managers had little information to offer them.¹³

However, by installing state-of-the-art sub-metering equipment capable of monitoring up to 16 electrical circuits per store, Shaw’s is now equipped with a toolkit that saves time, energy and maintenance costs. Based on daily energy downloads from the monitors, store managers receive exception reports that flag periods during which energy consumption is higher than expected. Predicted use is modeled using historical data, taking into account weather information for the particular time of year, and retail volume data for the time of day.

“With this system,” explains Kathy Loftus, Shaw’s energy and regulatory affairs manager, “we are able to diagnose a problem quickly, and either make a correction remotely through the energy management software, have store management take care of it, or dispatch maintenance personnel with a graphical representation of the problem.”

The resulting load profiles permit Shaw’s to target potential energy efficiency strategies like decommissioning refrigeration systems, implementing more aggressive controls for anti-sweat heaters and air conditioning systems, and developing custom lighting schedules.¹⁴ The company also is able to test the claims made by manufacturers of energy efficiency products, and then use that information to design systems more efficiently. Here are a few examples of anomalies that it has identified:

- Screw compressors, generally more efficient than traditional compressors, are not as efficient in Maine’s climate.
- A heat-recovery system using hot water from compressors increased in efficiency after the company made minor modifications.
- The manufacturer’s recommended set points for anti-sweat heaters caused the units to operate longer than necessary.

Shaw’s has cut costs further by identifying and correcting control failures and lighting system overrides that previously would have gone undetected (this is illustrated graphically in the discussion of lighting retrofits, below). These actions have generated additional savings estimated at between one and two million kWh a year.¹⁵

Shaw’s new energy monitoring systems reduce electricity use by 23 million kWh a year, while avoiding some 17,000 tons of CO₂, as well as 71 tons of SO₂ and 24 tons of NO_x.¹⁶

In addition to energy monitoring, Shaw’s has taken the relatively simple step of changing thermostat set points. By allowing stores to remain warmer in summer and cooler in winter, the company saves additional energy. The energy monitoring system quickly alerts store managers in the event of overcooling or overheating.

As originally authorized by management, the sub-metering and monitoring project for 110 stores carried a price tag of slightly over \$2 million, an internal rate of return of 27 percent and a simple payback of about four years.¹⁷

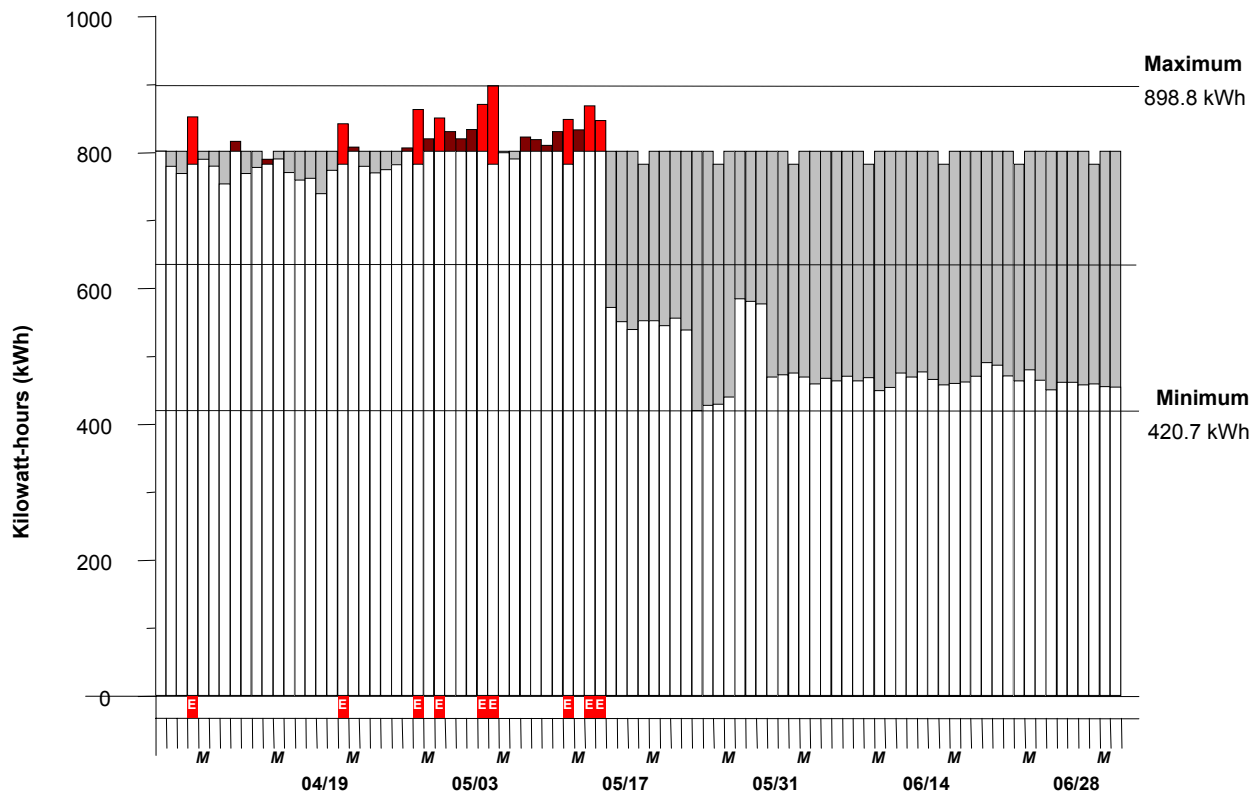
It was assumed that about five percent of the total cost would be provided by utility companies in the form of end-use energy efficiency program rebates. In the end, the project cost was lower – a bit less than \$2 million – because the company negotiated a lower installation price, with utilities contributing incentive payments that were three times greater than originally estimated. In the end, incentives accounted for more than 17 percent of the total project cost, and lowered the simple payback to just over two years.

Shaw’s has been retrofitting lighting systems since 1991, when it took advantage of existing utility incentive programs to convert several back room and perimeter area systems. At the time, sales area lighting consisted of metal halide fixtures, thought to be the most efficient for that application.

Since 1996, however, the company has designed and retrofitted its continuous rows of uniform fluorescent fixtures with highly efficient T8 lamps and electronic ballasts. The company also installed them in its refrigerated cases after the ballasts were improved to work well in cold environments. In addition to lowering lighting use, this has cut refrigeration loads by reducing the amount of heat generated inside the cases. Finally, Shaw's has installed state-of-the-art lighting in its distribution centers, including "hi/lo dimming" systems that automatically lower lighting levels when aisles are empty.

Lighting retrofits are very attractive investments for Shaw's. They can cut electricity use in half. To date, the company has spent more than \$4 million on them at 60 stores, for a per-store cost of about \$65,000. It consistently has found that these investments pay for themselves in three to four years, offering internal rates of return of up to 30 percent.¹⁸ Utility incentives have helped with up-front costs, while making for more attractive rates of return. In some cases, they have reduced payback to less than three years.

Shaw's estimates that it is saving roughly 20 million kWh per year as a result of lighting retrofits. These savings avoid more than 15,000 tons of CO₂, 62 tons of SO₂ and 21 tons of NO_x each year. The chart below illustrates the results of a lighting retrofit in one Shaw's supermarket. The red peaks on the bars during the early weeks of the retrofit record electricity use by the construction crews that performed the work overnight, when fewer lights normally are on. Beginning the week of May 17, the store's daily electricity use fell by an average of nearly 50 percent.



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Energy savings from a lighting retrofit at a Shaw's supermarket are shown here. Electricity use dropped dramatically after May 17, when the work was completed. The baseline, at about 800 kWh, represents store use prior to the retrofit.

Looking at Shaw's energy monitoring systems and lighting retrofits together, the company is reducing CO₂ emissions by more than 32,000 tons per year. This is similar to a cut in oil consumption of nearly 60,000 bbl per year or the removal of more than 4,000 typical passenger cars from the road.¹⁹ The company also has reduced SO₂ emissions by nearly 133 tons, and NOx emissions by some 45 tons.

Case Study: Safeway, Inc.

As in the retail stores examples, there are several instances where grocery chains have executed simpler energy-efficiency programs that have yielded positive results for stores and customers alike. The California Technology, Trade and Commerce Agency reports that Safeway Inc. not only is committed to energy conservation practices at its 500 stores in California, but at its 1,500 stores nationwide.



In 2001, Safeway, whose companies include Vons, Pak n' Saves and Pavillions stores, began reducing the lighting in its California stores.²⁰ The next step for Safeway is expanding its energy conservation program to educate customers, which is planning an outreach campaign to deliver the energy conservation message. Safeway's energy conservation measures include the following:

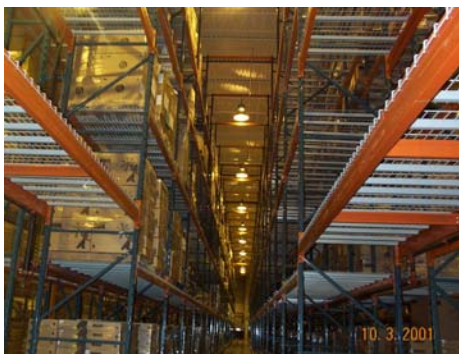
- Turn off exterior outdoor signage lighting in California.
- Reduce lighting in parking lot during non-business hours.
- Installation of computer system to adjust thermostats for heating.
- Post signs to remind workers to shut off unnecessary lights and close doors.
- Discussion of energy conservation measures in staff meetings.

Distribution Centers

Though distribution centers are not the focus of this report, in addition to conversion to HIF, several new lighting control technologies promise to produce large savings for distribution centers.

With the introduction of "instant on" HIF light fixtures, it is now possible to install occupancy sensors on every fixture in large open areas. The Gillette Company warehouse in Andover, Mass. replaced more than 300 of its 400W, sodium vapor light fixtures with new fixtures using 4-watt to 54-watt T5 High Output lamps (234-watts ea.). Each new fixture has its own occupancy sensor, which keeps the light turned off until someone approaches. The results of this lighting upgrade showed energy savings in excess of 75 percent, while light levels and quality improved.²¹

The second promising lighting technology is addressable electronic ballasts. Light fixtures utilizing these new ballasts can be controlled individually by low voltage, wireless, or power line communications. With addressable ballasts, occupants can control each light fixture and tell it when to turn on, turn off and what level to dim to. Addressable ballasts also can be coordinated with a computer based front end for an intelligent lighting management system.



Inefficient sodium vapor lighting in a large distribution center.



More efficient (HIF) lighting.

Daylighting Challenges

Daylit buildings use substantially less energy while providing a welcome connection to the outdoors. Natural daylighting contributes to reduced operating costs, increased worker productivity and the health and well being of occupants. It also provides a superior quality of light.

Many big box retailers are following the development of daylight harvesting technology, but applying it in all of their facilities has been an elusive goal. Some of these retailers have installed daylight harvesting controls in a few of their stores for evaluation but have not made it into a company standard. Despite the good public relations and all the energy saving and customer satisfaction case studies about the technology, it appears that implementing this technology “company wide” is easier said than done.

One problem seems to result from difficulties with the location of skylights relative to the products and equipment directly below. In most daylight harvesting installations, photocells are used to switch off or dim entire rows of lights when there is adequate daylight from skylights or other sources. However, if shelves or other obstructions block the light entering from one or more skylights or window, a dark spot can result. Whenever this condition occurs, the lights are turned on and the energy savings is lost.



Skylights provide daylighting in a supermarket

New technology promises to end this dilemma. With highly efficient T5 fluorescent lighting, dimming electronic ballasts and new photocell/dimmer controls, it is possible for every light fixture to have its own daylight dimming control. Then each fixture will dim independently but work together to maintain the desired light levels throughout the facility.

Daylighting Equates to Sales Gains

In a cross-sectional field study, The Heschong Mahone Group (HMG), a professional consulting firm which focuses in the field of building energy efficiency, statistically identified that diffusing sky-lights improve retail sales by 40 percent compared to retail stores without daylight, a significant measure of organizational productivity.

In this study, submitted to the California Board for Energy Efficiency in 1999, HMG looked at the effect of daylighting on human performance.²² The report specifically focused on skylighting as a way to isolate daylight as an illumination source, and avoid all of the other qualities associated with daylighting from windows.

HMG established a statistically compelling connection between skylighting and retail sales. The report analyzed data on the sales performance of a chain retailer that operates a set of nearly identical stores. The analysis included 108 retail stores where two-thirds of the stores had skylighting and one-third did not. The design and operation of all the store sites was remarkably uniform, with the exception of the presence of skylights in some. The electric lighting was primarily fluorescent. Daylight from the skylights often provided more than two-to-three times the target illumination levels. Photo-sensor controls turned off some of the fluorescent lights when daylight levels exceeded target illumination.

Monthly gross sales figures were averaged over an 18-month period and normalized for hours of operation, community income and competition. The report found that skylights were positively and significantly correlated to higher sales. All other factors being equal, and with 99 percent statistical certainty, an average non-skylit store in the chain would likely have 40 percent higher sales with the addition of skylights. The report concluded that if a typical non-skylit store were averaging sales of \$2.00/sq ft, then its sales might be expected to increase to between \$2.61 and \$2.98/sq ft with the addition of a skylighting system. Were the chain to add the skylighting system to the remaining 33 percent of its stores, yearly gross sales were predicted to increase 11 percent. The difference between having no stores skylit and all stores skylit is an increase of up to 40 percent in gross sales for the retail chain.

Case Study: HomeBase, Inc.



According to a report by Energy Design Resources—an educational resource funded by California utility customers and administered by Pacific Gas and Electric Company, San Diego Gas & Electric, and Southern California Edison, under the auspices of the California Public Utilities Commission—one big box retailer that has had success applying daylight technology is HomeBase, Inc., with a total of 83 home improvement stores, averaging 103,000 sq ft, in 10 Western States.

With sales, margins and profitability all under intense competitive pressure in a rapidly consolidating industry, HomeBase management called for a change in strategy to reverse weakening trends.²³ One result of this change in strategy was a commitment to daylighting in the remodeling of HomeBase stores into House2Home stores, so that all of their sites now feature extensive skylights, along with photo controls for general lighting.

“Our first reason is improved sales,” says the corporate energy manager. “Saving energy is a secondary consideration. Customers seem to agree.”

While not all customers are aware of the skylights, many interviewed at the site were enthusiastic about the bright, airy feeling in the stores. “It feels clean and healthy,” commented one customer. “I like coming to shop here because I don’t feel so crowded,” commented another.

The stores are designed with five percent of gross roof area in 4-by-8 double-glazed bubble skylights. Skylights are located based on the structural design of the roof, which makes their placement slightly irregular. They tend to be located above two out of three rows of shelving. The walls of the store, the truss work at the ceiling and the fire curtains are all painted white, helping to diffuse the daylight down to the store below. The central open areas receive 120- to 150-horizontal foot-candles of daylight on a bright, sunny day.

Those aisles with skylights directly overhead are somewhat brighter, at 80- to 150-horizontal foot-candles down the center of the aisle at midday in the summer, providing a very even illumination of 30- to 60-vertical foot-candles on the product shelves. Even the aisles without skylights directly overhead still maintain 30- to 50-vertical foot-candles on the product, with 40- to 50-horizontal foot-candles down the center of the aisles. This variation is entirely within the average person’s visual comfort range, and it adds some visual interest to the store’s appearance – making it seem natural and relaxed.

The manager of the Brea, Calif. store confirmed that he’d had no problems with the skylights. In fact, he found them to be a no-maintenance feature, and even to be self-cleaning, as dust and dirt tends to wash off easily with the rain.²⁴

The electrical lighting system includes metal halide light fixtures on a three-level circuit system. There are separate photo controls for each circuit, so that at modest illumination from the skylights, one-third of the lights turn off, and at full skylighting illumination, two-thirds of the lights turn off. The remaining one-third of the store lights are committed to emergency power back up, so that the store can never go completely dark. The lighting around the perimeter of the store always has at least half of the lights on at full power.

The 400-watt metal halide lamps are 16-ft on-center spacing for a lighting power density of 1.8-watt/sq ft. Some key products are highlighted with strip fluorescents under the shelves, adding perhaps 0.1-watt/sq ft for a total installed lighting load of about 1.9-watt/sq ft. During the day, the store typically operates at 1.3-watt/sq ft, with one-third of the lights turned off, or at 0.7-watt/sq ft with two-thirds of the lights off. The one area of the store with a dropped ceiling is the lighting fixture display, so that the fixtures can be shown in a natural ceiling setting at about a 12 ft height, without shadowing or glare from the skylights when customers look up.

There are many other ways to get light deep into a building other than through windows and skylights; they include light monitors, light shelves, atria, courtyards, glass or glass-topped partitions, top-silvering of Venetian blinds (to bounce light off ceilings) and light-colored paints and furnishings.

Conclusion

Big box retailers and grocers can vastly improve their energy usage, and the overall appeal of their stores, by simply applying a combination of the expert resources available, such as the Energy Star program, a little creativity and old-fashioned common sense. The equipment is cost effective and readily available, and usually results in a payback of two- to three-years.

With increasing market pressures from traditional and non-traditional competitors, there is a limit to how much profit retailers can squeeze out of every square foot. By investing in energy-efficient technologies big box retailers—with their 100,000 square feet of shopping area, long operating hours and large energy demands—create a win-win by spending less every time they flip a light switch or turn on the climate control system, and by improving the shopping appeal of their stores. And just as it worked for the leading department stores of the 1920s, it will work today. The big box retailers who continue to ignore these opportunities in favor of building and operating “cheap” are limiting their profit potential, and survival, in the long run.

Further Reading:

Energy Star

www.energystar.gov

<http://yosemite1.epa.gov/estar/business.nsf/webmenus/Business>

www.eren.doe.gov/EE/buildings_energy_audits.html

<http://yosemite1.epa.gov/estar/business.nsf/content/espdirectoryhome.htm>

Food Marketing Institute

www.fmi.org

Portland Energy Conservation, Inc.

www.peci.org/cx/index.html

Washington State University

www.energy.wsu.edu/ten/energyaudit.htm

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- ¹ U.S. Environmental Protection Agency Web site, <http://yosemite1.epa.gov/ESTAR/business.nsf/webmenus/Retail>
- ² Joseph Romm, *Lean and Clean Management*, (New York, NY: Kodansha International, 1994).
- ³ From an article on Nadel Architects in *Shopping Center World* (Sep 1, 2001).
- ⁴ B. Boswell, "Center Profile: The Vertical Solution." *Shopping Center World* (Nov. 1, 2001).
- ⁵ Romm, op. cit. (1994).
- ⁶ Ibid.
- ⁷ California Technology, Trade and Commerce Agency (CTTCA) Web site http://commerce.ca.gov/state/ttca/ttca_homepage.jsp
- ⁸ Ibid.
- ⁹ Ibid.
- ¹⁰ Ibid.
- ¹¹ The seven-part discussion in the paper is derived in part from information from the Food Market Institute, www.fmi.org
- ¹² The Shaw's case study is based on information provided by the company. For more detail, see Center for Energy and Climate Solutions Web site, www.cool-companies.org
- ¹³ Ibid.
- ¹⁴ Anti-sweat heaters are electric heaters that prevent condensation from forming in specific areas of refrigerated cases.
- ¹⁵ Center for Energy and Climate Solutions (CECS) Web-site, www.cool-companies.org
- ¹⁶ All emission reductions cited here are calculated based on New England regional marginal emission rates, provided by ISO New England.
- ¹⁷ Simple payback is calculated using constant (i.e., today's) dollars.
- ¹⁸ CECS Web-site, www.cool-companies.org
- ¹⁹ Ibid.
- ²⁰ California Technology, Trade and Commerce Agency (CTTCA) Web site http://commerce.ca.gov/state/ttca/ttca_homepage.jsp
- ²¹ Ibid.
- ²² Heschong Mahone Group, *Skylighting and Retail Sales: An Investigation into the Relationship Between Daylighting and Human Performance*, Condensed Report, (Heschong Mahone Group, Fair Oaks, CA, 1999)
- ²³ Energy Design Resources Web site, www.energydesignresources.com
- ²⁴ Ibid.