Cutting Costs With Energy Efficiency & Conservation

A Guide for Local Government Agencies

Flex your POWER.ORG

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INTRODUCTION

Saving Energy and Money

Energy efficiency creates jobs, new technologies and new industries - all while helping to keep the lights on for California's more than 36 million residents. In California, investing in energy efficiency programs and enforcing stringent building standards has proven a cost-effective way to help safeguard the reliability of energy resources. Over the past 25 years, approximately 9,000 megawatts (MW) of energy have been saved - the equivalent of the output of 18 500 MW power plants.

And these energy savings have had a positive impact on the economy. Between 1977 and 1995, state programs and standards - designed to conserve resources - added three percent to the rate of economic growth, helping make California businesses globally competitive.

Energy represents as much as 30 percent of a building's operating costs. Government agencies in the United States spend more than $10 billion a year on energy to provide public services and meet constituent needs. For America's primary and secondary schools alone, the annual energy cost is a staggering $6 billion - more than is spent on textbooks and computers combined!

How do these costs add up? Lighting systems represent as much as 30 percent of an institutional building's energy use and 40 percent of a school's total energy use. During the hotter months, energy-intensive air conditioning systems raise energy consumption - especially as wasteful lighting systems increase the need for more powerful cooling systems. During the winter months - according to the U.S. Department of Energy - space heating represents 37% of a typical government building's energy consumption nationwide.

Unfortunately, nearly one-third of the energy used to run a typical government building goes to waste - waste that costs taxpayers money. The least efficient schools use three times more energy than the most efficient schools. Taking steps to increase energy efficiency - as occurred at top-performing ENERGY STAR rated schools - translates to a savings of 40 cents per square foot when compared to the least efficient schools.

Undertaking energy efficiency measures can reduce energy consumption - and thus, utility bills - by 30 percent or more. This 30 percent reduction can lower operating costs by $25,000 per year for every 50,000 square feet of office space. And the best part is that these improvements in energy efficiency can often be attained through no-cost or low-cost projects.

Low-cost and no-cost projects have benefits beyond reducing energy consumption and cost - they often enhance the indoor environment of a building, increasing worker morale and productivity. Most energy efficiency measures improve the comfort and attractiveness of the indoor environment. Lighting retrofits, for example, reduce energy consumption and improve visual acuity. Better vision, in turn, helps workers complete tasks and reduce eyestrain. Likewise, upgrades to heating, ventilating and air conditioning equipment reduce energy costs and improve indoor air quality. At a minimum, this prevents risk of and liability for health problems like sick building syndrome and building-related illnesses. Across the United States, tens of billions of dollars each year could be saved by reducing indoor air pollution.

While occupant comfort is a worthwhile end in and of itself, improving the indoor environment also cuts costs in a number of ways. For government buildings, a better indoor environment may result in less employee turnover. Studies suggest that many energy efficiency measures can reduce absenteeism due to health issues and help prevent onsite accidents. In some cases, the physical work environment may actually help attract the best and the brightest workers - not surprising since up to 90 percent of our time is spent indoors. These benefits to worker performance could equal many more billions of tax dollars going to better use and preventing government waste.

Thoughtful energy management provides other, less tangible benefits as well. Investors are discovering that management teams successful at grappling with the complexities of energy and environmental management tend also to have the internal capacity needed to safeguard the overall financial health of a company. In fact, recent studies have linked energy management to stock market performance. And this phenomenon holds true in the public sector as well. Policies that address long-term energy and resource management needs in a coherent and responsible manner lead to fiscal savings.

Efficiency and Climate Change Mitigation.

Efficiency is key to climate change mitigation. The easiest ton of CO2 to remove from the atmosphere is the one that is not emitted in the first place. Greater energy efficiency in the Transmission and Distribution system means lower emissions in generation to deliver the same amount of consumed energy. Lowering the amount of energy consumed (or lost) effectively increases the share of renewables in the total, assuming the gains are offset by reducing the amount of energy produced from traditional generation sources.

Fuel conservation and diversification is another crucial point for efficiency. Reducing US dependence on foreign fuel-be it oil, natural gas or coal is an obvious security boost.

Furthermore, energy efficiency is intimately intertwined with grid reliability. In many areas of the US, transmission constraints have reached the point where they not only cost consumers billions of dollars in congestion charges, they threaten the integrity of the power system itself. Over the past twenty years, the situation has continued to deteriorate to the point where now the question of installing a new line is nearly moot in some locations. By the time it was completed, demand would long since have outstripped the ability of the local grid to meet it, so a short-term solution must be implemented in the interim.

This best practice guide contains tips and tools for local governments to improve energy efficiency. Just as no two buildings are identical, no two cities will undertake the same energy management program. The tools provided illustrate some of the most innovative strategies and technologies as well as some of the most successful case studies. Learning from these stories of success, city officials are encouraged to explore the many resources listed throughout the guidebook for more detailed information.

Flex Your Power thanks the following agencies, organizations, and people for their time and comments:

- California Energy Commission, Consumer Education Center.
- U.S. Environmental Protection Agency (EPA) ENERGY STAR, Commercial Building Program.
- U.S. EPA, Heat Island Reduction Initiative; State and Local Capacity Building Branch; and the Office of Air and Radiation, Office of Atmospheric Programs.
- Alan Pong, Ferreira Service Inc., energy engineering services.
- Jack Rosenthal, P.E., CEM, LEED AP, Glumac, consulting engineers for commercial, healthcare, institutional, and advanced technology sectors.

Comments, Questions and Submissions

Flex Your Power is continuously updating this guide, and encourages all comments, questions and submissions of information.

If you have a story that might be suitable for this or other best practice guides, or know of new innovations or building strategies not included, please email us at success@FYPower.org.

PLANNING AN ENERGY PROGRAM

Energy Profiles

An energy profile provides the basic building block of information needed to begin evaluating a property's potential for energy savings. This information also helps determine baseline

energy performance and can be used to benchmark a building's performance against comparable properties.
Basic components of an energy profile include:

- Annual energy use and cost, as given in utility bills from the previous year.
- Year of construction.
- General location (for climatic information).
- Total floor space, given in square feet and number of floors.
- Facility type(s), e.g., school, retail center, office building.

An energy accounting system records information from the energy profile over time. An accounting system is generally kept in a simple spreadsheet or tracked through computer software. Buildings equipped with an energy management system may be able to use this to automatically generate real-time information for an energy accounting system. Once ECMs or EEMs have been installed, this historical record enables energy mangers to later measure program results against baseline performance. It can also indicate when problems arise, such as through abnormally high energy costs related to equipment failure.

Added components of an energy accounting system may include:

- Monthly or more frequent energy-use and cost reports.
- Weather.
- Changes in occupancy or facility usage.
- Utility rate schedules.
- Performance tracking of major equipment systems.

Timing Energy Saving Opportunities
There are several telltale signs that indicate an energy saving upgrade is in order. Employees might complain of flickering fluorescent lights that hum loudly or poor indoor air quality with excessive humidity or chemical odors. Facility managers might notice an unusual jump in utility bills unrelated to rate increases or be frustrated by equipment that continually malfunctions despite regular operations and maintenance. Or, a simple walk-through might reveal uncomfortable drafts in interior spaces or condensation around windows and doors.

Even if problems are not easily discernible, management can use building maintenance schedules as an opportunity to replace aging equipment with more energy-efficient models. For others, an unrelated decision to remodel or renovate building space, perhaps due to change in use, could provide an opportunity to increase energy efficiency at little or no additional cost.

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Energy Audits

An energy audit first identifies how energy is used in a facility, and then recommends ways to improve energy efficiency and reduce energy costs. In practice, there is wide variance among the different levels of energy audits available. Or, as Albert Thumann writes in the Handbook of Energy Audits, "There is a direct relationship to the cost of the audit (amount of data collected and analyzed) and the number of energy conservation opportunities to be found."

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) identifies three levels of energy audits:

- Walk-through Assessment: energy bills are analyzed and, possibly, a brief visual survey of the facility is conducted. The subsequent report identifies no-cost and low-cost opportunities. This is the least costly of the three levels.
- Energy Survey and Analysis: a more detailed analysis is conducted, including a breakdown of how energy is used within the building. Recommendations consider a city or county's operations and maintenance, constraints, and economic criteria. Potential capital-intensive opportunities are identified in the final report for further research and analysis. This is the typical level of audit.
- Detailed Analysis of Capital-Intensive Modifications (Investment-Grade Audit): this analysis focuses on capital-intensive opportunities and provides a higher degree of monitoring, data collection, and engineering analysis. The report includes detailed cost and savings information with a high-level of confidence sufficient for major capital investment decisions, and may include a reasonable timeline for implementation of each recommendation.

Local utilities are valuable partners for energy audits. The utilities can arrange for one of their engineers to assist with an energy audit or can recommend third-party providers in your area. The utilities also have testing equipment, such as portable meters and

diagnostic software, that in-house facility staff can use to conduct an energy audit. Check with the local water agency, too, to see if they provide water audits - integrating energy-related and water-related upgrades into one action plan provides additional cost savings with the least amount of disruption to workers and building occupants.

Remember that certain problems only occur during a particular time or season. Time energy audits accordingly. For example, if you decide to upgrade chiller equipment that underperforms in warm weather, be sure to schedule the energy audit during summer months so that engineers can test it in the appropriate conditions.

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Pacific Gas and Electric, Energy Audit by Experts. http://www.pge.com/biz/energy_tols_resources/expert_energy_audit/

Pacific Gas and Electric, Pacific Energy Center, Tool Lending Library has thousands of measurement tools available for short-term energy projects like in-house energy audits. http://www.pge.com/003_save_energy/003c_edu_train/pec/toolbox/tll/tll_home.shtml

Southern California Edison, Online Energy Survey. http://www.sce.com/_Tools/Residential/HomeEnergySurvey.htm?from=changealightpromotion

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Certification Programs

Energy efficiency and conservation are major components of any green building program. Certification programs and “green” building guidelines are based on the collective experience of industry professionals - architects, designers, developers, academics, product manufacturers, utility representatives, facility managers, and government regulators. Most programs have been formally vetted and tested in real world conditions. Even if you do not intend to seek certification, these programs lay out sound guidance and tips on whole building design that may prove useful. Facilities that do achieve certification often enjoy media and public accolades for their efforts.

U.S. EPA, ENERGY STAR

The U.S. Environmental Protection Agency's (EPA) ENERGY STAR certification and labeling program for energy management is the most well-known in the United States; more than 56 percent of Americans recognize the symbol and equate it with energy efficiency. Since the program's inception in 1995, almost 2,000 buildings - representing 400 million square feet of commercial space - have been awarded the ENERGY STAR label. Approximately 13,000 organizations - including small businesses - use ENERGY STAR to improve their energy management practices.

ENERGY STAR benchmarking compares annual kilowatt-hours (kWh) and British thermal units (Btu) per square foot, commonly referred to as the energy use intensity (EUI) of a building. Most other programs use a scorecard system that awards points for specific building strategies, not for overall performance.

In order to be considered, a building's energy profile must be entered into Portfolio Manager, ENERGY STAR's online benchmarking database. Buildings are scored from 1 to 100. Those that receive a score of 75 or better (top 25 percent) may apply for the ENERGY STAR label. Benchmarking and labeling are free services provided by the U.S. EPA through its ENERGY STAR program.

U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) Green Building Rating System is quickly becoming the standard green building certification program in the United States and Canada. In its first four years, LEED has accredited almost 20,000 building professionals and has certified more than 230 building projects with another 2,000 projects registered seeking certification.

LEED is a voluntary program that rates building performance based on a point system. Building strategies include: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and operational or design innovations.

LEED standards are currently available or under development for:

- New commercial construction and major renovation projects (LEED-NC)
- Existing building operations (LEED-EB)
- Commercial interiors projects (LEED-CI)
- Core and shell projects (LEED-CS)
- Homes (LEED-H)
- Neighborhood Development (LEED-ND)

In California, Governor Schwarzenegger ordered that State buildings of 10,000 sq. ft. or more, new or renovated, meet LEED Silver or higher certification. Cities, counties and other institutional entities have mandated the use of LEED for building projects. San Francisco's Green Building Ordinance, for example, applies LEED standards to all city-owned facilities and leaseholds. Similarly, the University of California has incorporated LEED into its green building policy.

Green Building Initiative (GBI) Green Globes
In 2005, the Green Building Initiative licensed the Canadian program Green Globes for use in the United States. Green Globes is an online, interactive assessment tool designed for new construction (an existing building version is making its way to the market and may be available soon). Roughly 150 confidential questions are arranged in seven categories: project management, site, energy, water, resources, emissions and effluents, and indoor environment.

Although Green Globes is initially a self-assessment tool, buildings can be certified with third-party verification. Green Globes aggregates survey scores in an anonymous database that is used for benchmarking. Green Globes is dynamically linked to ENERGY STAR's Target Finder software so that information provided is automatically calculated into target goals for your project.

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State of California Green Building Initiative. http://www.energy.ca.gov/greenbuilding

Assessing Energy Performance

The best way to assess how well a building performs in terms of energy management is to track the energy profile over time, establish baseline data, and then compare the performance results against other, similar properties.

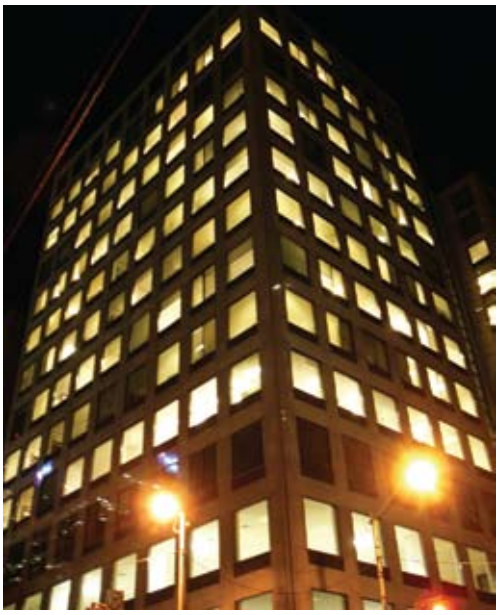
Without establishing a baseline for energy performance, facility managers have no way to know a building's potential for saving resources, both financial and natural. This is much like timing a runner. Without a stopwatch, we only know that the runner runs, not that she runs fast, or that she runs faster today than yesterday. Comparing energy use against an established baseline does the same thing for energy management that a stopwatch does for the runner.

There are two primary ways to establish baseline data:

1. Use an energy accounting system to analyze historical energy use, carefully taking into account any changes in operations, extreme seasonal weather or other factors that might affect the energy use intensity or energy costs at a building or property.
2. Model energy use in the building, also referred to as calibrated simulation. This involves the use of complex computer software to predict energy use in a building.

Often, energy efficiency and energy conservation measures are adopted to address discernible problems, such as uncomfortable indoor temperatures or wide fluctuations in utility bills. An energy accounting system that tracks the energy performance of a building and compares this to baseline data can help detect and confirm such problems, like malfunctioning cooling equipment that appears as a spike in energy demand of the heating, ventilating, and air conditioning (HVAC) system.

Modeling a building's predicted energy use goes a step further, and can identify buildings with suboptimal performance that may not have discernible problems.



A building with an oversized HVAC system running at full capacity, for example, will provide adequate climate control, but may consume as much as 50 percent more energy than necessary to do the job. Modeling can predict which subsystems should be downsized without compromising air quality or comfort.

In addition to analyzing energy performance against a baseline, owners and managers can use benchmarking to compare a building with properties of similar characteristics, such as climate, size, operations and age. This demonstrates whether a building's energy performance is in line with expectations. A new facility developed following California's stringent building codes, for example, should expect to perform as well as, if not better than, older buildings of similar size and operations. A low ranking, in this case, might alert building staff to conduct an energy audit that would identify areas for improvement. A high ranking, on the other hand, would demonstrate that the building was truly energy efficient and could be marketed as a best-in-class property.

Tracking Historical Energy Use to Establish Baseline Data

The easiest way to establish baseline data is to make a statistical comparison of historical energy performance. Depending on the scope of the existing energy accounting system, much of this information may already be in hand. Useful data streams and sources might include:

- Total demand, peak demand and energy cost - available from the local utility.
- Degree-day data - available from online sources like the National Climate Data Center.
- Building occupancy - available from building or company management, such as the human resources department or leasing office.
- Building operations - available from building staff and tenants.

When setting up an energy management system or energy accounting system, it is important to collect the right data. These systems can literally track hundreds of individual data points, quickly overwhelming the end user with too much information. To narrow and better target the information collected, adapt the energy goals and objectives expressed in the energy policy into key performance indicators. These indicators will then determine which data points are most useful to collect - data should be aligned with and consistent to the key performance indicators. This winnowing process reduces the number of superfluous data streams, making the information gathered easier to analyze and manage.

Advanced meters and submeters further facilitate data collection. In addition to providing real-time information about onsite energy demand and the related costs, advanced meters and submeters also may detect operational inefficiencies, equipment in need of repair, and billing errors. For more information, see Operations and Maintenance.

A number of outside sources can help establish both expectations and methodology for establishing baseline performance. Title-24 (California's Energy Efficiency Standards for Non-Residential Buildings) and the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) 90.1 Energy Standard for Buildings, for example, both provide information on the minimum performance levels a new building should attain in terms of energy efficiency. Local governments can adopt and adjust these standards to set their own goals and objectives.

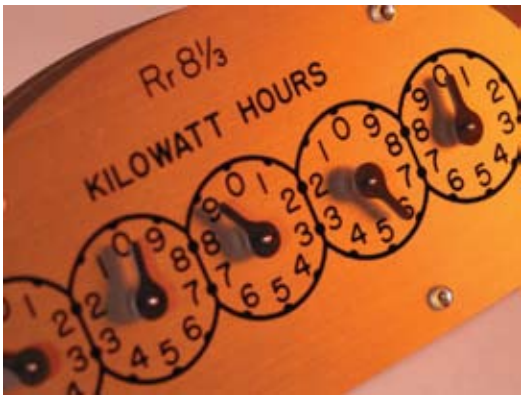
Example: lighting systems should beat Title-24 efficiency standards by 10 percent.

The International Performance and Measurement Verification Protocol (IPMVP) is particularly useful because it describes concrete steps for establishing baseline data. Similarly, ISO 14001, an internationally used standard for developing an environmental management system, includes guidelines for establishing an energy baseline and tracking energy performance. Local governments that adhere to management quality methodologies, such as Six Sigma and ISO 9000, should find that these programs, too, are consistent with and offer tips for performance tracking.

Modeling Energy Use to Predict Energy Use and Establish Baseline Data

Sophisticated software programs allow users to model, or simulate, a building's energy performance. This is usually done only when there is an absence of usable historical or post-retrofit data, or when it is difficult to isolate individual energy efficiency or energy conservation methods. Modeling can estimate how much energy is being used and make predictions about future energy use and costs. Modeling can also be used to predict which energy efficiency or energy conservation measures are the most cost-effective while pointing out potential tradeoffs between options. However, it is an expensive and timely process; using an energy accounting system and benchmarking performance are quicker and less costly ways to assess a building's energy performance.

Modeling is a complicated process that requires training and experience to administer properly. Software must be carefully selected and set-up to ensure that it has the capabilities needed to correctly model a building's specific features. Inputs into the computer simulation must be as accurate as possible, and may take considerable time and resources to collect and verify. Similarly, software must be carefully "calibrated" to ensure that predictions reasonably resemble actual conditions.



Results must then be assessed and shown to be reasonably accurate -- often anomalies arise that require further investigation.

Local governments taking this track should be prepared to invest time and money to ensure that energy modeling generates the desired results. It is not unusual to have 8760 hours of trend logging, for example, as part of the energy modeling - that's 24-hours a day, 7-days a week, 365-days per year.

Benchmarking to Compare Performance

Benchmarking allows government employees to compare a building's energy use intensity (EUI) against buildings of comparable operations, size, and climatic region. EUI is generally expressed as the annual average kilo-British thermal units and kilowatt-hours per square foot (kBtu/sq. ft. and kWh/sq. ft.), or as the total annual energy cost per year per square foot ($/sq. ft.). Although benchmarking cannot identify potential energy savings, it might suggest when energy demand or costs are out of line.

Benchmarking helps protect company assets.
One valuable benchmarking resource is the Commercial Building Energy Consumption

Survey (CBECS), a quadrennial sample survey that collects data on energy-related building characteristics, energy consumption, and expenditures for commercial buildings in the United States.

Another resource, based on CBECS, is ENERGY STAR's Portfolio Manager, an online tool that ranks buildings on a scale of 1 to 100. Buildings that score of 75 or greater achieve an ENERGY STAR label. Portfolio Manager can also continuously track and manage energy data, helping to simplify record keeping. Nationally, about 19,000 buildings have used Portfolio Manager, including 17 percent of all office buildings in the United States.

Besides Portfolio Manager, a number of other benchmarking tools, software applications, and services are available. For example, CalArch, developed by Lawrence Berkeley National Laboratory in partnership with the California Energy Commission Public Interest Energy Research (PIER) Building Energy Efficiency Program, compares California buildings of similar characteristics; it is accessible online and is quick and easy to use. The International Facility Management Association (IFMA) and the Building Owners and Managers Association (BOMA) are additional sources of information. Both associations conduct periodic surveys that compile useful information about member responsibilities and facility performance.

If benchmarking data suggests that a facility does not perform as well as it could, conducting an energy audit will identify areas of potential improvement. See the following section for more information.

ENERGY STAR Benchmarking
To use ENERGY STAR Portfolio Manager, buildings must have at least 50 percent of the total floor space occupied by at least one of the following: office (general, bank branch, financial center, or courthouse), hospital, medical offices, hotel/ motel, K-12 school, supermarket or grocery store, dormitory or residence hall, or warehouses.
Green Building Initiative

Green Building Initiative
Governor Schwarzenegger's Executive Order S-20-04, commonly referred to as the Green Building Initiative, directs the California Energy Commission to develop a plan to implement a State benchmarking program for all commercial buildings. The intent is to clarify which buildings are energy efficient, making benchmarking information available to potential tenants, buyers, and lenders. The proposed program will be coordinated with the U.S. EPA's ENERGY STAR benchmarking tool, Portfolio Manager.

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First Steps

Before investing in either energy efficiency or energy conservation measures (EEMs and ECMs), a local government should set up a wider framework for all energy planning and investment. This helps assure that resources invested, such as financial or human, are expended wisely and strategically. The two most critical pieces of such a framework are the appointment of an energy manager and the adoption of an energy management program.

An energy manager is responsible for facilitating and coordinating the planning, procurement and utilization of energy resources at a property, facility, or portfolio of properties. In some organizations, the energy manager is a full-time, dedicated position whose responsibilities might encompass a single building or a whole portfolio of properties. In others, energy management is just one part of the responsibilities of a facility or property manager. A background in engineering is common; increasingly, business and communication skills

are also required. The energy manager carefully analyzes a company's potential for investment, articulates findings and recommendations to company decision makers, oversees implementation of ECMs and EEMs, and then tracks and quantifies results stemming from the energy management program. In doing so, successful energy managers depend on their relationships with co-workers, such as building staff, business managers and company executives, as well as external partners, such as vendors, contractors, energy service providers and the local utilities.

If you think of the energy manager as the conductor of a symphony, then the energy management program is his baton, weaving together a dynamic set of operations, equipment and people into a finely tuned, and well-timed orchestration. The energy management program encompasses a company's energy-related priorities as well as a strategy to attain energy savings (expressed in kilowatt-hours and therms) and energy cost savings (expressed in dollars).

Steps to assess a facility's potential for energy savings can include:

- Create an energy profile that shows the energy performance of a facility and its operations; track this information over time to create an energy accounting system.
- Use the energy accounting system to establish a baseline for energy use and energy costs; this will be used later to verify program results.
- Conduct an energy audit that identifies and prioritizes energy efficiency investment options; the energy audit should include a timeline for implementing ECMs and EEMs as well as expected energy cost savings resulting from each recommended measure.

Steps to facilitate planning and implementation of an energy management program can include:

- Appoint an energy manager responsible for overseeing plan management.
- Adopt an energy policy that clearly articulates local government goals and objectives.
- Convene an energy team responsible for planning and implementation; assign the team roles and specific tasks.
- Develop an action plan to implement ECMs and EEMs, as identified and recommended by the energy audit.
- Develop a measurement and verification (M&V) plan, based on the energy policy and action plan, that clearly lays out the metrics used to establish baseline data as well as to measure subsequent program results.

In practice, the lines between these steps are blurred, and the timing of each depends largely on the individual characteristics and needs of a company. Some steps will run concurrently, while others may not be warranted at all. A city might decide to do all work in-house, for example, and not need a detailed M&V plan in addition to the goals and objectives outlined in the energy policy. Or a city might decide to convene an energy

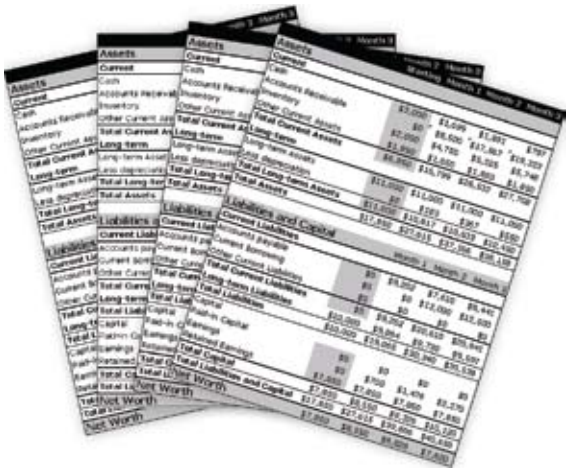
team that then develops the energy policy. Each step described in this best practice guide should be evaluated and tailored to serve the specific needs of your city or county.

FUNDING AND APPROVAL

Selling the Program

To have an energy project approved and funded, it must successfully compete with other capital investment proposals. The good news is that energy projects reduce operating expenses by as much as 30 percent. Whenever operating expenses decrease, net operating income (NOI) rises; this is one of the few ways to stimulate internal growth and is especially important since opportunities for external growth - buying and building - can be limited. NOI is used to calculate asset value, so it is important for evaluating the long-term financial health of a company. For every $1 invested in energy efficiency, asset value increases by as much as $3.

When attempting to get approval for an energy project, the first step is to understand the internal investment criteria of the municipality, often quantified in terms of the rate of return on investment (RRI). Use this information to weigh the cost-benefit of potential projects. Whenever possible, calculate the life-cycle cost, not just first-cost, since this can be misleading. Assess the life-cycle cost and relative net present value of projects so that the cost of capital and the tradeoffs between investment options can be fully identified.



For income properties, look at lease structures to calculate how much of a project's estimat ed energy costs savings might be retained by the building owner as opposed to the tenants.

The next step is to explore creative funding strategies, such as government and utility incentive programs. To secure rebates and grants before a project is fully implemented, carefully align the project to meet program requirements and then establish open communications with the local utility or authorizing government agency to facilitate approval. When working with contractors, discuss how performance contracts or performance guarantees might reduce first-costs or lower the risk of investment by tying payment to end results - usually measured in terms of cost reduction or utility meter readings.

When articulating the benefits of an energy project to internal stakeholders, speak dollars rather than kilowatts. Express both cost savings as well as the resulting increase in NOI.

Mention intangible financial benefits like increases in worker productivity and positive public relations stemming from environmental leadership.

ENERGY STAR Financial Tools
ENERGY STAR provides three tools that help assess the economics of energy projects. The Financial Value Calculator estimates potential financial returns that could result from increased energy efficiency. QuikScope helps allocate costs and savings between owners and tenants. The cash flow calculator helps decision makers assess the financing options for energy efficiency equipment.

Common Financial Definitions

- Simple Payback - the length of time needed to pay back the initial capital investment, usually expressed in years.
- Life-Cycle Cost Analysis - the total cost of a design choice over its serviceable life.
- Levelized Cost - the present value of the total cost of an investment, converted to equal annual payments.
- Net Present Value - the net result of an investment, expressed in today's dollars.
- Return on Investment - the income an investment provides in a year.

More definitions plus links to calculators can be found in Appendix 1.

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Current natural gas prices from the California Energy Commission. http://www.energy.ca.gov/naturalgas/index.html

Energy Design Resources, eVALUator online calculator is an easy-to-use Windows-based program that calculates the lifecycle benefits of investments that improve building design. http://www.energydesignresources.com/resource/131

BPG Appendix 1: Financial Calculators and Online Resources (PDF download, 84 KB).

http://www.fypower.org/pdf/fincalculators

Incentive Programs

California energy markets are in a historic period of change. Two forces have been driving this rapid change - deregulation and the emergence of several new technologies designed to improve the efficiency of traditional energy resources or the viability of renewable sources of energy. The widespread availability of enhanced automation for building equipment systems, for example, has markedly reduced energy consumption at many properties. Likewise, improvements in the efficiency of photovoltaic cells have helped the solar industry in its rapid expansion; shipments of solar panels increased nationally by 642 percent between 1992 and 2002.

At the same time, the overall growth of technology in everyday government operations has given rise to new demands for energy resources. Cities and counties increasingly rely on an assortment of technological equipment - computers, printers, scanners, faxes, servers - ramping up energy demand on a system already running at near capacity. To meet this demand, energy stakeholders have turned to energy efficiency and renewable energy as viable and cost-effective ways to add needed capacity.

These changes have clear benefits for local governments. Never before - and, perhaps, not again - have so many incentive programs offered rebates, grants, tax credits, and expertise to assist with energy efficiency projects. As energy efficiency becomes more commonplace, local governments that wait may not enjoy this same level of support - yet will still be held accountable under California's stringent building codes, like Title 24, the State's Energy Efficiency Standards. Taking full advantage of incentives while government and ratepayer funding is still widely available is in every local government's self-interest.

Saving a kilowatt is cheaper than generating one. Incentive programs are a win-win-win situation - good for the state and good for California ratepayers. Speak with your local utility before implementing energy upgrades to determine which incentive programs might be right for your project. You can also research incentive programs through the Flex Your Power website.

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information they need to make use of the federal income tax incentives for energy efficient products and technologies passed by Congress as part of the Energy Policy Act of 2005. http://www.energytaxincentives.org/

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Funding Sources

The Department of Energy describes three general financing mechanisms for energy efficiency projects: internal financing, debt financing, and lease or lease-purchase agreements. Another, less commonly used mechanism known as energy performance contracting, is also described. Energy managers can decide to pursue any combination of these mechanisms to suit their individual financial and building requirements.

Internal Financing
Internal financing is the simplest, most straightforward funding option for energy efficiency projects. Projects will be constrained by budget limitations and may have to compete with other capital investment proposals that have a higher rate of return on investment. As such, this funding source is best for projects that have a short payback period.

Debt Financing
Debt financing - loans - allow a city to have control over the repayment structure so that accounting records show a break-even or positive cash flow during the project's life. Energy cost savings resulting from the capital project can even be used to repay financing costs (this is sometimes called "Pay as You Save™"). Debt financing tends to be more complex than internal financing and requires some level of in-house financial expertise. Smaller projects may not make sense because of the high transaction costs and slower payback rate.

Lease and Lease-Purchase Agreements
An energy savings performance contract (ESPC) can be used if a facility is more than 40,000 sq. ft. and energy efficiency upgrades are expected to cost at least $200,000. A city enters into an ESPC with an energy services company (ESCO) to bundle all of the engineering, equipment purchasing, construction, installation, and commissioning needs into a single package. The ESCO guarantees that energy cost savings will repay the cost of the project and financing. Thus, a business uses operating funds rather than capital investment funds to finance a project, allowing for capital improvements that might not otherwise be undertaken due to budget constraints or credit worthiness. After a city repays the project costs, including ESCO fees and finance charges, it usually retains any additional energy savings.

Energy Savings Performance Contract
If a facility is more than 40,000 sq. ft. and energy efficiency upgrades are expected to cost at least $200,000, a city might consider entering into an energy savings performance contract (ESPC). An ESPC contracts an energy services company (ESCO) to bundle all of the engineering, equipment purchasing, construction, installation, and commissioning needs into a single package. The ESCO guarantees that energy cost savings will repay the cost of the project and financing. Thus, a business uses operating funds rather than capital investment funds to finance a project. This allows for capital improvements that may not otherwise be undertaken due to budget constraints or credit worthiness. After a city repays the project costs, including ESCO fees and finance charges, it usually retains any additional energy savings.

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EDUCATION

Employees

Even the most energy-efficient equipment is ineffective if individual behavior is not aligned with a city or county's energy goals. Energy and water waste are often the result of unintentional misuse, such as leaving lights and office equipment on when the building is unoccupied or opening windows while heating equipment is in operation.

Retrofiting can provide an opportunity to educate residents and business owners about the benefits and cost-savings associated with energy efficiency. And these education programs can also serve as positive public relations between the local government and the community. A recent special survey on Californians and the environment from the Public Policy Institute of California found that a majority of Californians feel that the environment is a top policy priority, even over economic growth.

A whopping 79 percent believe that all western states should increase energy efficiency by 20 percent by 2020. More than three quarters of Californians believe that steps need to be taken right away to counter the effects of global warming. Clearly, government officials that respond to these overwhelming public concerns will be viewed as valued leaders the community.

Cities that retrofit a lighting system, for example, can use the improvements to teach residents and business owners about the benefits and cost savings of new lighting technologies such as occupancy sensors and compact fluorescent lights. This enables building occupants to personalize the energy-saving lessons inherent in an energy program.

Peer-to-peer educational programs offer a way for building owners and managers to learn new techniques or to share their experiences. The Building Owners and Managers Association (BOMA), for example, has launched the BOMA Energy Efficiency Program (BEEP). BEEP teaches property owners, managers, and operators important strategies for optimizing their equipment, people, and practices. In partnership with the U.S. Environmental Protection Agency ENERGY STAR program, BEEP has and will continue to develop industry standards for operational excellence, document success through recognition programs, and communicate those successes to industry and stakeholders.

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Education Sparks New Innovations
Education programs create a means for managers to learn from building occupants, as well. Be sure to include a feedback mechanism so that after learning about the value of energy efficiency, employees can offer suggestions. Not only does this generate new and innovative ideas for the energy program, it also actively engages people in thinking about energy and its use.

Some common ideas for collecting feedback include:
- Prominently place a comment box near where employees congregate, like a cafeteria or locker room.
- Offer rewards and other incentives for ideas that are adopted.
- Brainstorm ideas as a group during trainings and meetings.
- Add energy efficiency criteria to employee reviews; make energy efficiency a factor in career advancement.

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BPG Appendix 5: FYP Education Boilerplate (PDF download, 5.6 MB) http://www.fypower.org/pdf/eduboilerplate

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LIGHTING

Offices and Workstations

Lighting represents approximately 22 percent of all electricity consumed in commercial office buildings. Thus, lighting is a major portion of total building operating costs. Retrofits to lighting systems can yield savings as high as 40 percent of current costs, and can easily be fit into routine building maintenance.

Retrofits are especially effective in buildings designed pre-1990s, before the widespread use of personal computers. As work moves away from the desktop and onto the computer screen, modern workstations require less ambient light

When retrofitting a lighting system, consider two related system components: the ballast and controls. Replacing magnetic ballasts with basic electronic ballasts can save a minimum of 12 percent of energy consumption, more if you invest in premium electronic ballasts. Premium ballasts come in three main types: instant-start, program-start, and dimmable. Controls, which should be matched to the appropriate ballast, greatly improve efficiency and offer higher flexibility to the end user. Occupancy controls shut off lights in empty areas and photosensor controls dim or shut off lights when natural light renders these unnecessary. Either control system can also come equipped with a timer.

New technological improvements in fluorescent luminaires have also dramatically reduced energy consumption while improving light quality. Switching out T12 fluorescents for efficient T8s results in higher efficacy (i.e., fewer watts per lumen). T8s last longer, requiring less maintenance over the useful life of the lamp as well as less waste in local landfills. Because light quality is also better, fewer fixtures per square foot are needed, making delamping possible. Fewer watts per fixture and fewer fixtures per square foot result in lower cooling loads, which mean that related cooling costs from operating climate control equipment are also reduced.

Despite these dramatic cost savings, many businesses have been slow to turn over outdated T12s. Of the 1.5 billion fluorescent lamps installed in the U.S. commercial sector,

58 percent are still T12s. This is a missed opportunity. Typically, lighting retrofits recoup costs quickly and are excellent, low-risk investments.

There are two related system components to consider as part of any lighting retrofit: the ballast and controls. Replacing magnetic ballasts with basic electronic ballasts can save a minimum of 12 percent of energy consumption, more if you invest in premium electronic ballasts. Premium ballasts come in three main types: instant-start, program-start, and dimmable. Controls, which should be matched to the appropriate ballast, greatly improve efficiency and offer higher flexibility to the end user. Occupancy controls shut off lights in empty areas and photosensor controls dim or shut off lights when natural light renders these unnecessary. Either control system can also come equipped with a timer.

What is a "light"?
All lights have a lamp, commonly but incorrectly referred to as the "light bulb." The fixture connects and positions this lamp to its energy source. In fluorescent and high intensity discharge (HID) fixtures, the energy supply is modulated through a ballast. Halogen and incandescent fixtures, on the other hand, connect directly to the energy supply. Taken together, the lamp, ballast, and fixture are called a "luminaire" - light is the product of a luminaire.

What's the difference between fluorescent fixtures, then?
Fluorescent fixtures are named by the diameter of the lamp. For example, a T12 is a 1-1⁄2" lamp, a T8 is a 1" lamp, and a T5 is a 5/8" lamp. The trick is to divide the number by 8 to determine the diameter in inches. Besides lamp diameter, fluorescents are sometimes further categorized by their lumen output - standard or high output (HO).

Quick Suggestions

- Fluorescent lamps are better than high-intensity discharge (HID) lamps.
- T8s are more efficient than T12s.
- Super T8s are more efficient than standard T8s.
- Electronic ballasts (fluorescent or HID) are more efficient than magnetic ballasts.
- Optimal electronic ballasts are more efficient than generic electronic ballasts.
- Choosing between instant-start, program-start and dimmable ballasts will depend on the application and local utility rate charges.
- Redesigning the system so that fixtures are delamped may achieve higher long-term savings than simply retrofitting fixtures.
- Assess life-cycle cost and benefits of lamps and ballasts.
- Remember to consider benefits derived from daylighting and reflective surfaces.
- Little things count, like light-emitting diode (LED) exit signs and outdoor lighting.

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Daylighting

Many people are familiar with the business maxim, “Cheaper, faster, better - pick any two of the three.” Unlike most things in life, though, daylighting achieves all three.

Daylighting is cheaper. The only investment needed is for design and installation of equipment related to the fenestration, e.g., a skylight, a light tube, or a clerestory. In general, horizontal installations like skylights, light tubes, clerestories and light wells are easier to install and more cost-effective than their vertical counterparts (windows). Adding photosensor controls allows you to maximize energy savings by automatically shutting off or dimming superfluous fixtures according to changes in the level of natural light. This combination of technologies maintains a consistent light level throughout the day and the seasons, and reduces peak operating costs.

Daylighting is better. Daylight literally outshines any artificial lamp on the market - it is brighter, more appealing, renders color more accurately, and is much better for visual acuity. This is important for visually oriented operations. Daylighting provides high-quality light without relying on expensive artificial fixtures.

And, while daylighting may not be “faster,” tenants often find that they get more accomplished in a shorter period of time while working under natural lighting conditions. Daylighting reduces eyestrain and is known to have subtle effects on productivity and comfort. Studies have shown that daylighting in schools improves student math and memory skills and increases sales in major retail centers. Anecdotal evidence supports these findings, suggesting that workers increase productivity and reduce absenteeism when provided with natural light. Daylit spaces tend to be designed with large expanses of windows that provide a view of the outdoors, another factor found to contribute to occupant comfort and worker productivity.

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Hallways and Corridors

Corridors and hallways tend to copy the lighting choices used in workspaces. Too often this means repeating the same fluorescent lighting designs, even though walking safely through a hallway requires far fewer lumens than reading or working on a computer. T8 fluorescent fixtures, which save energy in most applications, are wasteful when used to light hallways. T12s, of course, are even worse.

Pendants and wall sconces that use compact fluorescent lamps (CFLs) save energy and money. CFLs consume about 72 percent less energy than incandescent lamps, and have lower lumen levels as well as total wattage compared to full fluorescent fixtures. CFLs come in a wide array of designs and sizes to suit any style and space, adding decorative flourishes or architectural highlights that create a sense of change as occupants move from one area to the next.

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Restrooms and Closets

The easiest way to achieve energy and cost savings in restrooms and storage areas is to install CFLs with occupancy sensors. Occupancy sensors ensure that energy is not wasted lighting an empty room and make it easy for people to move into and out of low-occupancy areas. Using an occupancy sensor rather than a manual switch saves up to 60 percent of the energy needed to light bathrooms and closets.

Outdoor Areas

Outdoor lighting is so ubiquitous and yet so essential in the urban and suburban environment that most of us rarely see truly dark skies at night. Outdoor lighting gives us the ability to

see and be seen, effectively extending the hours during which we can use facilities like parking lots, walkways, entryways, outdoor patios and recreational areas. Although visual acuity is the primary goal, outdoor lighting is commonly used to add design or architectural details to facades and landscapes, drawing the attention of passersby.

In California, commercial and industrial outdoor lighting consumes an estimated 3067 gigawatt-hours (GWh) of electricity each year - this is enough energy to power more than half-a-million Californian homes. Commercial outdoor lighting alone accounts for three percent of all nighttime energy use, with demand peaking about 7 to 8 PM during the winter months; summer peak is about 9 PM. This demand tapers off around 1 AM as parking lots reduce lighting levels, remains constant until about 4 AM, then briefly spikes around 5 AM as the morning commute begins.

Replace Inefficient Lighting Systems

- As with any lighting system, choosing energy-efficient lamps and fixtures is the most important measure a company can undertake.
- Retrofit inefficient luminaries, replacing lamp, fixture, and ballast, or simply relamp (replacing lamp only).
- Replace incandescent lamps with compact fluorescent lamps (CFLs).
- Replace inefficient high intensity discharge (HID) lamps with more efficient HIDs like low pressure sodium (LPS) or high pressure sodium (HPS), depending on the color rendering needed.
- At the very least, replace mercury vapor HIDs, as these consume about three times the energy as the equivalent LPS luminaire.

High output fluorescent lamps are even more efficient, particularly new T5s, but check the temperature rating in case there are difficulties associated with low temperatures. Be sure to upgrade any magnetic ballast for an efficient electronic or digital unit. Seek the advice of a qualified lighting professional to help with any redesign of outdoor lighting.

Install Photosensors

Lighting controls play a large role in making outdoor lighting systems efficient and effective.

- Photosensors (also referred to as photocells) activate outdoor lighting as daylight diminishes. Commercial buildings tend to stay active through the early evening hours, so parking lots and walkways usually need moderate lighting levels (expressed as lumens) for the first few hours of evening and nighttime.
- A timer control can then be used to dim or turn off unnecessary lamps and fixtures in areas that are no longer active.

- Motion sensors can activate lighting as needed by building occupants or for security, providing ample illumination for the stray late worker who needs to safely cross outdoor walkways and parking lots.

Position Effectively

Location and position are also factors worth considering when designing an efficient lighting system. All lighting, both essential and decorative, should be positioned so that direct and reflected light falls down, and not up into the atmosphere or across into a neighbor's space. This helps decrease the bothersome incidence of glare, light pollution and light trespass.

Further Considerations

- Using lighting as a design element can have dramatic effects, but at 2 AM, no one is around to impress. Consider adding timers and reducing the incidence of design lighting.
- Remember that higher lumens do not necessarily translate into added security - studies indicate that outdoor lighting is not necessarily a major deterrent to crime and may, in fact, aid perpetrators of certain crimes like vandalism.
- Seek the advice of a lighting professional who can help design, implement, and test lighting levels in different outdoor areas to optimize the system and ensure safety compliance with lighting standards and building codes.

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Signage

Light emitting diode (LED) signs have come a long way. A variety of colors and designs are now commonly available to create colorful, engaging graphics and animation. Signs are safe for use indoors or outdoors, and can be sized to meet multiple purposes.

Every office building should adopt at least one important LED sign - the exit sign. LED exit signs are cheap to operate, require almost no maintenance, and last much longer than their incandescent counterparts. ENERGY STAR estimates that annual savings from 100 LED exit signs compared to incandescent signs equals more than $5,000 - that is $50 per sign per year! Over an LED's lifetime, 100 LED models save about $31,644 after higher first costs have been repaid. Savings are even higher if owners or managers qualify for purchase rebates or other incentives.

Since California building codes require exit signs or directional arrows placed at every exit door, corridor intersection, exit stairways and exit ramps, it is easy to see how these savings quickly add up.

Those who enjoy being on the cutting edge of technology might care to check out electroluminescent exit signs. These use only 0.25 watts for a solid-state green light that has no bulbs or parts to replace.

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CENTRAL HVAC SYSTEM

Heating Subsystem

Although most boilers are gas- or oil-fired (93 percent of the market), those that are electric typically operate at only 65 to 75 percent efficiency.

Consider upgrading to a more energy-efficient system. High-efficiency boilers have up to 90 percent combustion efficiency. The combustion efficiency of a typical boiler or furnace is 75 percent to 80 percent. Older boilers and boilers converted from coal have 60 percent to 70 percent combustion efficiency.

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Natural Ventilation and Air Infiltration

All buildings need some sort of natural or artificial ventilation. Not only does proper ventilation prevent the buildup of harmful indoor air contaminants like mold, mildew, and soot, it also plays a big role in controlling indoor temperatures.

Otfen, the best cooling is still as simple as opening a window. Large bay doors, clerestories, and/or windows are easily manipulated to allow outside breezes to push air into a building, forcing hot air upwards and out. In new construction or with major renovations, architects and engineers can model these airflow patterns and purposefully design apertures that maximize natural ventilation.

Wind-driven ventilators can also be used. These use no energy, unlike their mechanical counterparts that use electricity to power a small motor. Wind-driven ventilators provide natural ventilation and help exhaust indoor air to the outside.

With either natural or mechanical ventilation systems, free night cooling during warm summer months is an excellent no-cost way to lower energy use and stay cool. Open all air vents when nighttime temperatures drop so that the cool air can circulate and lower indoor temperatures. This technique is particularly suited to buildings with high thermal mass, such as those with concrete walls, since these buildings are slower to cool down, but slower, too, to heat up. Free cooling helps keep indoor temperatures comfortable even as outdoor temperatures rise.

Air infiltration - basically, uncontrolled air leaks - is the opposite of natural ventilation. In the summer, hot outdoor air enters inside while cool, conditioned air escapes outside. In the winters, cold air enters and warm air escapes. Besides adding to HVAC loads, air infiltration causes uncomfortable drafts and may lead to the buildup of humidity. To avoid air infiltration, insulate carefully around all doors and windows and install weather stripping. Also check curtains and doorways around cold storage, process freezing, and other refrigerated areas.

Optimization

Thermostat settings
In the winter, try setting the thermostat to the lowest point necessary, usually about 68ºF depending on stored products, operations, and local climatic conditions. Investigate ways to capture and reuse waste heat from production processes, or consider using personal space heaters to warm workers instead of central HVAC, especially in highbay facilities.

In summer weather 90ºF or less, you might be able to get by just running a dehumidifier and relying on natural ventilation from open windows, doors, or bays. When conditioned air is needed, set thermostat to the highest temperature possible while still staying comfortable, usually about 78ºF. Programmable thermostats help automate this task, and can save up to 25 percent on heating and cooling costs.

For more information, see Flex Your Power's product guides on programmable and automatic thermostats.

Zone control

The mark of an efficient HVAC system is that it only runs in areas where people actually are - nobody needs a conditioned conference room that sits empty. If a building is sparsely populated during off-hours like nights and weekends, HVAC operations should be scaled back or shut off completely. Again, programmable thermostats help automate this task.

Some HVAC systems allow zone control. Each zone is controlled by a separate thermostat that signals dampers to open and close as needed to deliver conditioned air only to occupied work areas, not to empty offices, vestibules, storage areas, or other unoccupied spaces.

Automation and optimization

An optimized HVAC system runs dynamically, with each piece of major equipment operating in careful coordination. Air quality and temperature are maintained within set parameters, using the least amount of energy necessary.

To do this, a building must be equipped with:

- An HVAC system.
- Controls on major equipment, such as compressors, fans, and dampers.
- An energy management system (sometimes referred to as a building automation system or enhanced automation).

In addition to equipment, optimization requires quality engineers with the knowledge and experience to configure the entire system. Engineers monitor equipment and operations over a period of time, thoroughly test equipment, and then make recommendations to management about possible upgrades. As the entire system is fine-tuned, major components are tested and balanced to work in close coordination. Although new equipment sometimes needs to be installed, the focus of this work is to improve the performance of existing equipment. In cases where activities within a building have changed since the initial installation - say an area once used as offices now houses a data center - yearly professional reviews can ensure optimization and efficiency.

Optimization takes time and a sizeable investment, but typically results in very quick payback (sometimes less than a year), substantial energy and cost savings, and greatly improved indoor air quality.

Careful optimization seeks to catch these mistakes and lost opportunities. Engineers monitor equipment and operations over a period of time, thoroughly test equipment, and then make recommendations to management about possible upgrades. Although new equipment sometimes needs to be installed, the focus of this work is to improve the performance of existing equipment. As the entire system is fine-tuned, major components are tested and balanced to work in close coordination. This work takes time and a sizeable investment, but typically results in very quick payback (sometimes less than a year), substantial energy and cost savings, and greatly improved indoor air quality.

Optimization has some special indirect benefits - besides lowering energy costs. Energy management systems (EMS) can control building systems other than the HVAC, such as lighting, fire and smoke detection, and security systems. This is particularly useful for companies that participate in demand response programs since energy-saving measures can be pre-programmed in advance of an electrical emergency. Besides cutting energy costs when rates are at their highest, this helps protect critical equipment

Several EMS use direct digital controls that allow managers to monitor and manipulate building systems over a secure Internet connection, enabling them to solve problems from any location. The EMS also generates reports that track energy use and equipment performance over time, providing better information flows for overall energy and facility management.

Finally, optimizing the HVAC system extends equipment life and reduces downtime for repair and maintenance. The system quickly detects when problems arise, and alerts facility staff when repairs are needed.

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Condenser Chilled Water Subsystem

Chillers are the most expensive piece of the HVAC puzzle and tend to have a long life. Because of this, property managers and owners should decide whether it is more cost-effective to retrofit an existing chiller or replace it entirely with a new, more efficient model.

Older systems tend to have oversized chillers that waste energy without providing greater comfort. Older, oversized systems are inefficient, consuming as much as twice the energy as their newer, right-sized counterparts. Chillers that have been poorly or irregularly maintained waste even more energy, increasing operation and maintenance costs. Now consider that the cost of running HVAC equipment is 41 percent of your total energy expenses - the unnecessary expense of poor equipment quickly adds up.

Chillers less than 10 years old can usually be cost-effectively retrofitted rather than replaced. The exception is if cooling loads have been significantly reduced through other upgrades, such as a lighting retrofit. In this case, it may be more cost-effective to downsize the chiller. Looking at the lifecycle costs and potential energy savings of the two options helps to determine the most cost-effective investment. Operational and maintenance savings resulting from a downsized chiller equipped with variable speed drives in most cases will make up for the higher first cost of replacement.

Conversely, if you intend to upgrade an undersized chiller to increase cooling capacity, you may want to first consider upgrading other building systems. According to ENERGY STAR, retrofits to lighting, plug loads, and the building envelope can reduce cooling loads anywhere from 10 to 40 percent. By first focusing on reducing cooling loads, you might be able to minimize or completely avoid the need to increase cooling capacity - a much better deal overall.

CFCs in Cooling Equipment

Chlorofluorocarbons (CFCs) were the most common refrigerants used in air conditioning and refrigeration equipment until the 1980s when scientists were able to show that CFCs caused significant stratospheric ozone depletion. Unlike ground-level ozone, which is the major constituent of smog and is bad for human health, stratospheric ozone prevents excessive cancer-causing ultraviolet radiation from reaching the earth. By 1995, refrigeration and air conditioning manufacturers had responded to concerns by phasing out the use of CFCs in all new equipment.

Despite manufacturers' efforts, a large number of chillers using CFCs are still in operation due to their long useful life. The Air-Conditioning and Refrigeration Institute (ARI) estimates that as of January 2005 only about 58 percent of the approximately 80,000 large tonnage liquid chillers using CFCs in the United States have been replaced or converted.

In order to help encourage building owners and managers to replace the remaining CFC units, the U.S. EPA developed a guide, "Building Owners Save Money, Save the Earth: Replace Your CFC Air Conditioning Chiller." In this guide, EPA argues that energy savings and reduced maintenance on new chillers can payback investment in five years or less. When other energy efficiency retrofits that reduce cooling loads are done concurrently, payback can drop to as little as two or three years with a return on investment of 20-35 percent.

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Controls and Load Reduction

Nothing affects comfort more than a building's climate control system. At the same time, nothing consumes more energy. Climate control accounts for roughly 41 percent of an office building's total electrical energy consumption - almost double that of any other building system. And, because daily high temperatures coincide with peak energy use, climate control equipment operates at its highest capacity during the most expensive utility rate time. Air conditioning alone is 45 percent of the total peak energy use of the commercial sector.

In office buildings, climate control is most often provided through a central heating, ventilating, and air conditioning (HVAC) system. The HVAC system regulates temperature, humidity, and indoor air quality by drawing outdoor air into the air handling subsystem, conditioning this air in either the chiller (cooling) or heating subsystems to correct temperature and humidity, then venting the conditioned air to locations throughout the building as needed. Methods for upgrading HVAC systems depend on the particular characteristics of the building, the existing equipment in place, and any problems that might have been detected in indoor air quality.

Central HVAC systems tend to be oversized and are not often set for optimal efficiency. Before adding additional cooling capacity, have a qualified engineer inspect the system to see if a redesign or tune-up may be in order. Companies have saved as much as 50 percent on their energy consumption by adjusting control set points and modifying existing equipment. Fine-tuning HVAC equipment also dramatically lowers CO2 emissions, important for companies participating in greenhouse gas emission reduction programs.

To optimize HVAC performance and reap additional savings, install an enhanced automated control system along with compatible control equipment on building mechanical and electrical systems. The HVAC, lighting, fire and smoke detection, and security systems can all be integrated into an automated control system. Enhanced automation allows facility staff greater zone control by continuously monitoring and adjusting lighting and HVAC equipment based on occupant densities and environmental factors. This allows load curtailment during peak times when utility rates are highest. Enhanced automation also decreases occupant complaints arising from poor indoor air quality since zones rarely fall outside of control set points. Those problems that do arise are detected quickly and repaired fast, often before occupants have even noticed. Because equipment is optimized and operated in coordination with the full system, equipment life is extended and downtime for repair and maintenance is minimized.

Other effective tools to reduce HVAC operating costs may only indirectly deal with the system. Before undertaking expensive retrofits, investigate ways to reduce heating and cooling loads. Lighting retrofits, building envelope improvements, and use of energy efficient office equipment all reduce heat buildup and lower cooling loads. Do these measures first, and make HVAC upgrades the last step in your energy program. This allows engineers to size the HVAC system, minimizing overall costs while ensuring that the entire building operates efficiently.

Greenhouse Gas Emissions and Electricity

Few people stop to consider the impact of commercial office buildings on climate change. While there are no visible smokestacks or tailpipes in close proximity, a full 50 percent of these GHG emissions from electricity are attributed to electricity imported from other states where energy sources may include coal and other carbon-intensive power production sources.

Cutting back on electricity use can help lower these figures and spare the air harmful greenhouse gases. A basic rule of thumb is that for every ten kilowatt-hours saved, 7.3 pounds of GHG emissions are reduced. For more information about how to calculate GHG emission reductions, see Volume III, Chapter I: Methods for Estimating Carbon Dioxide Emissions from Combustion of Fossil Fuels published by the Emission Inventory Improvement Program and the State and Local Climate Change Program, U.S. Environmental Protection Agency.

California Climate Action Registry

California has responded to climate change concerns in part by establishing the voluntary California Climate Action Registry. The Registry helps companies and organizations with operations in the state to establish GHG emission baselines against which any future emission reduction requirements may be applied. Once a company's baseline emissions have been established, emission reductions through energy efficiency projects can then be quantified. The Climate Action Registry is currently developing a calculator that will help translate energy savings in commercial buildings into GHG reductions.

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Air Handling Subsystem

Fans that move conditioned air consume about seven percent of total electrical energy in a building. Along with the ducts and dampers, this equipment is collectively known as the air handling subsystem of the HVAC system.

As with chillers, older central HVAC systems tend to have oversized fans. In fact, nearly 60 percent of all buildings have oversized fans that waste as much as 60 percent of the energy consumed. This money is literally blown out the door. Rightsizing fans removes excess capacity and lowers energy consumption of the air handling subsystem by an average of 50 percent.

Air handling subsystems are fixed at either a constant air volume or variable air volume (VAV). As the name implies, VAV subsystems enable fans to adjust according to the actual needs of building occupants. Additional energy savings can be made by installing variable speed drives (VSD) on VAV fans and motors. VSDs make sense for motors that run long hours or have fluctuating loads - the larger the motor, the bigger the savings possible. Adjust the air handling subsystem to the lowest point possible without compromising

occupant comfort and while continuing to meet local codes and requirements for air quality. This reduced flow can result in energy savings of up to 50 percent. Preset two or more pressure settings, e.g., daytime/nighttime or summer/winter, to maximize savings throughout the day and year.
Unfortunately, it can be quite expensive to replace a constant volume unit with a VAV. If it is not cost-effective to replace, improvements can still be made by rightsizing fans and replacing fan V-belts with synchronous belts, which help reduce slippage and wear.

Some air handling subsystems include an air economizer that automatically intakes air when the air is cooler than the return air, taking advantage of this free source of cooling. When outdoor temperatures rise, a damper closes vents so that only the minimum amount of outdoor air needed to maintain air quality is allowed to enter. Air economizers can also be used to pre-cool a building in the evening and early morning hours, further reducing the need to run cooling equipment.

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ClimateQuest, downloadable calculators that 1) analyze cost savings from an economizer, and 2) analyze ventilation loads. Website also has articles related to HVAC and heat recovery as well as historical weather data. http://www.climatequest.com/

Air Infiltration and Ventilation Center, international technical and information forum covering the areas of ventilation and air infiltration in the built environment with respect to efficient energy use, good indoor air quality and thermal comfort. http://www.aivc.org/index.html

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PROCUREMENT POLICY

Office Equipment and Appliances

Office equipment accounts for 26 percent of electricity used in office buildings - more than the entire lighting system (22 percent) and almost as much as the chilled water subsystem (28 percent). Yet this is the easiest area in which to achieve energy efficiency savings - simply retire outdated or malfunctioning equipment and replace with ENERGY STAR-qualified models.

Work with in-house procurement staff to develop company guidelines for purchasing ENERGY STAR-labeled equipment and appliances. Labeling and information are available for computers, copiers, power adapters, fax machines, laptops, monitors, multifunction devices, printers, scanners, and water coolers as well as appliances like dehumidifiers, refrigerators, freezers, and room air conditioning units.

Inefficient office equipment typically is coupled with inefficient power supplies, also referred to as power adaptors. ENERGY STAR estimates that there are 1.5 billion power supplies in the United States, or about five for every one person.

Unfortunately, these power supplies waste roughly 30 to 50 percent of the 207 billion kilowatt-hours of energy passing through to electronic equipment. In other words, the printer in your office could waste half the electricity paid to operate it, just like the telephone, the computer, the coffee pot, and so on.

To minimize this energy waste, check around the office for ways to reduce the total number of power supplies. Consider purchasing a multifunction device, for example, rather than separate scanner, printer, and fax to reduce the total number of adapters. Use surge protectors for all plugs, turning off the surge protector when the office is unoccupied. ENERGY STAR is developing a rating system to address power supplies, which should soon be available and will help in purchases of new equipment.

No-Cost Energy Saving Tips

- Set computers and monitors to “sleep” when inactive for more than a few minutes.
- Turn off office equipment at night, over the weekend, and during holidays.
- Make duplexing (double-side printing) the default mode for copiers and printers.
- Plug equipment into surge protectors, then turn these off when not in use.

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Community Choice Aggregation

With funding from the California Energy Commission's Public Interest Energy Research program, the Local Government Commission has worked with Navigant Consulting, Inc. to assist twelve California communities in their investigation of Community Choice Aggregation (CCA) feasibility. They are:

- Berkeley
- Beverly Hills
- Emeryville
- Los Angeles County
- Marin County
- Oakland
- Pleasanton
- Richmond
- San Diego County
- San Marcos
- Vallejo
- West Hollywood

What is Community Choice Aggregation?
Community Choice Aggregation (CCA), as defined by AB 117, permits any city, county or city and county to aggregate the electric loads of residents, businesses and municipal facilities to facilitate the purchase and sale of electrical energy. Prior to AB 117, individual customer participation in electric load aggregation programs required their positive written declaration indicating their choice to participate (opt-in programs). In contrast, CCA under AB 117 provides for aggregating customer loads within city or county boundaries, but gives each customer the opportunity to leave their community's aggregation program and still be served by the incumbent distribution utility (opt-out program). If a customer makes no negative declaration, that customer is served through the CCA program. This is a major departure from previous aggregation structures as it frees the aggregator from the need to market the program and ensures wide-scale customer participation.

The community choice aggregator must inform participating customers at least 60 days in advance of the date commencing automatic enrollment. Distribution utilities are directed to cooperate fully with any community choice aggregator in its efforts to develop their aggregation program including providing all necessary data as well as to continue to provide all metering, billing, collection, and customer service to retail customers that participate in CCA programs. Community Aggregation programs cannot begin until departing load fees are determined, and the California Public Utilities Commission (CPUC) has determined rules and protocols for implementing aggregation programs.

Guidelines are determined by the California Public Utilities Commission (CPUC), which is now preparing materials to help assist potential CCAs develop implementation plans and complete the registration process. The CPUC also sets the Cost Responsibility Surcharge for customers who leave IOU service. This surcharge ensures that all remaining IOU customers will not pay higher rates when other customers leave IOU service and helps pay back the costs of expensive, long-term power contracts entered into during the 2000-01 energy crisis, as well as other uneconomic IOU costs.

The Cost Responsibility Surcharge is determined by comparing these uneconomic costs to the current market rates for electricity. As market rates increase, the surcharge will decrease. Most of the contracts entered into during the crisis expire by 2012.

Pubic utilities do better on costs. Historically, public utilities across the nation have been able to offer rates that are 15-20% lower than investor-owned utilities, as private financing costs are more than twice those of a CCA. Based on a pilot project funded by the California Energy Commission, CCA capital costs were about 5.5%, compared to 12.9% for IOUs.

Amalgamating multiple cities and counties. AB 117 allows groups of cities and counties to join together to establish a CCA program. This provides economies of scale for energy contracts, administration costs and when interfacing with investor-owned utilities.

A study of seven Bay Area communities investigating CCA found that if they formed one joint CCA program instead of seven individual ones, they could save an additional 34 percent. A joint CCA may also reduce variability in electric loads (fewer usage peaks and valleys), allowing for larger baseload contracts (with generally lower prices than peaking or spotmarket contracts).

Community Choice Aggregation promotes energy efficiency. Community Choice Aggregation can allow communities to choose power sources that don't require inefficient distribution over long distances. For example, using solar and wind energy produced much closer to the needed service (air conditioning, heating, lighting, etc) prevents the losses of efficiency prevalent in long distance transmission.

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BUILDING ENVELOPE

Commissioning

Suppose the manufacturer of a precision sports car guaranteed to sell all the vehicle parts, fitted together in the correct position, but did not perform any quality control or make any adjustments before sending the car to the dealer. A buyer could not expect to go 0 to 60 in five seconds straight off the dealership's floor, despite the sticker on the window. The buyer would have to first take the car to a mechanic to have it tuned. Office buildings, with

their many sophisticated equipment systems that work together dynamically, are much the same as the sports car.

Commissioning is the process of ensuring that building systems are designed, installed, functionally tested, and capable of being operated and maintained according to the owner's operational needs. Different commissioning terms are used to refer to when the process is happening in the building's life; see below for definitions of commissioning, retrocommissioning and recommissioning.

	Commissioning	Retrocommissioning	Recommissioning
Application	New Construction	Existing buildings that have never been commissioned or whose age or operational changes have rendered the original building design and intent inadequate or inappropriate.	Existing buildings that have been commissioned or retrocommissioned.
Timing	After construction, but before occupation.	Occurs in response to problems or under-performance of building systems. Occurs periodically, ideally as part of the O&M schedule.	Occurs periodically, ideally as part of the O&M schedule.
Purpose	Ensures building systems will perform optimally.	Solves problems that have been preventing the building from operating optimally.	Ensures building is still operating optimally, i.e., ensures commissioning results persist.
Frequency	Once	Depends on building age and upkeep, but generally, once every 10 to 15 years.	Every 3 to 5 years.
Cost*	Varies according to size of building and complexity of systems: $0.50 to $3.00 per sq. ft.	$0.05 to $0.40 per sq. ft. Additional data are needed to help pinpoint costs based on specific building features and the scope of the RCx effort.	Lowest cost option for existing buildings and systems.

Currently, Cx is not considered standard practice, so building owners must make an additional investment to have their building properly tested and fine-tuned before occupying it. Although this adds an extra degree of time and money to the construction process, Cx is worthwhile since it usually results in substantial savings by catching and fixing all too common inefficiencies and deficiencies in building systems. A 1994 study of 60 commercial buildings, for example, found that over half had building control problems, 40 percent had heating, ventilation, and air-conditioning (HVAC) system problems, one-third had sensors that were not working properly, and 15 percent were missing specified equipment. These problems could have largely been avoided with commissioning. Yet most U.S. buildings are not commissioned.

To address this lack of commissioning during construction, building owners and managers can choose to undergo retrocommissioning (RCx), sometimes referred to as commissioning of existing buildings. RCx can occur at anytime during a building's life, and can be implemented while the building is occupied. Because typical energy savings achieved can reach as high as 20 percent without investing in new equipment, RCx is fast becoming recognized as one of the easiest and most cost-effective ways to improve energy efficiency. In fact, RCx often achieves a simple payback of less than 2 years, quite significant given the magnitude of savings possible.

RCx is generally best suited for larger buildings, though it can be appropriate and effective for buildings of many sizes. Since RCx deals with optimization of building systems, all energy-related upgrades and retrofits should be completed before tackling RCx - it is not cost-effective to fine-tune inefficient, outdated, or malfunctioning equipment systems. Installing an automated energy management system is also a good idea since this is useful for tracking and controlling energy use before, during, and after the RCx program.

Besides energy savings and lower utility bills, one of the chief advantages of any commissioning program is the improvement to the indoor environment. Cx and RCx tend to focus on the HVAC, which is both the most energy intensive system in a building as well as the root cause of the most common and most serious complaints. Even if the indoor temperature of a building is within the desired range, poorly tuned equipment can cause excessive noise, drafts, temperature fluctuations, odors, and humidity. Owners of income properties may discover that discomfort stemming from the HVAC system (or equipment restrictions meant to curtail cooling loads) force tenants to relocate. This can be very costly and in most cases, retaining these tenants can pay for the cost of RCx. A study cited by Oregon's Department of Energy, for example, estimates that the cost of losing one five-year office tenant can run from $91,875 to $109,375, which is 35 to 42 percent of the five-year lease value.

Benefits of Retrocommissioning
Building owners reap a host of benefits from the retrocommissioning process. These include:

- Energy savings.
- Other cost savings, including lower maintenance costs and a reduction in premature equipment failure.
- An improvement in indoor air quality.
- Increased occupant satisfaction and a reduction in complaints and tenant turnover
- An increase in the building's asset value.
- Improved ability to plan and budget for maintenance.
- Better-trained building operators.

Commissioning Adopters
The American Council for an Energy Efficient Economy investigated 38 energy-saving strategies, and found that RCx is one of the greatest potential energy saving tools.

The U.S. Green Building Council requires commissioning and retrocommissioning for its Leadership in Energy & Environmental Design (LEED) rating system for new construction and existing buildings, respectively.

California's Green Building Action Plan directs that all State-owned buildings 50,000 sq. ft. or more be commissioned or retrocommissioned. The Action Plan also directs the California Energy Commission to establish a commissioning program for commercial buildings to help meet the goal of reducing energy consumption by 20 percent by 2015 (as compared to a 2003 baseline).

The University of California's Green Building Policy includes a provision that all buildings will be part of a commissioning strategy to improve energy efficiency.
Key Commissioning Resources

Key Commissioning Resources
The California Commissioning Collaborative, a coalition of government, utility and building services organizations and professionals, provides information resources, tools and training to promote building commissioning in California.

The Building Commissioning Association has created a building commissioner certification process that can help building owners find qualified commissioners.

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Office Buildings

The building envelope, also referred to as the building shell, consists of all partitions that separate outdoor air and temperature from indoor spaces: windows, doors, walls, roofs, and foundation. The building envelope is critical for minimizing the buildup of humidity and uncomfortable drafts. To keep conditioned air inside, check and repair any leaks in seals and insulation around building partitions and ductwork in the HVAC system.

To prevent outdoor air and temperature from infiltrating conditioned space, install high efficiency doors and windows, whenever possible. Glazing or films for windows is another option, particularly for buildings in which window replacement is neither cost-effective nor practical. Glazing lowers the emissivity (i.e. radiation) of surfaces and reduces ultraviolet rays responsible for fading fabrics and furnishings.

Cool roofs are an excellent option because installation is cost-effective and non-disruptive to occupants. More information on cool roofs follows.

Shade is the most cost-effective and simplest way to reduce solar radiation. Architectural elements can be added that shade windows and doors - roof overhangs, light shelves, and fins or slats, fvor example. Trees make great shade, too. Properly placed, trees lower air conditioning costs by shading buildings and by lowering outdoor temperature through evapotranspiration. Trees also provide a significant community benefit by reducing stormwater runoff and trapping air pollutants like carbon dioxide.

A study of San Diego County by American Forests, for example, found that the urban forest removes 4.3 million pounds of pollutants from local air each year - a benefit worth $10.8 million annually. These trees sequester about 9,000 tons of greenhouse gases each year, storing a total of 1.2 million tons.

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Cool Roofs

Cool roofs are roofs with special coatings or surfaces that reflect heat. While this seems simple in concept, the cooling benefits can be quite dramatic. Consider that dark surfaces in the sun are up to 70ºF hotter than white ones - this means that when normal rooftop temperatures are peaking at 190ºF during the hot summer months, cool roofs only reach about 120ºF. The ability of your rooftop to reflect solar radiation and reduce surface temperatures is related to how hard cooling equipment needs to work to condition indoor spaces.

Besides lowering HVAC operating costs, cool roofs help others in the local community. In cities, building rooftops and paved surfaces collectively create urban heat islands. Researchers at Lawrence Berkeley National Laboratories and the U.S. EPA have found that these heat islands raise outdoor temperatures 6 to 8ºF above surrounding areas, which can lead to a higher incidence of smog.

Cool roofs make sense when:

- A building has high air conditioning loads and/or is located in a hot, sunny climate.
- The roof has a large surface area as compared to the overall building size.
- Re-roofing or other roof maintenance is scheduled as part of routine operations and maintenance.
- Constructing a new building.
- Installation is part of a wider effort to reduce cooling loads; cool roofs and good insulation levels go hand in hand.

Cool roofs are most effective during the hottest part of the day and the hottest time of year, coinciding with peak energy demand. By allowing you to turn down the HVAC - without sacrificing the comfort of employees or tenants - cool roofs reduce energy costs while ensuring that California has reliable energy during the critical summer months.

Remember that a cool roof is only one surface, and that any rooftop retrofit should be part of a wider effort to improve insulation of the building envelope. Installing proper levels of insulation provides year round benefits by preventing heat gain in the summer and blocking cold air infiltration in the winter.

Most Californian properties will benefit from the savings resulting from cool roofs. However, in a few regions, additional winter heating costs may outweigh summer benefits. This is especially true for mild climates with cool, cloudy summers, like San Francisco.
Temperature, Energy and Smog

Temperature, Energy and Smog
Temperature affects energy in a few important ways. First and foremost, high temperatures cause people to turn on their air conditioners, one of the most intensive uses of energy in home or office. Peak use of air conditioners contributes to peak energy demand in California, the time when higher energy surcharges and shortages are likely to occur.

Temperature also affects pollution in urban areas. All other things being equal, the higher the temperature, the worse the air quality is. Pollution is like a chemical stew that changes as temperatures rise. In Los Angeles, for example, pollution rises by three percent for every degree increase above 70ºF. One study conducted by the Lawrence Berkeley National Laboratory suggested that if all buildings in L.A. had cool roofs, the total savings from reductions in energy use and pollution prevention would reach about $500 million per year.

Cool Roof Calculator
The Department of Energy has developed a useful calculator for small- and medium-size businesses that estimates annual cost savings resulting from the installation of a cool roof. The calculator provides information based on location (climate, average temperatures), including 10 urban areas in California.

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DEMAND RESPONSE

Control Devices

The demand for peak load can mean the need for more power plants unless cities and local governments can conserve enough energy to avoid building new power plants. Automatic shut-off devices for air conditioners, water heaters, and other energy-using devices can help to alleviate stress placed on the grid during peak load periods and they lower overall energy consumption as a result. Furthermore, reducing demand at peak hours actually reduces the amount of pollution caused by generating power at peak times, as base load energy sources used at peak times tend to pollute more than non-base load energy sources.

Check with your local utility to see if they offer peak-interruption or other load management programs. If not, consider advocating for such a program.

Steps for implementing control devices:

3. Determine the types of energy-using devices you want to control. This will depend on whether energy use in your area tends to peak in the summer or winter.
4. Determine if the program will be cost effective. Utilities will want to be assured that the program will pay for itself. Start by calculating how many participants you need for the project to break even.
5. Decide if utilities will offer customers incentives, such as energy-efficient devices or discounted rates.
6. Market the program to the public. Public awareness of the program is essential to its success. This can be done through distribution of printed collateral, radio and newspaper advertising, and contacting customers directly.
7. Track the program's success. Run tests to determine actual system peak reductions.

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Programs

Demand response programs are an easy way for local governments to ensure their own reliable and affordable electricity. Administered by local utilities or third-parties, these conservation programs notify participants when to use less electricity in order to prevent electricity shortages or high spot market prices. Some demand response programs provide financial incentives or other benefits to customers who agree to reduce peak consumption or shift electricity use to off-peak hours. Peak hours are those times when electricity use is at its highest, typically between noon and 7 p.m.

The California Independent System Operator (ISO) triggers demand response programs when operating reserves are expected to drop below seven percent, meaning that blackouts are more likely to occur. Low operating reserves occur because of high peak demand, unplanned generation outages, transmission problems, or adverse weather. If reserves drop, California ISO will notify program administrators, who then alert program participants.

There are two basic types of demand response programs: reliability and pricing. Reliability programs are triggered the day of an electrical event to prevent or offset an impending emergency. Some are voluntary programs, meaning that there is no penalty if a business is unable to reduce its load. Other reliability programs are binding and invoke penalties for non-action. However, these programs are designed so that penalties are wholly or partially offset by financial incentives, such as lower overall rates.

Pricing programs, on the other hand, are tied, in theory, to the spot market price of electricity. On critical days, pricing programs invoke higher rates for electricity used during peak hours. These higher rates are only put into effect for a maximum of 12 days a year.

Participants in either program type (reliability or pricing) receive advance notification when electricity conservation is needed or new rates are put into effect. This extra response time allows cities and counties to prepare building occupants and work processes, greatly reducing the cost and inconvenience of power interruptions. Participation in demand response programs also helps avoid costly involuntary interruptions.

Local governments interested in demand response programs should contact their local utilities to ask for a no obligation demand response audit. Similar to an energy audit, a demand response audit examines building equipment systems and operations to determine

what opportunities exist for load curtailment. Your utility representative can then help you choose among the many programs available, matching your building's profile to the best-suited incentive packages.

Demand Response Tips for Office Buildings

- Set thermostats to 78 degrees.
- Shut off unnecessary lights and appliances.
- Postpone services like cleaning and maintenance until after 7 p.m.
- Invest in enabling technology, e.g., enhanced automation, interval meters, and demand lighting controls.
- Optimize use of on-site generation and fuel assets.
- Obtain buy-in from employees who might be impacted and provide conservation education to increase awareness.
- Review building operations to develop demand response strategies and processes ahead of time.

California ISO
California ISO is a not-for-profit public benefit corporation that manages the flow of electricity along California's open-market wholesale power grid.

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BPG Appendix 4: Demand Response Strategies (PDF download, 56 KB) http://www.fypower.org/pdf/drstrategies

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DISTRIBUTED GENERATION

Cogeneration

Cogeneration, also referred to as combined heat and power (CHP), has been around since the beginning days of central power. Thomas Edison used cogeneration as early as 1882 in America's first power plant, selling both electricity and the waste heat produced as a byproduct. Industrial facilities that require process heat or steam have long benefited from cogeneration systems that supply both electrical and thermal energy. More recently, owners and managers of commercial buildings have discovered that cogeneration can be a cost-effective source of reliable energy as well as heating and cooling - the single most expensive operating expense in typical buildings.

A cogeneration system consists of an engine, turbine, or fuel cell (prime mover) that generates on-site electricity plus a heat recovery unit that captures waste heat from the generation process. In commercial buildings, cogeneration systems are usually connected to an absorption chiller that provides heating and cooling for the central heating, ventilation, and air conditioning (HVAC) system. The absorption chiller, which is powered by thermal energy, replaces a traditional chiller powered by electricity. Cogeneration systems can also heat domestic water for use in the building.

Common equipment options for on-site electricity generation that are compatible with cogeneration include: reciprocating engines, steam turbines, combustion turbines, and combined cycle combustion turbines. Reciprocating engines are the most common and most efficient prime mover used in commercial cogeneration systems today - technologically the most mature of the distributed energy resources, reciprocating engines are manufactured inexpensively and are widely available. Microturbines, fuel cells, and Stirling engines may be economically viable for cogeneration in the next few years as technology advances.

Absorption chillers, although technically part of the HVAC system, are fueled by low-grade waste heat recovered from on-site electricity generation. Absorption chillers are available in capacities ranging from 100 to 1,500 tons and use environmentally benign refrigerants and absorbents instead of polluting chlorofluorocarbons. Although absorption chillers have a low coefficient of performance compared to electrical chillers, they are extremely cost-effective and efficient when used with a cogeneration system since very little electricity is used to power the chiller. Consider that the cost of cooling is about 22 percent of a building's total electrical expenses - the savings become clear.

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Solar Energy

According to data from the Energy Information Administration, net generation in the US came to over 3.9 billion megawatt hours (MWh) in 2005 while retail power sales during that year were about 3.6 billion MWh. Transmission & Distribution losses amounted to 239 million MWh, or 6.1% of net generation.

Solar energy and other renewables produced on-site help to address the inefficiency of power transmission over long distances. Since 1983, solar electricity in California has grown by an astonishing 37,950 percent, with photovoltaic (PV) installations generating as much as 759 million kWh per year - enough to power more than 125,000 California households. The total capacity of the 14,000 grid-connected PV installations in California

is about 100 megawatts, not including the many more PV systems that serve as stand-alone energy sources. The rise in grid-connected PV installations since 2000 has been truly tremendous, and includes installations at residential, commercial, industrial, and institutional sites.

Solar energy can be employed both actively and passively. Active uses collect solar radiation through mechanical devices that convert it into either heat (thermal collectors) or electricity (PV panels). Passive uses of solar energy, on the other hand, require no devices other than normal building components, like windows and walls that are designed and positioned to provide heating, cooling, or daylighting. While only PV systems are considered as distributed generation, all forms of solar energy can be cost-effectively implemented in a building or facility.

PV systems transform sunlight into usable, clean and renewable electricity. While humankind has always benefited from the indirect use of solar energy, such as calories derived from food crops, it is only in our relatively recent history that advances in technology and engineering have allowed us to tap the sun as a direct source of electricity. Photovoltaics were first invented in the early 1950s, with the initial focus of research on space satellite applications. Terrestrial applications were not widely explored until the 1970s after the nation suffered its first oil shock. It took another 20 years before the first grid-supported system was installed by PG&E in Kerman, California, near Fresno, in 1993.

PV systems consist of cells made of silicon semiconductors in which the movement of electrons when struck by sunlight creates electricity. Today's commercially sold PV cells have an efficiency of about 15 percent, meaning that they capture and transform about one-sixth of the sunlight hitting their surface; in the laboratory, it is possible to achieve efficiencies as high as 30 percent. Standard PV cells measure about five inches squared. These cells are grouped together as modules, with each module holding about 40 cells. Modules then are assembled as pre-wired, ready-to-install panels. Panels are installed as arrays, with about ten modules in each array - it takes roughly 10 to 20 arrays to power a single household, but hundreds can function together as a single PV system.

The cost of PV panels has dropped by 90 percent since the 1970s when they were first commercially available. These lower installation costs, coupled with rising energy costs from conventional utility generation, make PV systems a viable DG option. Incentives, like buy-down rebates and tax breaks, have reduced costs even further and are widely available across the state - these incentives will not last as the market for solar electricity expands. With rebates, PV systems cost about $4-5 per kWh; the cost per kilowatt-hour generally decreases as the size of the installation increases.

For a complete list of current financial incentives as well as applicable rules, regulations, policies, and programs, search the Database of State Incentives for Renewable Energy. Given that PV panels last 20 to 30 years, these systems make a sound long-term investment.

PV systems provide several benefits to building owners and managers. First, photovoltaics reduce a facility's total energy consumption from central power generators. Because PVs are basically cost free to operate once installed, the total cost of energy is reduced. Second, the maximum electrical output of PV panels perfectly coincides with peak energy demand, usually between noon and 7 p.m. during the summer months. Peak hours are the most expensive time to purchase energy, so any reduction in demand for utility power can have a major impact on overall costs. For ratepayers under time-of-use or real time pricing schedules, this is particularly important.

Besides reducing the cost of electricity, PV systems afford many additional benefits. A PV system can serve as backup power, helping to improve energy reliability at a facility. Power generated from PV panels is quiet, clean and sustainable, and can be easily integrated into building rooftops, facades, canopies, and windows. With no moving parts, PV systems are relatively easy and cheap to operate and maintain. Finally, public relations are improved; businesses that install PV systems typically receive positive media attention and are noted for their actions as good corporate neighbors to the local and state communities.

A recent report quantified public benefits stemming from PV systems as between $0.22 - 0.36 per kilowatt-hour of installed capacity. More than half of these savings stem from reduced consumption of natural gas. Even though California's energy portfolio consists of a variety of energy sources - hydroelectric, wind, coal, nuclear, and geothermal, to name a few - natural gas is the most common and the predominant source of peak power. Reducing the need for peak power means that less natural gas is consumed, which in turn helps stabilize gas prices and lower air emissions associated with the burning of fossil fuels. Solar electricity helps defer or avoid the costs of developing new generation and capacity to the grid system.

Million Solar Roofs Bills
SB1 and SB 1017, known as the 2005 Million Solar Roofs bills, seek to incentivize 3,000 megawatts of solar electricity by 2018. With strong support from Governor Schwarzenegger, passage of these bills would provide for buy-down rebates and tax credits for business and residential ratepayers. The bills encourage installation of solar systems on 50 percent of new home construction within the next 13 years.

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Solar Electric Power Association, webpage What Are Photovoltaics? http://www.solarelectricpower.org/power/what_are_pvs.cfm

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WATER USE

Waste Water

Municipal water supply and wastewater treatment systems account for about 35 percent of energy used by municipalities. Water and wastewater treatment and distribution in the United States is estimated to consume 50,000 gigawatt-hours - costing over $4 billion annually.

Water and wastewater agencies rely on electricity to pump, treat and distribute water. Pumping alone accounts for 5 percent of the state's peak load and 7 percent of California's

total electricity usage - high-level use that comes with a cost. As California's most significant energy users, water distribution or wastewater treatment facilities can each spend more than $500 million annually on energy, a figure that represents 50 to 75 percent of an agency's total costs.

To avoid the adverse effects of both rate hikes and rolling blackouts - which can have severe environmental and health impacts for the surrounding community - many water and wastewater districts have enacted conservation and efficiency measures.

Measures include adjusting operation schedules, increasing water storage, utilizing generators, optimizing cogeneration and installing efficient water system equipment, variable frequency drives, and advanced equipment controls. While treatment and pumping consumes the most energy, some agencies greatly benefit by auditing and upgrading building shells, heating, ventilation, air-conditioning and lighting systems. Some of these projects require a large investment in time, personnel and money, but the energy savings realized by the districts more than pays for the improvement.

Flex Your Power has worked with roughly 250 water and wastewater agencies to conserve 15 percent within their own facilities. Aided by federal, state and utility agency incentives, many water distribution and wastewater treatment facilities have improved the efficiency of the facilities and water systems.

There are several steps to consider when cutting energy costs associated with wastewater treatment.

Step 1: Gather Data

Conduct a water system audit, energy audit and/or technical engineering analysis of facilities to identify the areas of greatest need as well as the most cost-effective energy saving opportunities.

Monitor energy use and consistently look for ways to improve energy efficiency. Perform comprehensive energy audits and hire consultants to help staff operators and engineers review IEUA's energy centers. The review might consist of power readings and investigating conservation and self-generation options. Each plant and process (primary, secondary, and tertiary) can be evaluated on a case-by-case basis. Consultants, operators and engineers can assess the energy consumption of each plant and identify those that could potentially be run at off-peak hours. With the help of consultants and the engineering department, operators can learn to improve plant operation, collect more relevant data and design new projects.

Consider hiring outside contractors to help conduct an on-site, pre-project inspection of your facilities. The contractors can gather power and monthly kW and amp readings from monitors and chillers, audit the HVAC systems - including performing a chemical analysis of the HVAC water systems and gathering data from the HVAC water pumps.

Research cost-effective, energy-efficient treatments to determine the least costly technology for capital and annual Operations and Maintenance at your facility.

Prior to beginning an energy conservation project, you may want to internally analyze your past energy use and costs.

Identify existing energy conservation practices; identify critical systems and components receiving electrical power; determine duration of required operations time during loss of power; and contact industry peers, power specialists, suppliers, engineers, regulators, etc to poll what others are doing. Collect data through audits, surveys, and face-to face discussions. You may consider hiring an advertising firm to coordinate focus group research to test public outreach messages to encourage water and energy savings.

For a "How to" guide on hiring an energy consultant/auditor, energy services company or a construction manager, see the California Energy Commission's handbook on

How to Hire an Energy Auditor to Identify Energy Efficiency Projects
http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001C.PDF

How to Hire a Construction Manager for Your Energy Efficiency
http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001E.PDF

How to Hire an Energy Services Company
http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001D.PDF

For assistance in planning and designing energy projects, including an initial free feasibility study, see the California Energy Commission (CEC)'s Energy Partnership Program.

Step 2: Devise a Plan

Build an "Energy Team" comprised of department managers and engineers to guide and promote energy efficiency/conservation within and outside your organization. Appoint a coordinator to lead the team in designing, communicating and implementing projects.

Based on a careful review and analysis of the research gathered in Step 1, define the targets, objectives and quantifiable goals. Identify short-term goals for energy efficiency and discuss the assumed need, the most cost-effective practices, the staffing requirements and the community response.

After a review of your facilities, perform white paper assessments of operational needs. Help prevent rolling blackouts and ensure water supply in spite of external power interruptions. Include engineering, operations, maintenance, HVAC, and public information staff in designing and implementing your programs.

You may also want to consider a Green Infrastructure plan to alleviate strain on the energy system from intensive water treatment. See the EPA's webpage on Green Infrastructure for more details.

Identify feasible energy conservation measures for the existing facilities and find the most cost effective treatment of wastewater. Apply for financial rebates/grants when possible. Utilize online resources for help in planning and designing energy efficiency, conservation and outreach projects:

Use online resources. Utilize online resources for help in planning and designing energy efficiency, conservation and outreach projects:

Association of California Water Agencies
http://www.acwa.com/

California Urban Water Conservation Council
http://www.cuwcc.org/home.html

California Urban Water Agencies
http://www.cuwa.org/

List of Water Districts
http://www.lib.berkeley.edu/WRCA/district.html

Research funding options and set a budget. Local utilities and state agencies offer a wide range of incentives to underwrite energy-conserving behavior and investments.

Negotiate with natural gas providers for the best price possible for long-term natural gas contracts. Reduce on-peak demand at your water recycling plants by running generators more often. To learn more about utility services and rebate and incentive programs, check with your local municipal utility or contact:

Pacific Gas & Electric (PG&E)
http://www.pge.com/

San Diego Gas & Electric (SDG&E)
http://www.sdge.com/index.shtml

Southern California Edison (SCE)
http://www.sce.com/

California Energy Rebate Database
http://www.fypower.org/res/tools/rgl.html

Set a timeline. Target behavioral changes for faster and easier energy savings. Timelines

should take into account budget, rebate and grant qualifications and peak demand times.

Step 3: Implement Programs/Operations

Efficiency
Maintain water/wastewater system equipment. Test, clean and upgrade pumps and pipes as well as disinfection and control system equipment. Increasing maintenance activities will reduce power consumption. Upgrade motors - install energy efficient models. Although sometimes higher in cost, energy-efficient motors are two to eight percent more efficient than standard motors, have longer insulation and bearing lives, lower heat output, less vibration and lower failure rates.

Retrofit pump drives or install a more efficient pump with a Variable Frequency Drives (VFD) to act as the lead secondary pump. Unlike single speed drives, VFDs have a soft start and allow for precise control of motors and process, thereby extending the life and enhancing the efficiency of motors, as well as significantly reducing energy demand. Utilize other emerging technologies to make processes more efficient.

Use efficient heating, ventilating and air-cooling systems (HVAC). Replace inefficient HVAC equipment with energy efficient models and maintain HVAC systems to increase energy efficiency. Perform chemical treatment analysis on water system boilers and chillers and periodically clean coils. These processes not only extend equipment life, but also optimize heat transfer of equipment and save energy.

Choose efficient lighting. Retrofit T12 lamps (1-1/2 inch diameter) and magnetic ballasts with T8 lamps (1 inch diameter) and electronic ballasts, which provide nearly as much light and use approximately 40 percent less energy. Also replace fluorescent lighting fixtures with high-efficiency lamps and ballasts at the treatment plant and headquarters building and upgrade exit signs with LED (light-emitting diodes).Maintenance of Generators and Batteries
Maintain generator systems to increase energy efficiency. Replace old circuitry and batteries and upgrade circuitry on emergency generators.

Make energy efficiency a top priority in new construction projects. Take advantage of technologies such as the UV disinfection process which utilizes significantly less energy than standard systems and is easier to maintain and use in the long run.

Conservation
Conserve with efficient water/wastewater system equipment. Alter the schedules of high-energy-using equipment and processes to reduce usage during peak demand times and/or shift load to off-peak hours. Establish an Electrical Load Management System, utilizing time-of-use and differing rate schedules. Use programmable control systems and energy management systems to regulate schedules and turn off and/or by-pass less efficient system equipment. Install computerized management systems and devices that

will automatically regulate or enable users to completely control the use of energy in treatment and pumping equipment.

Choose alternative and/or renewable energy sources. Use alternative means of pumping water that require less energy for distribution such as landfill methane gas generators and on-site photovoltaic systems. Maximize use of cogeneration. Depending on anaerobic digester gas (ADG) production, wastewater facilities can optimize cogeneration engines to increase energy production, provide energy during on-peak or power crunch periods or sell energy to other areas.

Choose alternative water sources. Increase storage or reservoir use– pumping water from distant sources costs significantly more than from local sources. Conjunctive-use programs provide a greater and more reliable water supply.

Create employee awareness and education programs. Disseminate information and tips to employees through such media as e-mail, newsletters, memos and company websites. Encourage employees to participate in conservation efforts through incentive programs, contests, discounts, coupons and public recognition.

Create public awareness programs. Encourage the public to conserve water in an effort to conserve energy. See the Local Governments Best Practices Guide for tips on public awareness campaigns.

Step 4: Monitor and Measure Results

Gather information on an ongoing basis to monitor the progress of the program and to make adjustments to maximize results and adapt to changing circumstances. Create a tracking system or use monitoring tools provided by local utilities. Results should be measured against the original budget and goals of the program.Evaluate the success of the program by looking at resources saved, money saved, money spent, the impact on the local economy, city personnel response and the public benefit created.

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American Council for an Energy-Efficient Economy. http://www.aceee.org/

Landscaping and Outdoor Areas

Non-residential landscape irrigation accounts for approximately 7.5 percent of all urban water in California; residential irrigation uses another 27 percent of urban water. However, not all of this water is necessary to keep the grass green.

Drip Irrigation
Proponents of drip irrigation systems enthusiastically proclaim the significant water savings of drip irrigation versus the traditional overhead sprinkler systems. Yet drip irrigation was designed as a way to improve plant health and crop yields - water savings are an added bonus.

To understand this, think of a plant as a person who must choose between guzzling a bucket of water in one sitting or sipping multiple glasses of water over time as their thirst dictates. Like that person, a plant can only consume a limited amount of water at any given time; excess water tends to run off and is wasted. Over-saturation actually drowns roots, causing plants to wilt and die. In sandy or gravelly soil, over-saturation can also lead to deep penetration where water moves rapidly past the root zone and is wasted.

Another advantage of drip irrigation is control over where water goes. Or, to put it another way, where water does not go. Pavements (and people) stay dry, weeds in adjacent areas are discouraged, and brown spots caused by uneven watering can be completely eliminated. This means less maintenance in addition to lower water bills.

Turf can also benefit from drip subsurface irrigation systems. Drip is especially good for conquering such common lawn watering problems as awkward shapes and sizes, steep slopes, or narrow strips.

Remote Controls and Evapotranspiration
Automated irrigation systems run the gamut from a simple timer affixed to a faucet that turns water on and off at regular intervals, to complex digital remote controls that communicate with satellite weather stations. New advances have enabled digital systems to calculate local evapotranspiration rates (water loss due to evaporation from the soil and transpiration from the leaves), which can then be transmitted to irrigation controls so that watering schedules can be automatically adjusted.

Regardless of the sophistication of a system, irrigation controls reduce maintenance time, require less water, and improve plant life - all of which saves money while enhancing the beauty of your landscape.

Xeriscaping
When evaluating water efficiency measures for large landscapes, first consider your choice of plants. By selecting native species that naturally thrive in California's unique climatic

conditions, the need for intensive irrigation is greatly reduced or eliminated. This is known as xeriscaping. Native plants are particularly good for attracting special neighbors, like migrating birds and butterflies.

Parking Lots and Porous Pavement

Paved surfaces cover about 43,500 square miles in the continental United States, roughly the same area as the state of Ohio. These impervious surfaces contribute to urban heat islands and cost cities and counties millions of dollars for treatment of the subsequent stormwater runoff.

Porous, or permeable pavement, on the other hand, allows rainwater to penetrate paved surfaces and move into underground reservoirs. Eventually, this water joins natural groundwater, where it helps recharge local aquifers.

Porous pavements cost roughly the same to construct as traditional pavements, and may even be up to 25 percent cheaper. Although the financial return for individual companies is relatively low compared to higher return investments, there are significant benefits for the local community. Porous pavements help treat water by filtering out pollutants before they enter the groundwater and fresh water resources. Porous pavements also lessen the need for curbing and help prevent storm sewers from overflowing. Drivers benefit, too, since these surfaces offer better skid resistance.

Other Landscaping Ideas

- Offer landscape water-use audits
- Offer a training program for landscape maintenance personnel
- Utilize or establish an irrigation management information system
- Develop landscaping design requirements for new development and remodels
- Develop a service for landscape-plan design review
- Implement a water-efficient landscaping rebate program
- Develop water-conservation landscaping demonstration projects
- Sponsor a conference on water-conserving landscapes

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Conservation Planning

Develop conservation-oriented rate structures. This market-based approach will help local governments avoid profligate water use, and thus help them save energy as well. Metering can be a key component of these savings, reducing water demand from 20 to 45 percent. Once meters are installed, the rate structure can be designed to encourage conservation. Installing meters in new construction is easy, whereas retrofits may be more difficult and expensive. Volume-based and true-cost pricing are important when establishing rates, as volume discounts actually discourage water conservation. Connection fees can also help encourage conservation and should be based on a structure's anticipated water use and discharge. A retrofit ordinance can also be helpful. However, because of the likelihood of opposition from parties such as the real estate sector, any retrofit ordinance should be precluded by a quiet study of its feasibility.

Adopt a water waste ordinance. This ordinance should be accompanied by a public education campaign to address the opposition that is likely to arise. The list of "wasteful activities" should wax and wane with the availability of water, with the list growing in times of drought.

Develop a drought response contingency plan. Such a plan will obviate panic. Contingency planning allows officials to respond appropriately to the situation. A contingency plan might include such steps such as forecasting the supply situation in relation to demand, assessing drought mitigation options, establishing triggering levels, developing a demand reduction program, adopting a drought plan, and monitoring results.

Implement programs to reduce supply system leaks. Local water agencies will benefit from these programs because of their increased knowledge of the distribution system, more efficient use of existing supplies, reduced property damage, improved public relations, and reduced legal liability. A water utility should conduct a water audit to determine if a repair program is justified. Steps to conduct a water audit include quantifying the water supply and authorized metered and un-metered water use, quantifying water losses, and analyzing water audit results.

Protect hydrants from waste. In some jurisdictions, water hydrants are prone to tampering and vandalism. Efforts to prevent waste from unauthorized use may include a public education campaign and installing hydrant-locking devices. Steps to determine the need for hydrant protection include determining the scope of the problem by surveying the distribution network and assessing your alternatives.

Conduct an infiltration/inflow detection and repair program. Infiltration results from groundwater entering sewer lines through porous walls, cracks, or leaky joints. Inflow comes from storm drains illegally connected to the sanitary sewer system and from sources such as poorly sealed manhole covers. I/I detection and repair can save money, resources, and protect the environment. Testing methods may include smoke testing, rainfall simulation, manhole inspection, building plumbing inspection, flow isolation, television inspection (which is the most reliable), man-entry inspection, infrared thermography, and lateral testing. Once inspection is done, determine the structural condition of the pipe, the consequences of the failure, and the pipe's performance. Tabulate the size or capacity of the segment to be replaced and evaluate the life-cycle costs for alternative replacement and rehabilitation methods.

Reduce pressure in your water system. Studies indicate that by decreasing water pressure by 30 to 40 pounds per square inch, water use will drop by 3 to 6 percent. This can be accomplished with pressure-reducing valves on service lines. It may not be appropriate to reduce water system pressure in existing areas because fire-fighting capabilities and customer irrigation systems may be adversely affected. However, new areas can be designed to operate at lower water pressure (50 psi instead of 80 psi). Local governments can also identify unusually high water pressure areas and determine if water pressure can be reduced without a negative impact on stakeholders.

Audit and retrofit institutional and public facilities with water-conserving hardware. This includes installing retrofit water-saving devices on toilets and urinals, periodically adjusting flush valves on toilets and urinals, installing low-flow faucet aerators, faucets with automatic shut-off capacity, more efficient water-using appliances, as well as low-flow shower heads at gyms, pools, and schools. Other measures include installing water-efficient dishwashers and washing machines, recycling car wash water, installing meters, and conducting water audits. You should also cover pools to reduce evaporation. Routinely inspect plumbing fixtures to eliminate leaks. Audit monthly water bills to spot high bills indicating leaks or water misuse. Create public awareness about the importance of water efficiency and conservation - The best place to start taking such measure is in your own community.

New Development

Adopt an ordinance strengthening local building code standards. Improved standards (1 gpf for urinals, 2 gpm for lavatory faucets, 2.5 gpm for kitchen faucets, and more water efficient dishwashers and washing machines) would reduce indoor water use in homes by about 25 percent. According to the National Wildlife Federation, if these standards were applied nationwide, the annual water savings resulting from one year's worth of new construction alone would equal the amount of water used by a city of 100,000. If applied to the nation as a whole, these savings would translate to approximately 2,400 megawatts of electricity - the transmitted output of eight 500 megawatt coal plants. Oil and gas would be reduced by the equivalent of 40,000 barrels of oil per day. These water and energy savings would reduce greenhouse gas emissions and amount to $10 billion for consumers.

Industry
Provide audits and information on water-saving incentives to industrial business. Water is used by industry for cooling, landscape irrigation, sanitation, and as process water. Industry incentives for water conservation include reduction in cost of water and wastewater treatment. Possible programs include auditing utility water bills to help spot leaks in service pipes and domestic water pipes and to spot processes using more water than the system was designed to require, offering rebates for water saving devices, classifying and segregating process streams, reusing or reclaiming water from waste streams, changing production processes, converting from once-through cooling to closed systems, eliminating water waste associated with cleanup operations, using dirty water first and clean water last in washing operations, improving landscape irrigation, instituting employee education, and publishing a commercial guide for water-saving devices on your city's website.

Residential
Offer a water conservation device depot where residents can get free water-saving devices. This is a great option for special observances such as Earth Day and Water Awareness Week. Devices might include low-flow shower heads, toilet tank displacement devices, dye tablets to detect leaks in toilets, dual-flush devices, early closure devices, or flapper valves.

Distribute water-saving devices door-to-door. This program involves going door-to-door with two high-quality shower heads and two toilet tank "dams" along with dye tablets to detect leaks, instructions, and conservation literature. Offer free installation and pick-up of old devices. Staff should return to homes up to three times to be sure the devices are installed. This face-to-face marketing combined with free product and installation is highly effective and has secured a 75 percent installation rate.

Provide home water audits. This is a comprehensive evaluation of all indoor and outdoor water use. This will educate homeowners about water conservation practices. Typically this program is aimed at homes with above average water use. Steps in this process include establishing a database with the homeowners contact information and prior water use records, hiring and training auditors, mailing notifications to all potential auditees, contacting auditees and if possible, scheduling a visit, conducting both indoor and outdoor audits, creating a short report for the auditee summarizing the findings, mailing follow-up information and notices to encourage participation, and establishing an evaluation process to document program success.

Offer residential leak detection programs. Steps in this program include targeting homes with higher-than-average water consumption, training staff to use the leak-detection equipment for residential systems, directing staff to listen for leaks at each water meter and at an external hose bib at each house, confirming apparent leaks with a second visit, noting homes with leaks for later water-use analysis and leaving a door hanger notifying occupant of apparent leak, as well as conducting a telephone survey to follow up on the percentage of occupants who actually repaired leaks.

Offer toilet rebates. Steps include developing a marketing plan, conducting training seminars for plumbing suppliers, retailers, suppliers, and city and county inspectors, implementing the marketing plan, and inspecting each bathroom installation to ensure that it qualifies.

Publish a consumer guide for water-saving devices on your city website. Simply telling citizens to purchase and install water-saving devices is not enough. Publishing a guide that informs consumers about parts and equipment, indicates a price range for each item, and lists local suppliers is key. So as to avoid favoritism, the guide should include a disclaimer that the list of suppliers is not an endorsement, but should be used for informational purposes only.

Reclamation

Explore a reclamation ordinance. Reclamation projects can extend water supplies, reduce wastewater disposal costs, and save water and energy costs. Careful analysis of water reclamation possibilities is paramount because of the cost, public health issues, legal barriers, and environmental considerations. Steps include offering local financial incentives and taking advantage of state financial incentives or advocating to make them available.

Change plumbing codes to permit use of reclaimed water and gray water systems. Local governments may require dual water systems, which enable the use of reclaimed water in newly constructed buildings.

Explore opportunities for converting agricultural water to urban use. Relocating water from the farm sector to the urban sector involves complexities. However, as reallocation eliminates the need to build more dams, results in increased in-stream flow, and creates incentives to reduce overwatering of agricultural land - thus reducing the potential for erosion, waterlogging, and salinazation of runoff water - it may be a viable option for urban communities that are experiencing water shortages.

Cities must be careful that such measures do not result in the transformation of land from agricultural uses to urban space. They also must be explicit about provisions for environmental restoration of cities if they wish to prevent environmental damage.

Public Education

Implement an employee water-awareness program. Develop a city/community policy commitment. Create awareness of water conservation practices through posters, newsletters, booklets, website content, and speakers. Exchange water-saving ideas with other industries, businesses, or local governments near your community. Educate employees about the merits of conserving water at home as well as work.

Sponsor an awards program for businesses with excellent conservation programs. Ask the mayor or another prominent official to participate in the awards. Ask each entrant to specify the reduction of water use resulting from conservation measures utilizing process modification, retrofits, equipment replacement, reuse or recycling, or preventative maintenance, rescheduling, and other methods.

Incorporate conservation messages into water bills and urge private utilities to do the same. These messages can be printed directly on the water bill for cost savings. Messages might include a comparison between the water use of an individual and his or her neighbors, or between an individual's current water use and that of the previous year.

Offer educational water-conservation programs in schools. Such an effort will help to save water in the long-term as well as the short-term. Obtain approval for the water-education program from the superintendent of schools for the community. Organize water utility efforts, estimating the number of teachers and students expected to participate in the water-education program. Coordinate a teacher training, organizing distribution of curriculum materials to teachers, and monitoring and following the success of the program. Make adjustments as needed to maximize student contact.

Bathroom Fixtures

Without question, replacing high-volume plumbing fixtures is critical. That said, most water savings occur through proper maintenance of existing fixtures and plumbing, rather than through upgrades in technology. Even the most expensive, technologically advanced toilet is a waste if a leak goes without repair.

A small leak wastes about 20 gallons of water per day; a large leak can waste hundreds of gallons. Left unchecked, the price of minor leaks leads to major costs. Water audits that detect leaks and identify outdated fixtures offer fast - and often free - savings. Check with your local water utility to see if this service is provided.

Ultra-Low Flush Toilets

Flushing a toilet is, quite literally, pouring good water down the drain. In California, almost all toilets and urinals use otherwise drinkable (potable) water to flush waste into the sewer system.

If toilets were installed in the 1980s, they probably use 3.5 gallons per flush (gpf); if older, they may use as many as 7 gallons. Compare this to new, federally mandated ultra-low flush toilets (ULFTs) that only flush 1.6 gallons - saving up to 77 percent of water used. Admittedly, early versions of the ULFT were poorly received because of problems with clogging and double-flushing. Since then, manufacturers have all but eliminated these concerns; today's ULFTs perform even better than their high volume counterparts. These new toilets save water, are better designed, more durable, and have improved flush performance.

When calculating annual water savings from low-flow toilets, chances are good that the payback period will be relatively short. Local utilities offer great rebates, reducing the cost of upgrading your plumbing fixtures and increasing the rate of return on this no-risk investment.

Flushometer (Flush Valve) Toilets

The standard for commercial applications, tankless, flushometer toilets relies on the wider water supply pipes found in commercial buildings to deliver a high pressurized flush (23 to 40 psi). Most flow at 1.6 gpf, but some models are as low as 1.0 gpf.

High-Efficiency Toilets (Dual Flush and Pressure-Assisted)

The newest technology in toilets has enabled manufacturers to reduce gallons per flush even further. High-efficiency toilets (HETs) are those that perform 20 percent better than the mandated 1.6 gpf, meaning a maximum of 1.3 gpf. HETs can be either dual flush or pressure-assisted designs. Some rebate programs make a distinction between ULFTs and HETs, offering higher rebates for HETs.

We can thank Australia - the world's driest inhabited continent - for pioneering the dual flush toilet. Dual flush toilets, as the name implies, have two flush modes. The solid mode acts much like a ULFT, using only 1.6 gallons per flush. The liquid mode only uses 0.8 gallons per flush. Total water savings over a comparable ULFT are about 30 percent. While the first-cost is marginally higher than a ULFT, most water agencies offer rebates to help offset this.

ULFTs and dual flush toilets both rely on gravity to pull waste through the system. With pressure-assisted toilets, a tank in the internal chamber traps and compresses air, which is released as the water is flushed through the bowl at a rate of 70 gallons per minute-three times faster than a gravity toilet and twice as fast as one with a flushometer. These toilets are easy to identify by the powerful flushing noise. New models use only 1.0 gpf and are becoming increasingly quieter.

Waterless Urinals
Waterless urinals are cheaper to purchase and install, more hygienic, and less expensive to maintain than their flush counterparts. According to manufacturers, each waterless urinal can save up to 40,000 gallons of water annually - that's more than the average person uses for all of their water needs in a single year. Depending on water and sewer charges, payback can be as quick as one year.

End users will appreciate the waterless urinal. Since there is no water, bacteria and ammonia odors are minimized. Since there is no flush, it is not necessary to handle or touch the urinal. Maintenance is also reduced because of the elimination of stoppages, overflows, and leaking flush valves. This is especially true for areas with hard water, which tends to encrust pipes and valves over time.

Faucets and Showerheads
Be sure that all faucets and showerheads are equipped with low-flow aerators. You can check this by looking at the imprint on the side of the aerator, which should read 2.75 gpm (gallons per minute). Check with your local water agency since many install low-flow fixtures for free.

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Water Audits

Every Californian understands the importance of water conservation. Now energy stakeholders are beginning to realize that water use has considerable consequences for energy, especially in Southern California, which receives its water supply through incredibly energy-intensive and expensive water projects. Pumping and treating water accounts for 10 percent of California's total energy use. Although the cost to end-users of water and sewage is small compared to other utility costs, saving water is the responsibility of all Californians.

The commercial and institutional sectors use about 27 percent of the State's 7 million acre-feet of urban water, almost three times the use of the industrial sector (10 percent). Half of this is used to heat and cool buildings. Recent studies have suggested that cost-effective conservation could reduce non-residential urban water consumption from 15 to 50 percent.

Most water agencies in California offer free water use surveys (water audits) for commercial, industrial, and institutional customers. Like an energy audit, a water audit provides valuable information about a site's water use as well as options for reducing demand. Water audits focus on fixtures (flow rates and leaks), irrigation systems for landscapes and interior-scapes, and any water use associated with processes or operations. A water audit generates a detailed report listing site-specific recommendations. Depending on your local agency, you may even receive free replacement fixtures professionally installed-all for the cost of a local phone call.
Energy and Water

Energy and Water
The State Water Project delivers 2.3 million acre-feet of water each year, consuming approximately 5 billion kilowatt-hours of energy each year. It is the largest single end-user of electricity in the state. Much of this energy is used to "lift" water 2000 feet over the Tehachapi Mountains - the highest such lift of any water system in the world. Pumping one acre-foot of water to Southern California requires roughly 3,000 kilowatt-hours of energy.

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MOTORS

Energy Use Basics

Motor systems consume as much as 60 percent of all electricity in the United States; half of this electricity is used by the industrial sector alone. Motor applications vary as widely as the businesses they serve, but common ones include fans, pumps, compressors, and conveyance. Around 70 percent of the total electricity used by all U.S. manufacturers powers motors systems.

A well-designed and well-maintained motor system can reach 90 percent efficiency - meaning that 90 percent of the input energy gets converted to useful work. Unfortunately, only a small portion of the U.S. motor inventory falls into this category - the majority of motors in use are highly inefficient. The good news, though, is that as older motors are retired, opportunities arise to improve these statistics with newer, more efficient technology.

Opportunity for Savings

Plant managers often do not capitalize on the enormous potential for energy and cost savings - surprising, considering the importance of motors to manufacturers. A survey conducted by the campaign Motor Decisions Matter (MDM) found that only 12 percent of industrial managers knew that the lifetime operating cost for a motor is generally five times greater than the initial purchase price.

The U.S. Department of Energy (DOE) estimates that U.S. manufacturers could cost-effectively reduce motor-related energy use by 11 to 18 percent, yielding cumulative annual cost savings of up to $5.8 billion. Similarly, the American Council for an Energy-Efficient Economy (ACEEE) estimates that optimization of electric motor performance can save as much as 25 percent of total U.S. electricity use. For individual manufacturers, motor drive optimization potentially saves as much as 50 percent of motor energy use - significant when you consider that motor energy costs can exceed $1 million per year in large industrial plants.

Likewise, ACEEE estimates that fan and pump optimization could achieve electricity savings ranging from 20 percent to well over 50 percent. Fan and pump optimization relies more on aligning proper usage with process needs than on equipment upgrades - and thus involves higher engineering costs than equipment costs. Such projects have an average payback rate of 1.2 years, saving about $0.012 per kilowatt-hour (kWh) (not including consequent gains in productivity, which are common).

References

See Flex Your Power product guide on motors. http://fypower.org/ind/tools/products.html

The National Electric Manufacturers Association (NEMA) website contains information on the NEMA Premium® energy efficiency motors program, including product specifications and a list of participating partners. http://www.nema.org/gov/energy/efficiency/premium/

The Consortium for Energy Efficiency (CEE) website on Motors and Motor Systems includes a Motor System Tool Kit, efficiency specifications, resource links and information on the Motor Decisions Matter campaign. http://www.cee1.org/ind/mot-sys/mtr-ms-main.php3; http://www.motorsmatter.org/

Efficient Motors: Selection and Application Considerations. A brochure developed by CEE and the U.S. Department of Energy's Motor Challenge Program. Boston, MA: 1999. http://www.cee1.org/ind/motrs/motr-broch.pdf

U.S. Department of Energy (DOE) free software MotorMaster+ is an energy-efficient motor selection and management tool, including a catalog of over 20,000 AC motors. This tool features motor inventory management tools, maintenance log tracking, efficiency analysis, savings evaluation, energy accounting, and environmental reporting capabilities. http://www1.eere.energy.gov/industry/bestpractices/software.html#mm

U.S. DOE free softwarePumping System Assessment Tool (PSAT) helps industrial users assess the efficiency of pumping system operations. PSAT uses achievable pump performance data from Hydraulic Institute standards and motor performance data from the MotorMaster+ database to calculate potential energy and associated cost savings. http://www1.eere.energy.gov/industry/bestpractices/software.html#psat

Electrical Apparatus Service Association (EASA), Inc. is an international trade organization of over 2,150 electromechanical sales and service firms in 50 countries. The EASA website contains downloadable, in-depth guidelines to improve motor efficiency, repair worn or malfunctioning motors, and to help owners decide whether to replace or repair motor systems. http://www.easa.com/

Northwest Food Processors Association Efficiency Practices and Emerging Technologies websites offer useful information and tips for the food processing industry. http://www.nwfpa.org/eweb/DynamicPage.aspx?webcode=landing&wps_key=04223b93-b993-47b3-a60b-256a132395fc&site=energy; http://www.nwfpa.org/eweb/DynamicPage.aspx?site=energy&webcode=landing&wps_key=0829FD5E-F23B-46F6-AFDB-8D599BD29429

California Energy Commission websites on Food and Fiber Processing Technologies and Energy in Agriculture. http://www.energy.ca.gov/process/agriculture/food+fiber_processing.html

FOOD SERVICE

Tips for Energy Savings

Cook up some savings
Square-foot for square-foot, food service areas rank among the most energy-intensive commercial spaces in California. It's not just the cooking equipment that's to blame—heating, cooling, lighting and sanitation each account for major portions of the average cafeteria's electricity and natural gas consumption.

As you might guess, all that energy use means there's a lot of room to start saving. But here's something you might not have guessed: Saving energy—and thus saving money—is often easy. In some cases, it's as simple as changing a few everyday practices.

Take broilers, for example. Cutting out only one hour each day of broiler on-time could translate to a savings of around $450 annually. While $450 might not sound like much at first, it could be huge when you think in terms of your profit margin. Consider this: If your cafeteria operates with a profit margin of around five percent, you'll need about $9,000 worth of sales to earn $450.

Every dollar saved through energy efficiency is a dollar profit—and even modest improvements to efficiency can lead to major leaps in overall profits.
Tips for buying new cooking equipment

In the case of new appliances, it pays to look beyond the sticker price. Make an energy-smart purchase by thinking in terms of life-cycle costs, which include purchase price, annual energy costs and any other long-term costs associated with the equipment.

Thinking in the long term can really pay off. In the case of ENERGY STAR qualified connectionless steamers, for example, the water and energy savings over a conventional boiler-based steamer could add up to several thousand dollars in just one year! Multiply those annual savings by the entire life of the appliance, and the financial benefits of energy efficiency become truly striking.

If you're in the market for new equipment, consider the following general tips for minimizing life-cycle costs:

- Always ask equipment manufacturers and dealers for energy use information.
- Check online for efficiency information on specific makes and models. The Web site of PG &E's Food Service
- Technology Center is a great place to start. Find it at www.fishnick.com.

- Ask dealers about maintenance. In some cases, energy-efficient equipment may require more or less upkeep than the standard-efficiency counterpart.
- Buy ENERGY STAR qualified appliances whenever possible.

Audits
An energy audit is a great way to learn about how much energy you use and to identify customized options for becoming more efficient. Depending on your utility provider, both on-site and online options may be available—possibly for free. Flex Your Power's audit locator can help you identify programs in your area. Find it online at www.fypower.org/assistance.

See how you stack up
ENERGY STAR collaborates with Flex Your Power and provides free energy efficiency information and technical support for restaurants and cafeterias. For more information, visit www.energystar.gov/smallbiz and click on "Restaurants."

Appliances and Food Preparation
Saving energy in the kitchen. When it comes to saving energy in the kitchen, the way in which you use your appliances can be just as important as the appliances you use. Buying and using an energy-efficient oven, for example, is undoubtedly a good starting point and could trim hundreds of dollars from your annual utility bills - but saving the most energy and money will require something more: good practices.

Cut idle time. Do you need all of your appliances on, all of the time? Probably not. Idling appliances cost you money, so implement a startup/shutdown plan to make sure that you're using only the appliances that you need, when you need them. The savings can be substantial. Cutting only one hour of broiler idle time every day, for example, could save $450 annually.

Cook wisely. Ovens tend to be more efficient than rotisseries; griddles tend to be more efficient than broilers. Examine your cooking methods and menu and find ways to rely on your more-efficient appliances.

Maintain and repair. Don't let everyday wear and tear start driving up your energy bills. While a leaky gasket, clogged burner or loose oven-door hinge may not waste much energy, combine all three and suddenly the waste is not so insignificant. Stop waste by staying on top of repairs.

Recalibrate to stay efficient. It's likely that over time the performance of your kitchen appliances will degrade. Thermostats and control systems can fail or fall out of calibration. Take the time to do an occasional thermostat check and recalibrate as necessary to ensure that you're cooking at the right temperature. Repair or replace broken control panels on ovens, steamers, and other appliances with controls systems, and don't forget to replace missing knobs on manually controlled appliances like ranges, griddles and broilers.

Check pilot lights. Older gas-burning appliances typically feature pilot lights, which require a constant stream of gas to stay lit. Check pilot flames occasionally to make sure you're using only as much gas as you need. How do you spot an over-fired pilot light? A tall yellow flame is the giveaway.

Buy energy-efficient appliances. Inefficient appliances make for an expensive double-whammy: in addition to having higher operating costs, inefficient kitchen appliances tend to emit more heat than their efficient counterparts resulting in a hotter kitchen and potentially forcing you to spend more to cool the air. Buy ENERGY STAR qualified equipment whenever possible.

Buy with capacity in mind. Size up your food production needs and try to buy appliances that match your needs on a pounds-per-hour basis while allowing yourself a little headroom. Grossly oversized appliances can hit you in the pocketbook as both capital costs and operating costs. Overcapacity is particularly painful, as you pay to heat up the production capacity you will never use.

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See Flex Your Power product guide on motors. http://fypower.org/ind/tools/products.html

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performance data from Hydraulic Institute standards and motor performance data from the MotorMaster+ database to calculate potential energy and associated cost savings. http://www1.eere.energy.gov/industry/bestpractices/software.html#psat

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Buying and Operating Equipment

Steamers

Thanks to good heat transfer, steamers rank among the more energy-efficient kitchen appliances. But this doesn't mean they can't use a lot of energy. Until recently, most steamers were boiler-based water hogs, consuming an average of 40 gallons of water per hour. Bringing so much water to a boil requires a lot of energy-thousands of dollars worth per year for larger cafeterias. Fortunately, steamer technology has come a long way in recent years. New "connectionless" steamers operate as a closed system-without a boiler and a drain - so they consume far less water and, ultimately, far less energy. Many of the connectionless steamers are designed with output in mind and they can produce just as much food as traditional boiler-based steamers at a much lower cost to operate.

Tips for cooking with steamers

- Close the door! Your profits are literally evaporating away if you're operating your steamer with its door open.
- Use only as many compartments as you need. With steamers, two-or three or four compartments are not better than one when it comes to saving energy and money. Shut down unnecessary compartments during slow periods.
- Cut standby time. Eliminating an hour of standby time daily on a boiler-based steamer could save from $50 to $300 over the course of a year.

- Use the timer. Not using your steamer's timer? You're probably paying the price for it. Timers save energy by ensuring that the steamer runs at full heat only when needed.
- Keep it clean. Flushing out the boilers and removing mineral deposits will help ensure that you're always operating at maximum efficiency.
- Fix leaks. When gaskets loosen or tear don't waste time before repairing them. Steam leaks will reduce cooking efficiency and drive up utility bills.
- Invest in connectionless technology. Connectionless steamers require less maintenance than boiler-based steamers and consume far less energy and water. Field testing by PG&E's Food Service Technology Center has shown just how great the savings can be.

Connectionless Technology
In one head-to-head challenge between a three-pan connectionless steamer and a traditional, boiler-based steamer, the connectionless steamer slashed annual water bills by $2,000 and annual electricity bills by $3,000. Get in on the savings—look for an ENERGY STAR qualified connectionless steamer.

Broilers
Broilers are true kitchen workhorses, but their dependability and usability come at a price: All that scorching heat requires a great deal of energy—perhaps more than any other appliance in the kitchen. PG&E's Food Service Technology Center has reported that one broiler can use as much energy as six fryers! Making matters worse, broilers tend to rank among the least efficient appliances in the kitchen. Fortunately, a few good cooking habits can help trim energy waste and have a direct impact on your bills.

Cut preheat time. Don't start the heat before you need it—you'll waste energy and needlessly heat up your kitchen, forcing your air conditioner to work harder. Few cooking appliances require more than 20-30 minutes to preheat.

Reduce the cooking area. Because broilers use so much energy, turning off a section of your broiler can yield noticeable savings.

Eliminate standby time. Don't leave your broiler at full heat during long lulls in activity—turn it down or off whenever possible. If you can manage to cut three hours of standby time every day, you could save upwards of $1,350 annually.

Rely on your griddle. For some cafeterias, griddles may be good alternatives to broilers. Thermostatically controlled griddles tend to use far less energy than broilers, and grooved griddles can be used to sear "grill marks" onto foods so they looked broiled.

Align broilers with exhaust hoodsSometimes appliances get pulled out for cleaning and don't make it all the way back under the exhaust hood, adding extra heat and smoke to

the kitchen. Make sure that your broiler is fully under the hood and pushed as far back to the rear wall as possible.

Pasta cookers

It may surprise you to find out that doing something as simple as boiling water could be costing you thousands of dollars per year, but it's probably the case-especially if you happen to cook enough pasta to require a dedicated pasta cooker.

Dial in the savings. Do you boil water with your temperature dials to the max? If so, you might be throwing away more than $1,000 per year. Find the minimum settings required to maintain a boil—your food will cook just as fast, and you'll slash your energy bills in the process.

Cut the idle time. Shutting down appliances during slow hours is always a good idea. In the case of pasta cookers, you could save $600 annually simply but cutting out two hours of idle time each day. If you can't shut down your pasta cooker, consider at least turning it down-a pasta cooker standing by at less than boiling temperature will use far less energy than a pasta cooker running a constant boil.

Ovens

In terms of energy efficiency, ovens are usually mid-level performers—they're often more efficient than broilers, but less efficient than steamers and pressure cookers. Although to date no ovens have secured ENERGY STAR status, several energy-efficient convection and combination-style models are available, with some even qualifying for utility-sponsored rebate programs.

Use "combi" mode sparingly. Combination ovens are attractive because of their versatility as a cooking platform and their space-saving ability to mix the duties of ovens and steamers. Unfortunately, this double-duty can come at a cost—combination mode can use double the energy use of convection mode. Worse still, ovens operating in combination mode can use upwards of 40 gallons of water per hour! Typically, it is not necessary to operate these units in the combination mode during an entire cooking cycle. Follow the manufacturer's recommendations—use the oven's built-in programmability and limit the amount of cooking in the combination cycle.

Cut idle time. The bigger the oven, the more energy you're wasting by leaving it idling. The amount of energy wasted can quickly add up, especially with conveyer ovens, which allow heat to escape at both ends. Turn ovens down or off during slow periods, shut down your backup ovens during lulls and shut oven doors all the way when the oven is empty but still on.

Keep it full. It is more efficient to cook in a fully loaded oven than a partially loaded one. If you're workload permits it, cook in large batches and then turn off the oven in between loads.

Maintain seals and hinges. When seals and gaskets tear, replace them. When oven door hinges loosen, tighten them and re-align the doors.

Ranges
Like broilers, ranges are manually controlled and can be energy guzzlers depending on how you use them.

Maintain and adjust burners. Wavy, uneven or yellow flames are all signs that it's time for a good burner cleaning and adjustment of the air shutter. Loosen the adjustment screw and move the shutter until the flame is bullet shaped and mostly blue, then retighten the screw. Never drill out the burners or the gas orifice to get a bigger flame—you'll end up lowering the efficiency of your burner.

Put a lid on it. Use a lid on stockpots to hold in heat, boost efficiency and shorten cooking times.

Consider induction technology. Induction ranges are a potential alternative to traditional range tops. Induction range tops are more expensive then traditional gas or electric ranges but offer very high efficiency, rapid heat up, precise controls, and easy maintenance. Induction hobs can be purchased as single units or grouped together and can be set on top-of or built-into counter tops. Induction cook tops do require magnetic cookware in order to work properly.

Griddles
Griddles are one of the few pieces of cooking equipment that can be purchased with either manual or thermostatic controls. Typically, thermostatically controlled griddles cost less to operate. Utility rebates are available for the most efficient thermostatically controlled griddles.

Cut standby time. Chances are that you don't need your griddle ready and waiting all day, every day. Save up to $250 annually by cutting out three hours of griddle standby time per day.

Invest in a double-duty griddle. When the time comes to invest in a new griddle, consider a model that features both grooved and flat cooking surfaces—especially if you do a lot of broiling. As mentioned earlier, griddles tend to be more efficient than broilers, and grooved griddles can achieve broiler-like char marks on food. Shifting cooking duties from a broiler to a grooved griddle will save money.

Fryers
Thankfully, if you're in the market for a new fryer it's pretty simple to get a jump on energy

savings—fryers are one of four classes of kitchen equipment that are ENERGY STAR rated, and there are utility rebates for qualified models. Simply look for the ENERGY STAR label when narrowing down your purchase options; once you're up and running, mix in some of the smart cooking practices below and you'll be on the fast track to lower bills.

Cut idle time. PG&E's Food Service Technology Center has observed that kitchen fryers tend to spend upwards of 75% of the day idling. Cutting out four hours of idle time each day could save around $250 annually for a gas fryer and about $350 for an electric fryer.

Check and adjust thermostats. Are you cooking hotter than you think? It's not uncommon for fryer thermostats (or any other appliance thermostat, for that matter) to lose accuracy over time. Invest in periodic temperature checks and recalibration as necessary.

Buy an ENERGY STAR qualified fryer. It pays to look for the ENERGY STAR label when shopping for a new or used fryer. Fryers that have earned the ENERGY STAR are up to 25% more energy-efficient than standard models. With natural gas fryers, the added efficiency could save you about $350 annually.

Braising Pans

Close the lid. PG&E's Food Service Technology Center has found that you can use 50% less energy simply by closing your braising pan's lid during periods of extended use.

Buy an insulated braising pan. In the market for a braising pan? Look for one with insulated walls.

Refrigerators and Freezers

How often do you think about your refrigerator? Refrigerators tend to have tank-like durability, which can make them easy to forget about. But just because your refrigerator is working doesn't mean that it's working well—at least not when it comes to energy efficiency. As with any other mechanical equipment, refrigerator performance can dip over time. A few upgrades and a bit of maintenance can have a positive impact on your electricity bills.

Turn off door heaters. Saving money and energy doesn't get much easier than this. Simply switch off the door heater on your reach-in refrigerator or freezer and you could save up to $75 annually per door.1 Turn that switch back on if you notice significant frost around the door or if there is water dripping on the floor from the front of the refrigerator—never do anything that compromises safety or performance.

Allow for air circulation. Refrigerators remove heat from inside the box and reject that heat out through the coils on the top or bottom of the unit. Don't push your reach-ins into tight spaces where that heat will build up or the unit will end up working harder and using more energy.

Clean condenser and evaporator coils. If you take a look at your refrigerator's condenser you'll see that the fins are magnets for dust and grime. Debris like this builds up on the fins, blocks air flow across the coils and drags down refrigeration efficiency. Dirty coils can also lead to early equipment failure and are sited by one manufacturer as the number one reason for service calls. Similarly, check and clean evaporator fins; find them behind the evaporative fans in your walk-in.

Close the lid on your food wells. Leaving the lid up on your prep table could increase electricity consumption by up to 50 percent.

Check and set defrost cycles. Defrosting is an energy-intensive process that can vary dramatically from cafeteria to cafeteria, so it's important to take some time to figure out which defrost settings are right for you. The key is to only defrost for as long as you need, which in most cases is no more than 15 minutes, four times daily. Find your defrost time clock: Use the pins on the outside ring to set the number of defrost cycles, and use the center dial to set how long each defrost cycle lasts. One cafeteria owner observed by Southern California Edison's engineers saved more than $800 annually by shortening the length of each defrost cycle from 70 minutes to 15 minutes.

Replace old gaskets. Add new door gaskets to any refrigerator that has torn or loose door gaskets. In some areas, utility rebates are available for gasket replacements, and there are service companies that will turnkey replace all the worn gaskets in a cafeteria.

Upgrade your walk-in. Strip curtains and automatic door closers are inexpensive, easy-to-install upgrades suitable for just about any walk-in. By some estimates, strip curtains alone can cut outside-air infiltration by 75 percent. Utility rebates that cover a big chunk of the upfront costs to purchase a strip curtain are often available. With a rebate, the payback on a strip curtain is usually well under one year.

Use efficient lights. Swapping out incandescent lights for low-temperature CFLs in your walk-in is a smart move. Incandescent lighting gives off much more heat than CFLs, forcing your refrigerator to work harder.

Shade remote condensers. Direct sunlight can really put a dent in the efficiency of a remote condenser. (Remote condensers are usually associated with walk-ins and can often be found on rooftops.) Use a few strategically placed panels to shade the condenser from direct sun during the hottest part of the day, while still allowing for good airflow into and around the condenser unit.

Insulate suction lines. On refrigeration systems with remote condensers, suction lines transport refrigerant from the evaporator to the compressor. Adding inexpensive insulation to suction lines can help keep them from absorbing heat during the transfer process, ultimately making the entire refrigeration process more efficient. Check with your utility—rebates may even be available to offset the cost of the insulation.

Add night curtains to display cases. Open-case refrigerators may be a great way to put products at the customer's fingertips, but they're typically not a top choice when it comes to energy efficiency. Cut down on energy waste by installing night curtains, which will help trap cold air inside the refrigerator case while you're closed. The curtains are relatively inexpensive, and utility rebates are available in many parts of the state.

Recharge low refrigerant. Operating a walk-in with too little refrigerant puts extra strain on the compressor, driving energy costs up and increasing the risk of equipment failure. Fortunately, it's fairly simple to keep track of your refrigerant level; simply look for the sight glass—the small window into the refrigerant line—on the condenser. If you see bubbles while the system is running, then it's probably time to arrange for a recharge.

Switch to efficient fan motors. Installing efficient fan motors—specifically, the "electronically commutated" (ECM) variety—on a small, two-fan walk-in freezer has been shown to save about $200 a year per fan. Naturally, the bigger the refrigerator and the greater the number of fan motors replaced, the greater the electricity savings will be. If you're in the market for a new walk-in, then California law requires you to install efficient fan motors. If you have an existing walk-in, consider swapping out the old fan motors for newer ECM models. Don't wait until your old fan motors fail: It's actually cheaper to plan ahead and upgrade to ECMs early rather than waiting for an emergency service call. There are currently rebates available for ECM motors; check with your utility to see if you are eligible.

Buy ENERGY STAR. Starting January 2006, California law requires that any new reach-in refrigerator or freezer sold is at least ENERGY STAR qualified or equivalent. Some reach-ins are more efficient than others, and utility rebates are available for the most efficient models. Find a list of the top performers at www.fishnick.com/rebates.

Ice machines

Shop for efficiency. Ice machine manufacturers voluntarily list the water and energy-use numbers for their ice-cube machines with the Air Conditioning and Refrigeration Institute (ARI) at www.ari.org/directories/acim. With this list in your hand, you can comparison shop for the most efficient ice machine and save yourself hundreds of dollars a year in water and electricity. Many utilities offer rebates for purchasing efficient ice machines, so check with you energy provider or ice machine dealer to see if you qualify.

Size matters. Here's an interesting tip: Bigger ice machines are typically more efficient than smaller ones in the sizes used by most cafeterias. For instance, a 520 pound-per-day machine will make ice using as little as half the energy needed by a smaller 200 pound-per-day machine. The best part is that the bigger 520-pound machine does not cost twice as much as the 200-pound unit. So, choose wisely and you could get twice the ice capacity at half the energy cost per pound of ice. The larger machine also makes it easier to shift all of your ice making to nighttime hours.

Shift ice production. Cut down on your daytime electricity demand by installing a timer and shifting ice production to nighttime off-peak hours. Most cafeterias pay less for electricity

at night and you'll be turning off a hot, noisy piece of equipment during normal kitchen hours.

Pick your plan. When it comes to utility plans, being picky can be a good thing. Most utility providers offer an array of rate plans, so take the time to find out which one is right for you. Simply call your provider—they can help guide your decision by examining your billing history. The right plan can save you hundreds and sometimes thousands of dollars a year.

The Importance of Peak Power. Becoming more energy efficient is good business—for you and for the state as a whole. By consuming less electricity, you'll be helping to stabilize California's power grids during peak hours, which refers to the time of day—roughly between noon and 7:00 p.m.—when electricity demand is highest. If you're on a time-of-use electricity rate schedule, it's also when electricity is most expensive.

When peak energy supplies are at their lowest, a Flex Your Power NOW! alert is triggered. That's your signal to cut back on electricity use wherever possible. Here are some good options for cutting demand during a Flex Your Power NOW! alert:

- Turn off non-essential lighting
- Set air conditioners a couple of degrees higher
- Shut off unneeded cooking equipment
- Make sure walk-in doors are shut (don't prop open)
- Turn off all outdoor lighting

For more on Flex Your Power NOW!, peak electricity, and time-of-use electricity plans, log on to www.fypower.org/now.

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Insulation

Holding cabinets
When it comes to saving energy with hot food holding cabinets, the answer is in the insulation. Well-insulated holding cabinets have been shown to be up to 65 percent more efficient than non-insulated models. Expect to save between $350 and $450 annually simply by choosing a good insulated cabinet.

Shut it off! The U.S. Department of Energy reports that holding cabinets are frequently left on overnight. Don't waste energy by heating empty space—implement a shutdown schedule and make sure your cabinets are part of it. A non-insulated holding cabinet left idling for eight hours every night could wind up costing you around $500 per year!

Buy an ENERGY STAR qualified cabinet. As of January 2006, California law requires that any new holding cabinet you purchase be at least an insulated ENERGY STAR qualified cabinet or equivalent. Still, some insulated cabinets are more efficient than others. Utility rebates are available for the most efficient models.

The Biggest Energy Users
If you're looking for a shortcut to the biggest savings, consider focusing your attention on what are likely some of your kitchen's biggest energy users: broilers, hot-top ranges, boiler-based steamers, pasta cookers, conveyor ovens and combination ovens.
Don't wait: Go to ENERGY STAR

With ENERGY STAR steamers, good things come to those who don't wait. That's because the savings are usually huge. In most cases it makes financial sense to make the switch to an ENERGY STAR steamer right away, rather than waiting until your old boiler-based steamer is ready to call it quits. PG&E's Food Service Technology Center has found that an ENERGY STAR qualified steamer, under heavy operating conditions, could save thousands of dollars in annual energy and water costs.
Putting Energy Use in Perspective

Sometimes it's difficult to appreciate just how energy-intensive kitchen equipment can be. Here's some info to help put things in perspective—and to underscore the importance of saving energy in your kitchen:

11,000 kWh is enough energy to . . .
. . . power a typical electric open deep fat fryer for about a year.
. . . power the average California home for nearly two years!

Case in point: Porto's Bakery, Glendale
Porto's Bakery is a great example of how energy-efficient natural gas appliances can help keep energy bills to a minimum. Working with the Southern California Gas Company as part of a major expansion project, the bakery was outfitted with energy-efficient griddles, ovens, fryers, and other pieces of cooking equipment. The investment in energy efficiency paid off: "Even though our sales went up by 40 percent, our gas costs stayed the same," reports Raul Porto, the bakery's owner.

Case in point: Montebello Unified School District
With an assortment of energy-efficient steam kettles, braising pans and other equipment, cafeterias throughout the Montebello Unified School District (MUSD) are saving natural gas and cooking smart. Southern California Gas Company helped make the upgrades happen, providing more than $12,000 in rebates for new gas equipment, which is saving the district as much as $18,000 a year in energy costs. "With the money saved through energy efficiency, the school district budget can be spent in direct support of our students," said Derrick Williams, MUSD's energy manager.

Efficient Cooking Appliances: Taking the next step
Make an ENERGY STAR list. EPA's ENERGY STAR program takes the guesswork out of buying efficient equipment. Whether you're in the market for new or used equipment, start your hunt by making a list of the ENERGY STAR qualified models that fit your needs.

Focus on these as you start narrowing down your options.
See what utility rebates are available. Some energy-efficient cooking equipment qualifies for rebates from utility providers. To find out more, call your utility provider directly, log on to Flex Your Power's program finder at www.fypower.org/programs or visit the Food Service Technology Center's rebate page at www.fishnick.com/rebates.

Ask questions and check online for reviews. If no ENERGY STAR qualified models exist for the type of equipment you're looking for, don't worry—you've still got options. Ask distributors and manufacturers for energy use info, and check online for equipment reviews that mention energy efficiency. The website of PG&E's Food Service Technology Center is a great place to start. Find it at www.fishnick.com.

Sanitation and Water Use

Save water to save energy
For cafeterias, saving water—especially hot water—makes great economic sense. By conserving hot water you trim two bills: one for the water and another for the electricity or natural gas used to heat it.

Don't ignore leaks. Water leaks are no small problem when it comes to energy efficiency. A leaky sink or dish machine, or a stuck solenoid valve, that loses one-tenth of a gallon per minute will waste more 50,000 gallons over the course of a year. If that same leak just happened to be hot water—you'd be spending hundreds of dollars heating water only to send it right down the drain!

Check your water temperature. Use a thermometer to make sure you're water heater isn't working any harder than it has to; hot water should be around 140 degrees at the faucet of the pot sink closest to the dish machine.

Add aerators. Hand-sink faucets can use as much as 10 gallons of water per minute when not equipped with energy-efficient water aerators. Outfit the hand sinks in your kitchen and bathrooms with low-flow aerators—you'll cut water use and ultimately save on water-heating costs.

Add insulation. Heating water is a significant expense for most cafeterias. Fortunately, it's relatively easy to reduce that expense by adding insulation to your hot-water system. Start saving by simply wrapping your hot-water pipes with the insulated covers available at many hardware stores.

Activate the automatic flue damper. Many commercial hot water heaters have an automatic flue damper that closes when the burners are off. This damper saves energy by blocking heat from escaping up the flue. Make sure that the damper motor's switch is in the "on" position so that the damper will operate properly.

Control the recirculation pump. If your hot water system includes a recirculation pump, install a timer that turns the pump off when your kitchen is closed. You'll reduce the heat loss from your hot water pipes, potentially saving hundreds of dollars on energy costs.

Switch to low-flow pre-rinse spray valves. Depending on the size and workload of your cafeteria, a low-flow spray valve could save you more than $1,000 annually. The secret to the low-flow valve's success is its ability to save in three ways at once. By lowering your water consumption, the sprayer simultaneously slashes your water, wastewater-disposal and energy bills. And don't worry, low-flow doesn't mean slow—low-flow spray valves are engineered to work as well as or better than standard valves. As of January 2006, any new pre-rinse spray valves that you purchase are required by law to be low-flow models; however, thousands of old sprayers are still out there wasting water and energy. You may be able to replace your old valves for free by taking advantage of a give-away program through your local utility or water district. For more information and a list of qualifying low-flow pre-rinse spray valves visit www.fishnick.com/saveenergy/sprayvalves/

Dishwashers

From an operational standpoint, dishwashers are one of the most expensive pieces of equipment in your kitchen. Every rack of dishes you wash can include as many as eleven separate cost items within the three main categories of water, water heating and chemicals. Smart purchasing, operations, and maintenance can save you thousands of dollars in the dishroom.

Don't waste the space! You'll pay the same amount to run a halfway loaded dish rack as a fully load one, so make sure you only run fully loaded dish racks through the dish machine. Cutting wash cycles could save you hundreds of dollars annually.

Turn it off. High-temp dishwashers typically feature internal tank heaters. If you've got one of these dishwashers and you're not turning it off at night, you're wasting energy by heating water that you don't need. The same holds true for booster heaters: turn them off at night to save. Finally, don't forget to turn off the dishwasher exhaust hood while you're at it!

Check rinse pressure. Pay attention to your dishwasher's pressure gauge—if it's showing pressure above 25 psi, there's a good chance you're using much more water than is necessary. Most dishwashers require only around 20 psi.

Check water temperature. Follow manufacturer specifications for tank temperature and rinse temperature.

Operate conveyers in auto mode. If you have a conveyer-style dishwasher, make sure you're using it in auto mode, which saves electricity by running the conveyer motor only when needed.

Add or maintain wash curtains. Wash curtains—the plastic strips that hang on both sides of conveyer dishwashers—improve washing efficiency by trapping heat. Replace curtains when the old ones begin to fall apart.

Design your new dishwashing system with both energy and water efficiency in mind. If you're in the market for a new dishwashing system, it'll pay to look into energy-efficient gas booster heaters. Compared to a standard electric booster heater, a gas booster heater could trim energy costs significantly due to the relative lower cost of natural gas as a fuel, (though keep in mind that a gas booster heater could have a higher first cost and installation cost than the electric unit). Also, look for dishwashing systems that use one gallon or less of water per rack washed—typically, the less water required per rack, the less you'll pay in energy costs.

Consider heat recovery. Refrigerant heat-recovery systems use waste heat from the walk-in refrigerators and freezers to preheat water that can be used in the kitchen. These systems are relatively simple and have reasonable payback periods when installed in kitchens with moderate to high hot-water needs.

Case in point: Merkl's Deli & BBQ, Chula Vista
Merkl's Deli & BBQ in Chula Vista was designed with energy efficiency in mind. Among other features, the deli is outfitted with low-flow spray valves, which perform as well as standard valves but save vast amounts of water and cut water-heating costs. "They work great," reports Steve Wilson, one of the deli's co-owners, speaking about the spray valves. "I've actually been able to turn the water pressure down with them."

The California Urban Water Conservation Council (CUWCC) estimates that small and very small cafeterias can use low-flow spray valves to cut water-heating energy by around 7,600 kWh annually. In addition to saving hundreds of dollars on electricity costs, conserving 7,600 kWh would prevent nearly 12,000 lbs of CO2 from entering the atmosphere. For more information on spray valves, visit the CUWCC online at www.cuwcc.org.

Heating and Cooling Systems

When it comes to annual energy use in California cafeterias, heating and cooling systems account for a big piece of the pie. In fact, for most cafeterias, heating and cooling is second only to food preparation in terms of annual energy consumption.

Rely more on fans, less on air conditioning. Air conditioners and central cooling systems require a tremendous amount of energy; most fans, on the other hand, do not. Research indicates that energy use falls by four to five percent for every degree that you raise your cooling thermostat. Easing back on central cooling by only three degrees Fahrenheit could trim air conditioning costs by 12 – 15 percent. One way to improve customer comfort is to compensate for the difference in air temperature by using an efficient ENERGY STAR qualified ceiling fan to keep the air moving in the dining room.

Inspect, clean and maintain equipment. Dirty heat-transfer coils (the winding metal coils on the back of an air conditioner) and torn or misaligned ducts can both drag down the efficiency of your climate control equipment. Clean and mend where you can.

Replace dirty air filters. Don't let your air filter get too dirty—a grimy filter will impede airflow, forcing your heating and cooling motors to work harder. As a general rule, check and change filters at least once every three months.

Install a programmable thermostat. Still setting your thermostat by hand? Consider adding some precision to the process by adding a programmable thermostat and using its "night setback" mode. With automatic setback, never again will you have to remember to turn off the heat or air conditioning at the end of the workday.

Find out if an energy management system is right for you. If your cafeteria has a centralized heating and cooling system, an energy management system (EMS) may be able to cut your energy costs dramatically. Finding out if an EMS is right for you might take some footwork—you'll need the help of an energy expert on this one. But the extra effort may be worth it since an EMS can also control other systems like lighting and kitchen exhaust fans—automating your operations and compounding energy savings.

Taking the next step. Investigating your climate control options can really pay off, especially if your cafeteria has a centralized heating, ventilation and air conditioning system (commonly referred to as an HVAC system). HVAC systems that are improperly calibrated or that rely on outdated equipment can waste a lot of energy. Here are three options for getting the process started:

Call your utility provider. In many cases, finding out more about your heating and cooling options is as simple as picking up the phone—most utilities either offer a suite of energy efficiency services or can direct you to others that do.

Check out your audit options. Service providers throughout the state offer energy audits for small businesses—sometimes for free. See what's out there by using Flex Your Power's audit locator. Find it at www.fypower.org/assistance.

Check for grants, rebates and incentive programs. Use Flex Your Power's program finder to identify heating- and cooling-related rebate and incentive programs in your region. Find it at www.fypower.org/programs.

Ventilation

An unbalanced or poorly designed kitchen exhaust system can spell trouble both for your cafeteria's air quality and for your utility bills. Get ahead of the game by enlisting the help of an expert to design an optimized exhaust setup.

Catch all that you can. At least in principle, kitchen ventilation is a straightforward art with a simple goal: Capture and contain as much cooking effluent—the combination of grease, smoke and heat that emanates from each appliance—as possible. In practice, however, the task is much more challenging. Cross drafts and misaligned appliances can allow heat and smoke to spill into the kitchen. Spillage leads to a hot, uncomfortable working environment and higher energy bills if you air-condition your kitchen. Cut down on spillage by adding inexpensive side panels to hoods that are failing to capture, and push each appliance as far back against the wall as possible to maximize hood overhang and close the air gap between the appliance and the wall.

Rebalance your act. If you have not performed an air balance recently, it's time to call a contractor. Time, maintenance, broken belts, and poor commissioning all lead to kitchen exhaust systems that are out of balance—moving too much or too little air, spilling and costing you money. This tip applies to your dining room HVAC as well; outside doors that are hard to open because of suction or that blow open by themselves are a sure sign that it's time to order an air balance.

Consider variable-speed exhaust. Typically, kitchen exhaust hoods have two settings: "off" and "on". Naturally, "off" is ideal for when the kitchen is empty, and "on" may be great for the frenzied dinner rush—but neither is quite right for the afternoon lull, the post-dinner wind down, or any other situation when the kitchen isn't operating at full capacity. Variable-speed, demand-based exhaust controls get around this problem by using sensors to monitor your cooking and varying the exhaust fan speed to match your ventilation needs. Demand ventilation controls typically reduce the cost to operate an exhaust system by anywhere from 30 to 50% and can be installed on either new installations or retrofitted to existing hoods.

Maximize overhang. A four-foot deep hood is somewhat typical for cafeteria exhaust, but you'll capture more smoke and heat with a five- or six-foot deep hood.

Group heavy-duty appliances together. If you're designing a new kitchen, try to group your heavy-duty appliances (e.g., broilers, wok ranges, salamanders) together in the middle of your appliance lineup. You might also consider placing the broiler under a separate dedicated exhaust hood with a higher exhaust rate and leaving the light-duty equipment under the original hood at a lower rate.

Learning more about kitchen ventilation
If you're getting ready to design a new kitchen or renovate an old one, check out "Improving Commercial Kitchen Ventilation System Performance," a two-part kitchen ventilation design guide written by the experts at PG&E's Food Service Technology Center. www.fishnick.com/ckv/designguide/

LESSONS LEARNED

The number one reason for local governments to invest in energy efficiency is to cut operating costs and free up tax dollars for other uses. Cities and counties that initiate programs reap significant savings that continue year after year, even after investment costs have been recouped. Optimized operation of building systems reduces maintenance and repairs, while prolonging the useful life of capital-intensive equipment.

Currently municipalities are faced with rising energy costs as well as greater demand for energy to power office equipment and other electronic or mechanical devices. Reducing energy use reduces operating costs and frees up much needed funding for other programs while obviating the need to build new power plants to meet increasing peak demand.

Quantitative financial benefits from energy efficiency projects:
- Lower utility bills by as much as 30 percent or more.
- Reduce peak energy use; lower utility rates for peak use.
- Increase net operating income.

Qualitative financial benefits from energy efficiency projects include:
- Increase asset value - for every $1 invested, asset value increases by $3.
- Reduce maintenance and repairs of equipment.
- Prolong the useful life of capital-intensive equipment.
- Boost worker productivity and reduce absenteeism due to health issues.
- Retain existing tenants and attract prospective ones.
- Reduce risk liability associated with indoor air quality.
- Demonstrate the ability of facility staff to contribute to bottom-line performance.
- Report energy use efficiency and water use efficiency to constituents and other stakeholders.

Corollary benefits from energy efficiency-projects include:

- Reduce 6 lbs. of greenhouse gas emissions for every 10 kilowatt hours saved.
- Improve comfort of building occupants; eliminate drafts and temperature fluctuations.
- Increase attractiveness of interior design.
- Minimize visual and audio distractions.
- Improve visual acuity through lighting retrofits.

- Improve reliability of energy for the local community.
- Conserve limited water resources, minimize wastewater, and reduce stormwater runoff.
- Comply with government environmental, health, and safety regulations.
- Garner positive media and public recognition for environmental stewardship.

Local governments across the country are investing in energy efficiency to help minimize the impact of volatility in U.S. energy markets. Energy management systems and energy projects provide civic leaders with powerful tools to take control of energy reliability for their constituents. Reducing operational costs allows municipalities to put financial assets in the places where they are needed most. A host of incentive programs and service providers support these efforts, available to those willing to explore their energy options. The time is now. Flex Your Power.

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