School Operations and Maintenance: BEST PRACTICES FOR CONTROLLING ENERGY COSTS

A Guidebook for K-12 School System Business Officers and Facilities Managers

August 2004

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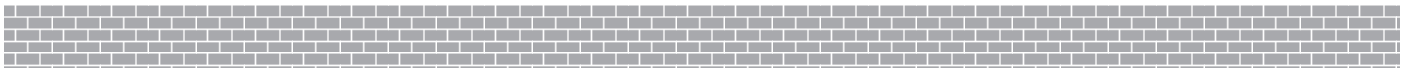

School Operations and Maintenance: Best Practices for Controlling Energy Costs

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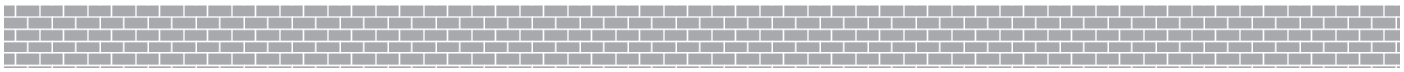

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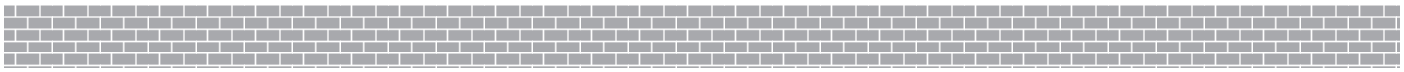

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EXECUTIVE SUMMARY

Overview

Operations and maintenance (O&M) offers not only strategies for maintaining facilities, but also opportunities for reducing energy costs and increasing energy efficiency at existing schools, regardless of age. This Guidebook provides detailed and practical guidance on how K-12 school districts can plan and implement enhancements to their current O&M programs that can successfully maintain their facilities while also reducing energy costs up to 20%. Most of the energy management strategies detailed in the Guidebook entail limited capital costs and produce rapid paybacks, in most cases, of less than two years.

This Guidebook is intended for school district facilities management staff and school business staff (including Superintendents and School Board Members) who have the authority to implement such a program. School-based maintenance and custodial managers may also use this resource to help them identify and understand program details and to see the contribution they can make to the new O&M effort.

The Guidebook is designed to meet the specific needs of school district staff for integrating energy efficiency into school building operation and maintenance by providing not only technical information, but also organizational information on barriers, challenges, and the necessary steps required to develop this type of energy management program within the school district organizational structure. In addition, it contains case studies that are essential to providing experience-based observations and "real life" approaches to which school district staff can relate.

This Guidebook identifies common strategies that have proven successful in a wide variety of American school districts, providing an overview of the broader issues raised in published O&M "literature," as well as in the real-life school-based professional experiences of its authors and contributors. It offers a clear understanding of the various staffing, program design, and other options available to school administrators as they plan and implement the details of their district's O&M effort. With a more complete knowledge of all the options and alternatives, school administrators will be better able to design and implement an energy management effort that is appropriate to, and successful in, their own district.

Major Conclusions and Recommendations

1) High energy costs are not "fixed" and can be reduced by 5% to 20% by effectively managing, maintaining, and operating school physical plants, regardless of school age.
2) School organizations can readily utilize techniques to systematically assess O&M practices in their physical plant as well as the magnitude of potential energy-saving opportunities resulting from changed O&M practices.
3) Substantial energy savings can be achieved from improved O&M practices without significant capital investments.
4) The biggest challenges to obtaining school district cost savings are not technical. Active and continuing support by senior administrators, as well as staff training and motivation, is critical to the success of energy-efficient O&M management efforts.

5) A significant number of American school districts, large and small, have had success in achieving energy cost savings by means of improved O&M.
6) A number of external sources of support are often available to assist schools in enhanced O&M efforts.
7) Energy-efficient O&M programs must be carefully planned and must be appropriate to the size, resources, and "culture" of each school district in order to be successful.

Energy Costs, O&M and Budget Priorities

Each year, school districts are faced with tough decisions on how and where to cut costs to meet tight budgets. Increasing costs of energy and replacement of equipment continually generate problems for school districts budgets. Nationwide, schools spend $8 billion per year on energy. Although this may seem like a staggering amount, energy costs represent only 2 to 4% of school districts budgets. Therefore, school administration officials may be tempted to pay little attention to managing or monitoring energy costs at the facility level.

However, as a percentage of manageable costs, energy costs are more prominent. By implementing energy-efficient operations and maintenance strategies, school districts can generate substantial energy cost savings, extend the life of equipment, and improve the overall physical environment in their school facilities. These strategies range from simple no-cost measures to others that are more complicated and expensive, and some of these strategies can generate savings that are realized immediately.

An energy-efficient O&M program, conducted in a cost-effective manner, can save your district up to 20% on energy bills. However, cost and energy savings will vary depending on initial starting points for your facilities and O&M program. The money your school district saves on energy expenditures can be allocated towards your primary mission: enhancing education.

Understanding Program Issues and Pitfalls

To successfully implement an energy-efficient O&M strategy requires time, patient advocacy, and overcoming significant organizational challenges. Your school district staff, at both the school board and facility level, must be committed to the new O&M effort. This commitment is crucial to the success of your program.

The early stages are the most important to developing and implementing an energy-efficient O&M program. During the initial program planning, successful school districts have often worked towards attaining a reasonable level of fluency with the technical and organization issues associated with O&M enhancements. They focused on understanding concepts and vocabulary in order to communicate effectively with all staff levels. You should not attempt to be an expert in all areas during these early stages.

There are extensive sources of assistance that can provide essential support to the development of your energy-efficient O&M program. Local electric and gas utilities are likely the most important potential partner and source of assistance to your school district. In addition, other school districts and local non-profit organizations can provide free support to your new O&M effort. Performance contractors and energy consultants are also available through various contractual arrangements.

O&M program managers will likely face numerous challenges and obstacles when starting and operating an energy-efficient O&M program. Administrators and staff may be unaware of O&M energy savings opportunities, and decision-makers may be unaware of the long term cost consequences of inadequate O&M funding. In addition, districts may lack clearly defined energy objectives, crucial information may not be available to facility and staff, and there may possibly be an under-investment in building staff training and motivational incentives.

Once you are comfortable with the broad O&M issues, you can begin to assess your own district. Proceed by collecting key information about your facilities and organization. We recommend a series of information-gathering sessions with the district faculty department staff and O&M facility staff members from specific schools. It is also a good idea to conduct one or two simple "walkthrough surveys" to produce highlights of how typical buildings are being operated and maintained with respect to energy use.

Planning and Implementing an O&M Program That Fits Your District

Support from school system leaders is essential for a successful energy-efficient O&M program. In most districts, the place to start is with the Superintendent. The failure to obtain early support from the Superintendent has doomed prospects for changes in school O&M practices in several such attempts around the country. It is also crucial that all levels of your district staff play an active role in your new energy-efficient O&M program. Some districts have formed small, strong, and persuasive district-wide energy management committees consisting of custodial, maintenance, administrative, faculty, and other staff members. These committees seem to work best if the members are appointed by, and responsible to, the Superintendent.

The next important step in the planning and implementation process is to conduct an availability assessment of district staff and financial resources necessary to support a new internal program. If the decision to move forward with the development and implementation of a new program has been made, you should determine what type of energy-efficient O&M program fits the needs of your district. There are a variety of energy-efficient O&M program options available, including: 1) Energy Tracking and Accounting, 2) Voluntary Energy Awareness, 3) Performance Contract, and 4) Quick and Low-Cost Strategies. In the past, successful districts have often found it extremely beneficial to investigate all of these program options until finding one (or a combination of programs) that was tailored to the culture and resources of their school district. Keep in mind that what was successful for one school district may not be successful for your district.

Once a new energy-efficient O&M program is authorized, some of the key activities for the energy management committee or the designated management entity include the following:

- define a district-wide energy policy,
- develop a program staff and budget, and
- recognize and monitor staff members.

Finally, your district should be cognizant of these six critical factors when implementing your new energy-efficient O&M program:

1) The O&M program and program managers must be visible to Superintendent, School Boards, and other staff, program objectives and progress should be reported periodically,
2) Energy savings are not immediate, but develop over time,
3) Distribution of school-specific information to building staff is essential,
4) Problems must be recognized and "tweaks" made to ensure success of your program,
5) External support is vital,
6) Detailed energy policy should provide guidelines for O&M program and define broad cost and performance objectives.

Technical Opportunities for Energy Efficiency Improvement

Energy-saving opportunities can be found throughout your school district. Successful districts have frequently found significant savings by improving the control and scheduling of building operation and equipment. Energy saving strategies can be categorized as:

1) Limiting equipment operation exclusively to occupied hours and to building areas actually requiring energy services.

2) Ensuring that there are adequate provisions and scheduling for weekend and vacation shutdown procedures.

3) Performing low-cost repairs or improvements, such as steam pipe insulation or exterior weatherstripping, in-house.

4) Following required scheduling and maintenance procedures for equipment.

5) Periodically tuning-up, calibrating, and ensuring proper operation of school facility equipment.

Because of varying building ages, staff expertise and equipment inventories, an assessment of operation and maintenance practices is essential to identifying energy savings opportunities at individual schools. On average, lighting, space conditioning, heating, and cooling account for the majority of school energy end-use, and they also typically represent the largest cost saving opportunities for your school district. However, energy end-use statistics are heavily dependent on your climate region. For example, in hot humid climates like Florida, cooling accounts for as much as 41% of total energy consumption, whereas many northern schools have minimal air conditioning expenditures.

Schools with successful energy-conserving O&M efforts have found numerous low-cost and rapid payback strategies in building systems including:

- lighting,
- computers and office equipment,
- building envelope,
- heating, ventilation, and air conditioning,
- water heating,
- kitchen equipment and procedures,
- swimming pools,

- vending machines,
- portable classrooms.

Real World Experiences

To provide helpful "real world" examples, the Guidebook presents detailed case studies from diverse school districts in California, Florida, Maryland, Michigan, New York, and Washington. Some of the case studies focus primarily on the organizational issues associated with how school districts have gone through the process of developing, adopting, and implementing O&M energy management policies and programs. They reveal what district employees working in energy management have learned from their experiences. Other case studies are more technical, providing a more detailed review of specific operations and maintenance best practices in schools. These case studies also demonstrate the cost-effectiveness and potential energy savings of energy-efficient O&M activities.

References and Resources

Various types of informational resources are available to your facilities O&M staff and school business officials, including operations and maintenance guides, energy management guides, technology-specific information, and training resources. Many of these resources are available via the Internet.

CHAPTER 1. INTRODUCTION

The purpose of this Guidebook is to provide you with technical and organizational information on the opportunities, challenges, and steps related to integrating energy management with your operation and maintenance practices. The guidebook is designed to help you tailor such an integrated program to your school district organizational structure. Although published resources on O&M for energy management and preventive maintenance do exist, none currently address the needs of school facility managers and maintenance personnel for integrating energy efficiency improvement in school energy operations and maintenance. In addition, existing documents are typically targeted at large commercial/industrial facilities addressing issues in a business-related organizational structure.

Even though they are not specifically targeted to address the needs of school facility managers and maintenance personnel, there are several good sources of information in various aspects of energy management available, including:

- Avista Services, Resource Wise, *A Manual for Managing School District Resources*,
- Association of School Business Officials International, *School District Energy Manual*,
- U.S. Department of Energy, Federal Energy Management Program, *Operations and Maintenance Best Practices - A Guide to Achieving Operational Efficiency*.

A more detailed list of resources is available in Chapter 7.

This Guidebook aims to increase the awareness of the potential for energy savings through O&M procedures and approaches, and to improve the understanding of specific energy-savings actions. It also focuses on motivating school systems to perform energy-efficient operations and maintenance practices, and provides guidance on how to implement procedures and motivate school personnel to act. In addition, this Guidebook provides information on national programs and resources to assist schools in this area. This publication enables school district maintenance personnel across the country to apply and tailor the guidance approaches contained in the document to address their specific needs.

1.1 Target Audience

This publication targets senior facilities staff at the school district level, school business officials, those who have the authority to implement a program, and school-based operations and maintenance staff.

1.2 Organization of Document

This Guidebook is organized into seven chapters and 3 appendices. This chapter provides an introduction and an overview of the publication.

Chapter 2 discusses energy expenditures for school district budgets. It examines energy use in schools as it relates to educational objectives. Chapter 2 also defines operations and maintenance, and discusses the need for energy management O&M programs.

Chapter 3 focuses on assisting you with achieving a working knowledge of both the broad issues associated with O&M programs, and the current state of building operations and maintenance in school districts. This chapter informs you about O&M program issues, and identifies sources of outside assistance. It also provides an understanding of the broad technical opportunities and the likely pitfalls to revitalizing O&M programs. Chapter 3 also reviews the initial assessment process for identifying school district opportunities, including determining what information is available, where an O&M program is appropriate, what facility management systems are in place, the potential for outside assistance, benchmarking, and potential barriers.

Chapter 4 addresses your district as a unique organization and how to involve senior administrators and motivate staff at all other levels to implement a district-wide O&M program. The main purpose of this chapter is to provide a clearer understanding of the various staffing, program design, and other options available to school administrators as they plan and implement the details of their O&M effort. It focuses on initiating a collaborative working process to include the necessary school district staff in planning and implementing an O&M effort.

Chapter 5 provides energy end-use profiles for school facilities. These profiles are based on regional data and are divided into 5 climate zones. Energy end-use profiles are important in determining where the largest opportunities exist for cost savings. In addition, Chapter 5 illustrates the technical opportunities for energy efficiency improvement that may be available at the school facilities in your district. This chapter also lists examples of energy- and cost-saving O&M strategies for various technologies including:

- lighting,
- computers and office equipment,
- building envelope,
- heating, ventilation, and air conditioning (HVAC),
- water heating,
- kitchen equipment,
- swimming pools,
- vending machines,
- portable classrooms, and
- other special equipment.

Chapter 6 contains case studies and other experience-based observations and successful "real-world" approaches that in-school staff can relate to. There are two types of case studies included in the document: organizational and technical. Organizational best practice case studies demonstrate how school districts have gone through the process of adopting, developing and implementing O&M energy management policies and programs. Technical best practice case studies review the operation and maintenance best practices that should be conducted in school and discusses them both strategically and in terms of tasks and activities (elements of an energy management program).

Chapter 7 contains bibliographical information for several operations and maintenance guides and resources, energy management guides, technology specific resources, and training resources available to O&M staff and school business officials. Chapter 7 also includes a list of useful organizations and programs with

their Internet addresses. A brief description is provided for each resource, except the list of Internet sites.

Three appendices accompany the chapters of this Guidebook. Appendix A furthers the discussion of identifying sources of outside assistance from Chapter 3.2.2. The outside sources illustrated in Appendix A are government agencies, consultants, local and non-profit organizations, and energy service companies. Appendix B reviews O&M program manager qualifications and provides a detailed list of performance responsibilities. Appendix C illustrates examples of school energy policy statements and implementation plans.

1.3 Input from Reviewers

Reviewers for the Best Practices Guidebook were identified based on their reputation and experience and on the recommendations of respected members of school business, facilities, and energy fields, including organizations contributing to the development of this manual, such as Association of School Business Officials (ASBO) and Association of Higher Education Facilities Officers (APPA). Each potential reviewer was contacted with a request for their participation in reviewing different stages of the manual development. Additional recommendations were supplied by some of the first round of potential reviewers. Reviewers were asked to recommend case studies that they felt complemented the guidebook discussion. Some recommended their own school district programs or others they had been involved with, while others recommended the school district programs of their colleagues. Some of these potential case study contacts subsequently referred what they thought was an even better program. Other case studies were identified through Internet-based research of government programs and press releases.

CHAPTER 2. ENERGY COSTS, O&M AND BUDGET PRIORITIES

Overview:

- Energy costs are a major component of the school budget.
- Nationwide, schools spend $8 billion per year on energy.
- Energy use in school facilities relates to educational objectives.
- Good O&M practices increase energy efficiency.
- Energy efficiency O&M programs can save up to 20% on energy bills without a major initial investment.
- Energy savings opportunities range from simple no-cost to more complicated and expensive strategies.

2.1 Energy Costs are a Major Component of the School Facility Budget

Energy expenditures pose an annual problem for school district budgets. In recent years, districts have been increasingly hit with budget cuts that leave school boards with the tough decision of how and where to decrease district expenditures. At the same time, rising energy costs soak up dollars that could be better used in the classroom. The result is often the cutting of special programs, supplies, and staffing. No matter where the cuts are made, the students are affected.

Energy expenditures, unlike jobs and supplies, cannot simply be cut by decree. *Nationwide, schools spend $8 billion per year on energy, second only to spending on books and computers.* The National Center for Education Statistics[1] reports that while the rate of inflation only rose 3.4 percent, per pupil energy expenditures rose 22 percent from 2000 to 2001. Had energy expenditures risen only at the rate of inflation, an additional $1 billion would have been available for school districts. Rapid increases in energy prices make it difficult for school districts to anticipate how much they will spend on energy when determining the following year's budget. No matter what the energy bill, funds spent of energy are funds that can't go to teachers, supplies, building repairs, or other programs that enhance education.

School district business administrators and school boards are probably aware that a typical school district pays approximately $1.00 per square foot annually for energy costs. This means that even a mid-sized school district may pay more than a million dollars a year for electricity and heating fuel. The good news is that, unlike the costs of staff contracts and debt service, school district energy costs can be actively managed and minimized. Active management of energy costs is possible for both new and older existing school facilities.

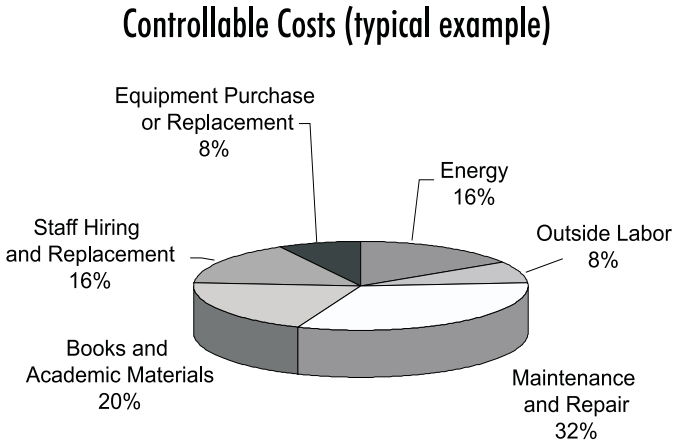
Even though annual energy costs can reach $250 per student, this typically only represents 1 to 2% of school district budgets.[2] As a result, school administrators frequently pay little attention to managing or even monitoring these costs at the facility level. The top priority is usually to pay the utility bills as they come in, without review.

"Operations and maintenance will account for about 6% of the cost of a building over its life span. Salaries will account for 92%. When you think about how comfort affects productivity, it is pretty clear that attention to O&M is a good investment."

-Don Lavada, New York State Energy Research and Development Authority

Despite this relatively low percentage of overall district budgets, energy costs actually represent a much higher proportion of district variable or "manageable" costs and expenses that are not mandated by contractual and other legal obligations. For example, school administrators have little or no near-term flexibility to reduce staff salaries or benefits embedded in long-term labor agreements. Nor can they readily reduce other "fixed" costs, which can represent up to 85% of annual district budgets.[3] In contrast, energy costs represent, on average, 16% of district "controllable" costs. As a result, in this era of tight budgeting, energy cost management has the potential of becoming a major source of avoidable district expenditures. Energy-efficient operation and maintenance (O&M) is a critical element in working toward this objective.

There are two ways to manage energy costs: 1) "cost-based" or "budget-based" management, where you obtain lower rates, reduce budgets, etc.; and 2) "usage-based" management, where you manage actual consumption by improving efficiency or improving control.



Unfortunately, many school districts have been decreasing, not enhancing, school maintenance efforts. O&M budgets have been a major victim of state and local budget cuts. O&M spending per student is at its lowest level in 30 years, inevitably resulting in more poorly maintained and operated facilities.[4] Clearly, deferred repairs can have an impact on the condition of school buildings and the learning environment. However, one of the less visible products of this trend is a deterioration in the energy performance of school buildings with a resulting increase in energy operating costs. Identifying these hidden costs is key to effectively implementing improved O&M.

In the eyes of many administrators, O&M cuts are "low-cost" or "no-cost" strategies to survive in a tough fiscal environment.

To counter this short-term, "penny-wise, pound-foolish" perception, it is essential to show the tangible benefits of maintaining good O&M practices in contrast to the actual costs of O&M spending reductions. Besides wasting energy, diminished attention to O&M has other important consequences as well, affecting not only equipment longevity but also the comfort and healthfulness of the learning environment.

The Impact of O&M

Here are some examples of O&M impacts on boilers, cooling towers, and other critical building systems:

- Cleaning Centrifugal Chiller Water Tubes: This is necessary to prevent scale build-up on the inside of the tube. If it is not done periodically, the build-up will lessen the chiller system's efficiency.
- Cleaning Air Conditioning Evaporator and Condenser Coil Fins: They can get clogged and lose efficiency due to reduced heat exchange.
- Operation of Air Conditioning and Heating Controls: If a relay goes bad and a system continually operates 24/7, the next electric bill could be $1,200-$2,000 higher.

Throughout this guidebook, as the authors discuss methods for energy savings and energy efficiency improvement, bear in mind that the focus is on avoided costs, the real reduction in dollars that come from an O&M activity. These include lower utility bills as well as lower costs for equipment repair and replacement over the long term.

School districts will have to make a modest initial investment in order to establish and implement an effective energy operations and maintenance program that will reduce operations and maintenance costs. However, this additional effort and budget will quickly achieve savings that will far outweigh the initial, or up-front costs.

2.2 Energy Use in School Facilities Relates to Educational Objectives

The physical environment provided by school facilities plays an important role in achieving the overall educational objectives of the school. A growing body of research shows that indoor air quality, ventilation, and thermal comfort, lighting, acoustics, and building age, quality, and aesthetics are all linked to educational achievement and student performance. As schools age, they often require more repairs and additional maintenance efforts. Approximately 50% of public schools in the United States are planning at least one major repair, renovation, or replacement of a building feature within the next 2 years. While tending to these facility-related problems, schools may experience lost instructional time or reduced attention to educational aspects.

"Every dollar spent on maintenance and repair will save districts six to ten times that amount in the long run"
-Claire Barnett, Director of the Healthy Schools Network

"Good school buildings contribute to good education just as bad school buildings interfere with it. Studies demonstrate the relationship between school infrastructure and student achievement, but this relationship is not straightforward, and a myriad of other variables go into making good schools. In other words, school infrastructure contributes to but does not decide the quality of a school. As such, infrastructure is not distinct from other issues of school reform or educational excellence; rather, school infrastructure decisions are a central component of whole-school reform."

Source: Planning Guide for Maintaining School Facilities, National Forum on Education Statistics and Association of School Business Officials International, p.14, February 2003.

"We all know that clean, quiet, safe, comfortable and healthy environments are an important component of successful teaching and learning."

"School facilities affect learning. Spatial configurations, noise, heat, cold, light, and air quality obviously bear on students' and teachers' ability to perform. Empirical studies will continue, focusing on fine-tuning the acceptable ranges of these variables for optimal academic outcomes. But we already know what is needed: clean air, good light, and a quiet, comfortable, and safe learning environment. This can be and generally has been achieved within the limits of existing knowledge, technology, and materials. It simply requires adequate funding and competent design, construction, and maintenance."

Source: Mark Schneider, Do School Facilities Affect Academic Outcomes? National Clearinghouse for Educational Facilities, Nov 2002. www.edfacilities.org/pubs/outcomes.pdf

Several studies and surveys show that school facilities have a direct affect on teaching and learning. Poor school conditions make it more difficult for teachers to deliver an adequate education to their students. Physical conditions also have direct positive and negative effects on teacher moral as well as effectiveness in the classroom. In addition, poor school conditions can adversely affect the health of teachers and students, and increase the likelihood that teachers will leave their school and the teaching profession.

A National Center for Education Statistics (NCES) survey of teachers found that significant numbers—20% in Chicago and 40% in Washington, DC—felt that their school facilities were unsuitable for effective teaching and learning. The most serious complaint, by 2/3 of the Washington teachers and half the Chicago teachers, was poor indoor air quality. In addition, 1/3 of the teachers complained of uncomfortable temperatures. Other complaints related to O&M included inadequate lighting and dirty or inoperable windows.

For more information on this survey, visit *www.edfacilities.org/pubs/teachersurvey.pdf*

A U.S. General Accounting Office (GAO) survey found that one in five schools has problems with indoor air quality. HVAC systems were listed as "less-than-adequate" in 36% of the schools. This survey reported that the major building-related problems were inadequate outdoor air ventilation and water damage leading to mold. The root cause of many of these problems in the schools was inadequate and/or deferred maintenance of school buildings and HVAC systems.

Evidence continues to grow supporting the idea that there is a correlation between the physical condition of a school building and student academic performance. It is simple, really, if students are more comfortable in the classroom, they are more likely to perform at a higher level. An effective O&M program can drastically increase student and teacher comfort and performance.

2.3 Good O&M Practices Increase Energy Efficiency

2.3.1 What is Operations and Maintenance (O&M)?

Operations and maintenance are the activities related to the performance of routine, preventative, predictive, scheduled, and unscheduled actions aimed at

An Energy Showcase of the Wrong Kind

In the 1980s a progressive suburban school district built one of its new elementary schools as an "Energy Showcase," with a myriad of energy-efficient features, including automatic lighting controls, an energy management system, multiple HVAC zones, variable-speed pumps, and an air-to-air heat exchanger. After only a few years, most of this equipment was no longer operable, with controls bypassed.

- The problem: Poor maintenance. The current building services manager wanted to do his job, but he had been given no training, no manuals, no spare parts, and no budget.
- The result: Instead of being an "Energy Showcase," the school was actually using more energy than the average elementary school in the district.

preventing equipment failure or decline with the goal of increasing efficiency, reliability, and safety. A preventive maintenance program refers to the organized and planned performance of routine maintenance activities in order to prevent system or production problems or failures from occurring. This is in direct contrast to deferred maintenance or reactive maintenance (diagnostic or corrective maintenance), which is conducted to correct an existing problem.

According to a Minnesota Office of Legislative Auditor report, the average deferred maintenance costs for Minnesota were $3.5 million per school district for the 1998–1999 school year. Thirteen districts reported $10 million or more in deferred maintenance.

In addition to cost, there are additional impacts of poorly maintained facilities, including student and teacher performance, health, and morale. The National Center for Education Statistics reports the cumulative effect of deferred maintenance to be approximately $113 billion nationwide for all K–12 public schools.

For more information, see the Digest of Education Statistics 2000 at *http://www.nces.ed.gov/*, or the National Center for Education Statistics website at *http://www.nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001034*.

On the other hand, a well-designed O&M program can generate substantial energy savings for your district, in both new and older buildings, without significant investment. A good O&M program is proactive in its responses and corrects situations before they become problems.

"Frequently, districts that are scrambling to find cuts rob facilities budgets to avoid cuts on the curriculum side, for example. If there is no way to document and maintain efficiency savings over time, there is no way to distinguish between a cut and an efficiency gain. Facilities will have little incentive to strive for efficiency if they cannot get recognition for their efficiency gains and/or if they believe their reductions are true cuts; not a "harvest" of efficiency."

-- David Furr, Salem-Keizer School District, Oregon

"Preventive maintenance really contributes to our ability to control energy consumption. We required it in our performance contract and it has really been worth it."

-Barry Picklesimer, Harford County Schools, MD

Over its lifetime, school facility operating costs will eventually exceed the cost of new construction.

As detailed later in this document, energy efficient operations and maintenance efforts are generally low in cost and can yield rapid returns with significant annual energy savings, perhaps 10% or more, which can be redirected toward other school district objectives. As reported in the Federal Energy Management Program (FEMP) *Operations and Maintenance Best Practices Guide*, "It has been estimated that O&M programs targeting energy efficiency can save 5% to 20% on energy bills without a significant capital investment." Other studies report savings in this same range.

These kinds of generalizations can be misleading. Energy savings must be referenced to a starting point or baseline level that includes many operating factors, such as weather, building occupancy, hours of use, and additions or replacement of equipment. Obviously, how much you can save also depends on the baseline condition and operating practices of the building. A school district that has been paying attention to energy efficiency opportunities over time will already have earned much savings and therefore will not see the level of additional savings that a district that has avoided making improvements for years would see.

The electricity and natural gas rate structure poses another problem in projecting energy cost savings. For a flat rate billing structure, an average electricity price is satisfactory, but otherwise the dollar savings will depend on when the energy savings occur. For example, an occupancy sensor that shuts off the lights in an unoccupied room is saving more expensive electricity at midday than at night, so it must be evaluated accordingly.

2.3.2 The Need for Energy Management O&M Programs

"It is really important to be clear with management. We have abandoned the word "savings" in our discussions and use instead "cost avoidance."
-Al Eilbacher, Carroll County Schools, MD

Research studies estimate that nearly one third of the energy consumed in the U.S. school is wasted.[5] The most energy-inefficient schools use almost four times as much energy per square foot as the most energy-efficient schools.[6] If schools can reduce the amount of wasted energy dollars, they can redirect that money toward their primary mission: education.

In 2001, 61 percent of public school districts reported a shortfall in energy funding—**with 83 percent of those schools attributing that shortfall to increases in the cost per unit of energy, *not* increasing demand.**[7] The following were responses to the shortfalls:

- 75% reallocated funds from other programs;
- 53% tapped unappropriated surpluses;
- 46% used a large proportion of the nonpersonnel budget;
- 8% rolled the shortfall over to the next fiscal year;
- 7% used short-term loans to finance the shortfall; and
- 6% closed schools or sent students home early on at least 1 day to reduce energy expenditures.

Much of the current effort of government programs to improve energy efficiency in schools has been on the design of new school facilities. The U.S. Department of Energy estimates that high-performance schools can save some 40 to 50% percent of their energy budgets through better design and use of energy-efficient and renewable energy technologies. But these new buildings represent only a few hundred buildings a year, a small fraction of district square footage and energy

consumption, so most school administrators hoping to achieve significant energy cost savings will need to target the energy performance of existing facilities. In addition, even the most efficient of new schools must be operated and maintained properly in order to avoid wasting energy and accruing unnecessary costs.

2.4 The Approach to Energy Savings Opportunities

Energy savings opportunities throughout your district can range from simple, no-cost strategies such as shutting off lights in unoccupied rooms, to more complicated and more expensive strategies such as installing automatic lighting controls or retrofitting lights, windows, or HVAC equipment. In order to be successful, your district must make the commitment to save money and energy. A building performance assessment and establishing goals were often the first steps taken by successful schools towards implementing an energy-efficient O&M program. Action plans were then developed and implemented based on the building performance assessment and school district goals.

For more information on energy management, visit the websites at:

- Energy Star for Schools K–12 Program
  http://www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12

- U.S. Department of Energy, Rebuild America, EnergySmart Schools
  http://www.rebuild.org/

- The Alliance to Save Energy
  http://www.ase.org

Setting Priorities Based on Cost Effectiveness

The next few chapters outline an approach to developing and implementing an energy efficient O&M program for your district. These chapters review the broad issues associated with O&M programs, and the current state of building operations and maintenance in school districts. They also examine various staffing, program design, and other options available to school administrators while developing the details of their O&M effort. Energy cost-saving strategies with relatively short payback periods, generally less than two years, are the main emphasis of the technical opportunities chapter.

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[1] National Center for Education Statistics, "Effects of Energy Needs and Expenditures on U.S. Public Schools". www.nces.ed.gov, Accessed October 2003.

[2] Joe Agron, *Absence of Resources*, American School & University, April 2003, p.29.

[3] Cost breakdowns are only initial estimates and need to be confirmed.

[4] Joe Agron, *Absence of Resources*, American School & University, April 2003

[5] Department of Energy, www.doe.gov, accessed October 2003

[6] Ibid

[7] Ibid

CHAPTER 3. INVESTIGATING O&M FOR YOUR DISTRICT: UNDERSTANDING PROGRAM ISSUES AND PITFALLS

Overview:

- Initial program planning is a must for a successful O&M program.
- You must assess the conditions in your school district:
  - determine your district's energy costs and compare them to other school districts;
  - determine what information and management tools are available to manage your energy costs.
- O&M program managers should utilize sources of outside assistance, such as your local utilities, to provide assistance in reducing your energy costs.
- O&M program managers must prepare for challenges and obstacles to starting and operating an energy-efficient O&M program.

3.1 Overview/Summary:

Chapter 2 provided a concise overview of energy costs and O&M budget priorities. Chapters 3 and 4 will be about your district as an organization and "HOW" to inform and motivate staff at all levels to actually implement a district wide O&M program that can achieve sizable energy efficiency improvements and operating cost savings.

The objective of this Chapter is to provide initial guidance on investigating and, if appropriate, pursuing this effort. It will also assist you and your district organization in successfully navigating from where you are now to a future where your physical plant is operated and maintained in a manner that is both more systematic and less expensive over the lifetime of your facilities. The Chapter reviews the experiences of a wide variety of American school districts in establishing such O&M programs. This information is presented to help you make an initial assessment of O&M opportunities in your own district, anticipate the likely problems and pitfalls you may encounter, and ultimately come to preliminary conclusions that can be the basis of discussions with a wider audience of district staff.

It must be emphasized that, although a small but growing number of school districts are successfully adopting this type of O&M strategy, success requires time, patient advocacy, and usually, significant organizational challenges. **Energy savings of up to 15% are achievable but will not be realized until the new O&M effort is actively supported by crucial staff at both the School Board and facility level.** Six months or more may be required before a new O&M program is fully implemented. Facility assessments will be required, staff must be trained, and new district policies and objectives must be defined and promoted to internal staff.

The early months of this process are the most important. This is the time when you can begin to assess the actual opportunities and pitfalls in your own district and become the "early advocate" for a new approach to O&M. It is the time for you to

Key Questions to Be Addressed in This Chapter

- What are my district's energy costs and how do they compare to other school systems?
- What information and management tools are available to manage district energy costs?
- Are there significant O&M opportunities in my district?
- What are the likely organizational challenges to improving district O&M?
- Are there sources of external assistance?

assess the interest of senior administrators and other staff critical in taking the next steps. This early momentum is critical; once other administrators, staff and other stakeholders become involved, the process becomes a team effort that will draw on a broad range of resources that have already been developed by others in pursuit of the same objectives. The closer you get to actual program implementation, the broader the array of support available. For this reason, we will focus on developing early momentum.

3.2 Overview of The Five-Phase Development Process

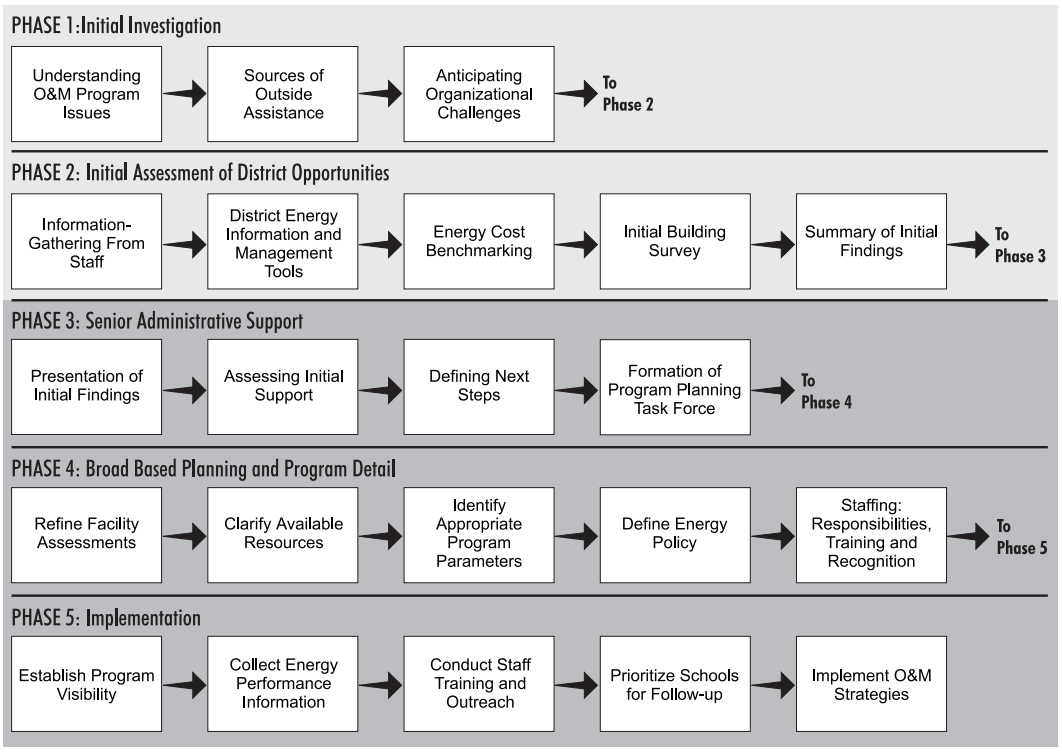
The graphic below illustrates a five-phase investigative and implementation process. The first two, described in this chapter, are primarily focused on helping the reader gain a working knowledge of both the broad issues associated with O&M programs, and the current state of building operation and maintenance in his or her district. The final three phases, which are addressed in Chapter 4, instruct the reader on how to: present initial assessments to a broader audience of senior staff; develop specific implementation strategies; and illustrate the successful implementation of an energy-efficient O&M program.

3.3 Initial Investigation Phase

3.3.1 Educate Yourself—O&M Program Issues

It can't be overemphasized, no individual alone can accumulate all the information and complete all the tasks required to design and implement a successful school O&M program. Even for the smallest districts, this type of program is inescapably a team effort requiring the active involvement of senior administrators, principals and custodial and maintenance staff.

The reader's first task is to achieve a reasonable level of fluency with the technical and organizational issues associated with school O&M enhancements. A solid



grasp of vocabulary and general technical concepts will be essential in persuading high and low level staff of the benefits of improved O&M. A note of caution as you investigate: **Don't make the mistake of aspiring to be the expert in all realms**—focus on understanding concepts and vocabulary so you can effectively communicate with all staff levels. In all likelihood, your greatest value is that of a generalist who understands the overall school district organization and is able to speak effectively with a variety of staff audiences.

Understanding O&M Issues

- Identifying sources of outside assistance
- Understanding the broad technical opportunities
- Understanding likely pitfalls to revitalized O&M programs

3.3.2 Identifying Outside Assistance

Other than closely reading this Guide, step number one is: Start finding some help! Particularly in tight fiscal times, it is the uncommon school district that has the staff, expertise and resources to plan and implement an O&M effort entirely on its own. In most cases, even if energy bills are becoming a growing problem inertia is too great, staffs are too busy with other priorities and technical expertise seems too limited. Tackling an entirely new "noneducational" program seems out of the question.

Extensive outside assistance and support is often available, frequently at no or low cost. Don't be intimidated: finding and securing that help may require some persistent effort (and maybe arm-twisting), but the benefit to your school operations will outweigh the time invested. Obtaining outside help has been a critical factor in the success of the majority of successful school O&M programs. The table below briefly summarizes possible sources of assistance external to your district as well as likely costs and the types of support that may be available. The text that follows will highlight a sampling of the types of assistance that may be available to you. Further detail is provided in Appendix A.

1) Electric and Gas Utilities:

Your local utilities are probably the most important potential partner and source of assistance to local school districts. Frequently, utilities are able to provide very substantial assistance to school districts seeking to reduce energy costs. School districts and municipalities are highly important and visible custom-

Outside Sources of Assistance

	Electric and Gas Utilities	Other School Districts	Consultants	Government Agencies	Local Community Non-Profit Educational Assistance	Energy Service Companies
Costs	Minimal or None	Minimal or None	Moderate to High	None	Minimal or None	None
Technical Assistance	Frequently	Frequently	Yes	Sometimes	Frequently	Yes
Grants or Rebates	Sometimes	No	No	Sometimes	Unlikely	No
Financing	Unlikely	No	No	Sometimes	Possibly	Yes
Training	Frequently	Frequently	Yes	Sometimes	Frequently	Yes
Staffing Provided	Occasionally	No	Yes	No	No	Frequently

ers to regulated utilities. For a variety of reasons, utilities are often eager to provide assistance and to form "public partnerships" with large public sector customers such as schools. Although this interest varies widely by state, we cannot overemphasize: **Districts should thoroughly investigate the availability of assistance from your gas and electric utilities**. Sometimes persistence is required but utilities are very reluctant to appear unsupportive of public schools, particularly efforts to reduce costs in tight fiscal times.

Across the U.S., utility assistance to school O&M efforts has taken a variety of forms and has included substantial financial, technical, and administrative support. A few examples of the most frequently available support will be described in detail in the subsequent text. See Appendix A for more detailed information on additional support options.

Detailed Energy Consumption and Load Data

In order to bill its customers, gas and electric utilities collect metered energy consumption data for each school. At a minimum, this information reflects the monthly kilowatt hours (electric) or thousand cubic feet (gas) consumed in the prior month. If requested, many utilities will provide this monthly data in electronic format. That will enable schools to utilize computer software to more easily track and analyze on-going energy consumption at all schools.[1]

Metering at large schools frequently includes hourly or even 15 minute "demand" or "interval" data. This information can be extremely useful in assessing building performance and energy consumption on a daily basis. Using this data, utilities will often assist in the analysis of school "load profiles." These profiles provide districts with the ability to identify large sources of off-hour energy consumption resulting from poorly controlled lighting, or HVAC, or underperforming energy management systems. This is a crucial opportunity to assess the efficacy of your building control systems and strategies and is much more difficult without utility data assistance.[2]

Utility Technical and Staff Assistance

Utilities are densely populated with engineering and trained technical staff. In many cases, school districts have been able to access this staff expertise to assist in improving energy performance of their schools. **In several states, utilities have technical staff whose full-time responsibility has been to assist school district O&M programs** within their utility service territory.[3] The role of these utility support staff is to provide the initial impetus and ongoing support for the many technical and organizational elements of new school O&M efforts. In other states, utilities have provided occasional but significant staff time to support specific project elements as requested by school districts. Among other projects, utility staff have played a key role in performing building audits, providing computer systems and energy data support, and providing school energy program printing and promotional assistance.

Staff Training Assistance

Utilities have frequently been helpful in establishing and staffing training programs for school facility personnel. This assistance has typically taken two forms; first, utility technical staffs have provided assistance in designing training curricula and actually presenting training material to school custodial and mainte-

nance staff. Secondly, a number of utilities have subsidized the tuition costs associated with outside technical training of school staff.

A prominent example of utility training assistance has been the Building Operators Certification program (BOC), a comprehensive building operations and maintenance training effort currently in place in 14 states. Utilities have played a major role in the funding and implementation of this effort and have often subsidized tuition costs for school personnel.[4]

2) Other School Districts

Don't reinvent the wheel!

Although energy cost management through improved O&M may be a novel concept in your district, it has been widely applied in a wide range of school settings in the U.S. Taking advantage of the experience gained in these districts will be of great benefit as you investigate and ultimately implement an energy-efficient O&M program in your own district.

Investigating and implementing a new program will require that a wide range of information and new materials be available and distributed in your district. Staff will require training curricula, district energy standards, maintenance checklists, and a wide range of other administrative materials. Fortunately, there is an abundance of this type of material readily available from other districts. See Chapter 7 for details.

As you move forward with O&M, contact with other local school districts can also be quite helpful. Nearby school districts may be close enough to actually collaborate on specific shared projects. For example, in Massachusetts senior O&M staff from three large urban districts meet regularly to enhance energy software skills and assist each other in building O&M assessments, and, in 2002, they co-developed an energy-training workshop for custodial staff.

"Network with other RCMs and each other as much as possible. Don't reinvent the wheel. Virtually every aspect of your job has been done before by other RCMs who are willing to help."
-David Furr, Salem Kerzer Public Schools

3) Consultants

When utility and other sources of low cost assistance are insufficient, some districts have chosen to utilize outside consultants or vendors in limited and strategic ways. Costs must be carefully managed but some districts have used this resource successfully to help "jump start" their new O&M efforts with targeted building audits and technical assessments. Note, however, that many energy consultants tend to focus primarily on capital-intensive equipment or system upgrades and may have minimal experience with a primarily low-cost O&M focus. When assessing the qualifications of a consultant, remember that practical experience with existing school building systems and O&M issues is probably more valuable that an engineering degree alone. The authors of this Guidebook have found that engineering "design" firms are often inexperienced in this regard.

"A few technical audits at the outset performed by outside firms were useful in convincing senior administrators of the attractiveness of expanded O&M in our district."
-Roger Young, Manchester Essex Regional School District

Assessment of building operations and estimation of potential savings is the most frequent role played by school O&M consultants. In addition, in some districts consultants have also played an important training role and have worked with custodial staff to design and deliver energy maintenance training customized to the specific needs of school staff. Consultants with more specific engineering expertise have also assisted schools in the "recommissioning" of major mechanical systems and the detailed analysis of utility and energy management system (EMS) data to detect abnormal energy consumption problems and detect equipment control malfunctions.

3.3.3 Understanding the Broad Technical Issues

Understanding O&M Technical Issues

- Don't try to become an expert
- Identify key technical resources
- In depth: Focus on a single building system

Unless you are associated with the district Facility Department, it is unlikely that you have extensive expertise with the more complex building systems such as boilers or unit ventilators. However, gaining a working understanding of the vocabulary and broad technical strategies underlying O&M is critical. An ability to discuss these issues is essential to being an effective advocate with both administrators and more technically inclined district staff.

At the risk of repeating ourselves endlessly, the technical issues involved in beginning an O&M effort are usually less challenging than the organizational pitfalls. For the less technically inclined, we do encourage a two-step strategy to achieve an initial fluency in core technical issues. First, in addition to closely reading Chapter 3 of this Guide, we encourage a review of one or two of the technical resources listed in Chapter 7. Many of these documents are available free or on-line. Of particular value are: *The School District Energy Manual, A Planning Guide for Operations and Maintenance, Portland Energy Conservation Incorporated O&M Assessment Guide, and the Federal Energy Management Program O&M Manual.*

In addition, it is often useful to focus in depth on a single particular energy savings strategy or individual building system, which may be of particular and timely interest to your district. An example of this would be a focus on building shut down procedures in anticipation of winter or summer vacation. Other examples might include classroom lighting controls and illumination levels, reducing off-hours energy consumption, boiler maintenance and combustion efficiency or building temperature control and setbacks.[5]

3.3.4 Initial Investigation Phase: Challenges to Starting and Operating a Program

Chapter 6 describes the experiences of six school districts, which have successfully implemented energy cost management O&M programs. A number of school facility professionals around the U.S. have had sustained success with comprehensive programs of this type.

Why, then, are these O&M strategies not more widespread? Although 400 districts may have had sustained success with revitalized O&M, this represents less than 3% of the 14,800 American public school systems The obvious question is this: "What prevents the other 97% of school districts from implementing O&M strategies which reduce facility operational costs? **If large savings are achievable from O&M, why aren't these strategies standard practice in all school districts?**

Unlike the purchase of a new boiler plant, implementing an improved O&M effort requires a shift in priorities and on-going and continuing leadership from senior district administrators. Perhaps more importantly, it requires improved technical skills and heightened attention to building performance on the part of custodial and maintenance staff at all district facilities. In a sense, success in this type of program requires a "cultural shift" is many districts in which communication, cooperation and consensus building between custodial, maintenance and administrative staff is critical.

A successful O&M program must clearly address the organizational issues likely to be encountered. An essential element of designing and implementing a successful O&M effort is anticipating and planning for the pitfalls likely to occur. Many of the barriers are a variation of two major themes; 1) the limited internal availability and distribution of complete, accurate and timely information with respect to energy cost, facility performance and staff maintenance and operational practices; and 2) the lack of clear district leadership in energy management objectives and an associated under-investment in the staff resources and training necessary for effectively managing facility operating costs and reducing life cycle costs of school buildings.

Included in this section are the typical obstacles that school districts may face when developing and implementing an energy-efficient O&M program. However, these obstacles are not necessarily present in equal measure in all school districts.

Obstacle #1: Administrators and Staff are Unaware of O&M Energy Savings Opportunities

The technical elements and tasks associated with improved O&M generally do not require a sophisticated understanding of building operation or technical systems. Nevertheless, in most school districts, administrators and maintenance staff are unaware of the opportunities for large energy cost savings through improved O&M of their schools. They are not aware of the degraded energy performance of their facilities or building systems. They are simply unaware of the energy cost implications of the operating, scheduling and maintenance practices prevalent in their district.

Perhaps the most prominent reason for this is that energy-focused O&M programs are a relatively new development and only exist in a limited number of school districts nationwide. As a result, few district staff or administrators have been exposed to the concept, either through personal contact or via exposure through their professional training or organizational affiliations.[6] A second reason is that district staff associate "energy-efficiency" improvements primarily with more capital-intensive approaches. Many staff are probably aware of the cost benefits of new classroom lighting technologies or new high efficiency boilers that cost tens of thousands of dollars and have paybacks of five to ten years. However, few if any, are aware of O&M program opportunities that can produce savings with little or no financial investment.

Obstacles to Revitalized O&M

- Ignorance of energy opportunities
- Budget cuts and negative consequences
- Lack of district expectations or policy
- Under-investment in building staff (incentives and training)
- Limited resources and expertise
- Limited mission and clout of facilities departments
- Lack of comparative energy consumption information
- Lack of a board constituency

Obstacle #2: Decision-Makers are Unaware of the Consequences of Inadequate O&M Funding

In recent years, operations and maintenance budgets have been among the first victims of school district belt-tightening. O&M spending per student is now at its lowest level in 30 years, inevitably resulting in more poorly maintained and operated facilities in many districts. O&M cuts are the first "victim" of annual belt-tightening exercises.

Unfortunately, this type of budgetary decision is typically made without benefit of a factual understanding of the negative consequences. The argument is often made that school O&M can be reduced or deferred without significant costs or impacts on primary educational objectives. In the eyes of many administrators, O&M cuts are perceived as "low-cost" or "no-cost" strategies to survive in a tough fiscal environment.

The facts are that chronically deferred maintenance and reduced focus on operational management do result in multiple and significant near and long term costs to the district. Senior administrators should consider the following "invisible" cost consequences of under-investment in O&M:

- Increased likelihood of unpredicted and unbudgeted capital expenses such as catastrophic equipment failures due to poor maintenance or poor operational control;
- Reduced equipment reliability and service life resulting from failure to follow maintenance schedules as defined by equipment manufacturers;
- Increased incidence of building mold and associated health impacts on students and staff;
- Diminished occupant comfort due to drafts and poor temperature control;
- Unnecessary environmental impacts from excessive fuel use.

Obstacle #3: Districts Lack Clearly Defined Energy Objectives

Challenge:
Your district must develop and distribute clear building and energy performance standards.

As mentioned before, district energy costs are normally the largest single budget item other than teacher salaries. Despite this, most school districts lack standardized guidelines or an "energy policy" which defines specific energy cost objectives, detailed building procedures and associated staff responsibilities. With rare exceptions, expectations or guidelines for operational costs at individual facilities are completely absent.

The lack of a clear and district-wide policy for building operations virtually eliminates the ability of school districts to effectively manage the energy component of operational costs. Without direction or clear expectations from senior administrators, building management practices become decentralized and driven by school-specific staff comfort and convenience, not the strategic and fiscal goals of the school district as a whole.

Obstacle #4: Under-investment in Building Staff Training and Incentives

Improvements in O&M practices are rooted in improved custodial and maintenance skills and motivation. Although leadership from the top is essential, it is the support and actions of custodial and maintenance staff which will determine the success or failure of an energy efficient O&M program. These are

the individuals who intimately know the problems in their own buildings and actually control and operate lights, boilers and other building systems.

Lee Provost, founder of SchoolDude.com, thinks this is one of the absolute keys - creating principal and staff incentives to save energy supported by use/cost information on a year-to-year basis. He believes a best practice is to implement a program that actually shares savings with the school principals to redirect to their school programs based on achievements.

Despite their importance in determining the safety, healthfulness and operational efficiency of school buildings, **the fact is that custodial and maintenance staff are too often undervalued and undertrained for their responsibilities.** In a surprising number of schools, some facility staff are unfamiliar with basic operating and maintenance practices associated with energy-efficient use of building mechanical equipment and energy management systems. They may also lack incentives or recognition for expanding their skills or for proactive efforts to reduce building operating costs.

Obstacle #5: Facility Staff Lack Crucial Information

In most school systems, the central district office pays energy bills without any involvement on the part of the staff that administers and operates the physical plant in individual schools. Certainly, there are administrative advantages of centralized district accounting payables processing, but if principals and building O&M staff **lack any sense of their energy costs or how they compare to other schools, how can they identify energy waste and operate their buildings at least cost to the district?** The answer is, without information, they can't. Lacking any benchmark to prior energy use or costs, how can they detect the onset of energy system failures such as hidden leaks in distribution systems of heated air, hot water or steam? Again, the answer is, they can't.

"I have never seen an energy bill for my school. I have absolutely no idea what my monthly energy costs are."
-Quote from Elementary School Principal in Worcester, MA

Obstacle #6: Limited Mission of Facility Departments

Exacerbated by continuing cuts in facility operating budgets and the increasing practice of deferring subcritial maintenance tasks, most school districts in America have been reduced to a reactive, rather than a proactive, approach to maintaining facilities. This means that basic equipment and building maintenance practices have been cut to the bone. In this climate, responding to emergencies and equipment failures has become the role of facility departments and O&M staff. In general, proactive or preventive approaches have been displaced by a mission of crisis management. Proactive approach to maintenance is the only strategy that can ensure that buildings and equipment are operating efficiently.

Facility Departments frequently lack the opportunity to effectively defend both the importance of good facility practices and the importance of adequate O&M budgeting. A second, and related issue is the lack of strategic role or political clout of facilities departments within their district organizations. Despite the costs involved, building operation tends to be a low profile function; in the absence of emergencies, senior administrators are rarely involved and thus play a minimal role in day-to-day operations. Lacking high-level building operations objectives, senior administrator communication with maintenance managers and staff is often minimal.

COULD WE MAKE THIS WORK IN MY DISTRICT?

Assessing Conditions in Your District

- What information is available?
- What facility management systems are in place?
- What are some potential sources for outside assistance?
- What are your current facility energy and O&M practices?
- What are your district facility "hot buttons"?
- Which barriers are most likely?

3.4 Initial Assessment of District Opportunities

3.4.1 Gathering Information from Staff

Once you feel fairly familiar with broad O&M issues as they have arisen in other school districts, it becomes time to assess your own district. Only after collecting relevant current information about your own facilities and organization is it possible to become an effective advocate for changes in your own district.

Prior to making proposals to Superintendents or school boards, our recommendation is to conduct a series of information-gathering sessions with key staff at two levels; 1) District Facility Department Staff; and 2) O&M Staff at specific schools. You should follow up these sessions by comparing your findings with information and resources utilized by other districts.

An essential ingredient of effective management is the availability of adequate information and management tools for decision-makers. An educational example of this is the importance of standardized test scores and grade failure rates. Without good information of this type, Superintendents and school boards are unable to make accurate decisions with respect to the allocation of teaching staff or appropriate student curricula.

To develop an O&M program that is workable in your system it is essential to "take stock" of your district by asking some of the following questions:

- What tools and information do staffs currently have to effectively manage energy costs?
- What is the current status of O&M practices in my district?
- Would changes in facility O&M practices likely produce significant operating savings?
- Would senior administrators actively support an O&M effort?
- What local resources may be available to assist?
- What is the perspective of facilities and building staff?
- How do district energy costs and O&M practices compare with those of other school systems?

Field Staff Interview and Informal Building Survey

- Selection of specific schools, and associated head custodians
- Beginning of educational process for staff
- Criteria for selected schools—large, typical, heavily used or problem schools.

Prior to these information-gathering sessions, it is essential to remember that mutual respect and teamwork between staff at all levels will be critical to any successful O&M efforts to emerge from this process. A judgmental or "top-down" model is unlikely to work.

Above all, don't assume that current O&M practices are the product of poorly performing custodial and maintenance staff. In reality, current practices in your district are more likely the result of chronic staff and budget cuts and the district's failure to establish clear and consistent building performance objectives and to adequately train and equip building staff to achieve them. In most cases, custodial and maintenance staff consider themselves skilled and professional members of the district team. In your conversations with staff, you may encounter defensiveness. Try to reassure them that a new O&M effort will be to their benefit; they will benefit from increased resources, increased training, and will be acknowledged as playing a strategic cost management role in the school district organization.

Prior to meeting with staff, it is useful to provide them with an explanation of your objectives and express your hope for improvement in district O&M resources and better management of operating costs. It is also helpful if staff to be interviewed are prepared with current energy bills and basic building information.[7]

3.4.2 Benchmarking

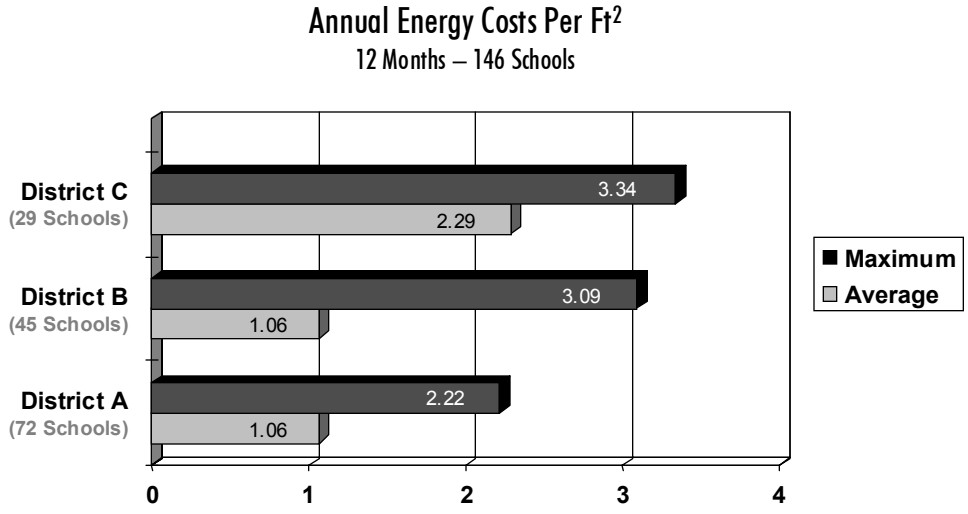
After collecting information from staff, a final step in assessing the possible benefits of energy-efficient O&M is a comparison of your district's energy costs with those of other districts. Although energy cost information may not be well organized and completely accurate, a simple benchmarking exercise may still be possible which would allow you to compare your district **with other districts.**

Caution:

School energy expense information is frequently inaccurate, particularly for individual schools.[8]

As your district continues to pursue energy cost management, staff will likely become familiar with a variety of benchmarking strategies. In particular, as more accurate energy information becomes available, it becomes possible to compare monthly and annual energy costs between individual schools, specific categories of schools, and with other systems. In addition, a key component of the "energy accounting" approach to be discussed in Chapter 5 is month-to-month and season-to-season tracking of energy performance of individual schools.

The following chart was the result of a district-to-district benchmarking of three Massachusetts school districts. All had roughly similar operating conditions, building ages and weather. A couple of items are particularly interesting. First, a district-to-district comparison revealed that "District C" had extremely high-energy costs per square foot in comparison to the other districts. Second, although Districts A and B had lower overall costs, their poorest performing schools ("maximum") used twice as much energy per square foot as their averages.



The U.S. Environmental Protection Agency/Department of Energy's benchmarking tool, Energy Star, is a good, no-cost, first step for school staff seeking to assess their district's energy costs. Energy performance can be tracked for individual buildings as well as aggregates of buildings.

For more information on the U.S. Environmental Protection Agency's benchmarking tool, visit *http://www.epa.gov/eebuildings/benchmarking/default.htm*

Using the Energy Star program requires only the basic information you have collected to date. Staff will only need to spend about 30 minutes using the tool to benchmark building energy use. Information required includes total square footage and typical building age, the types of space usage, and energy billing information.

The Energy Star program gives each building an energy consumption score, from 0 to 100, that indicates how well its energy performance compares with similar schools in the U.S.

3.4.3 Informal Building Walkthrough Survey

Although it is possible to spend hundreds or even thousands of dollars on a detailed energy audit or building O&M assessment, one or two simple building "walkthrough surveys" should provide you a tangible sense of current building conditions and staff O&M practices. Particularly if conducted in conjunction with a custodial or maintenance staff interview, a walkthrough shouldn't take more than two to three hours.

The point of a walkthrough survey is NOT to take measurements or conduct technical equipment testing. The objective is to produce a quick snapshot of the highlights of how the building is being operated and maintained with respect to energy use. Although a variety of useful building survey protocols are available from school districts, utilities, consultants and government agencies, the primary information of importance is the following:

- Building use and occupancy schedules;
- Shutdown procedures during unoccupied periods;
- Status of control strategies for major building systems;
- Classroom lighting levels and fixture control;
- Boiler and cooling system efficiency and maintenance practices;
- Condition of steam, water or air distribution systems;
- Temperature control and setbacks;
- Condition of building envelope, windows and weatherstripping;
- Identification of prominent problems (indoor air quality etc.);
- Control of computers, vending machines and other plug in loads;
- Assessment of staff expertise.

Sample questions for assessing your district's energy saving opportunities is available at the end of this chapter.

3.4.4 Summary of Findings

The last step in the investigative process detailed in this chapter is to summarize your findings in a manner that is complete and accessible to other District staff. Whether your "research" has taken a few weeks or a few months, the process of reviewing and summarizing will usually produce clarity with respect to your district's overall building practices and prospects for better management of operational costs.

It must be stressed that your findings will be preliminary due to your time constraints and limited technical expertise. You simply will not have had the resources or time to complete a comprehensive assessment of your entire district. For this reason we recommend against making specific program or implementa-

tion recommendations at this point. The key objective should be to describe recent fact-finding activities and summarize your preliminary conclusions.

Major Issues to Summarize:

- District Energy Costs and Comparison to Other Districts
- General Strategies to Manage Operational Costs with improved O&M
- Success Stories in Other Districts
- Prevalent O&M Practices in Your District
- Availability of Adequate Information and Management Tools
- Prospects for Energy Cost Reductions
- Possible Sources of External Assistance

"A quick walk through the building after hours can be quite revealing. For buildings where equipment should be OFF after hours, managers can detect stray equipment operation by simply entering the building during unoccupied hours and listening for unexpected noise. Building staff should perform an after-hours walk-through once every six months to observe the behavior of heating and cooling equipment, lighting, and office equipment such as copiers, printers, and computers."

-Source: Portland Energy Conservation, Inc., Putting the "O" Back in O&M, U.S. EPA, September 1999. Page 21.

[1] It must be noted that obtaining similar fuel oil consumption data is unlikely.

[2] Don't hesitate to request the permanent or short-term installation of interval meter equipment if none is currently installed at a specific school.

[3] The utility sponsors of "Resource Conservation Manager" (RCM) programs in west coast and northeast states have typically provided full-time staff to support these efforts.

[4] See http://www.boccentral.org/around/ for BOC contact information

[5] Utilities and other outside resources can be helpful in investigating many of these issues.

[6] A recent notable development in this regard are the recently published "School District Energy Manual" and "Planning Guide for Maintaining School Facilities" but published with major assistance from the Association of School Business Officials (ASBO). See appendices for details.

[7] In addition to energy costs, basic building "profiles" should include building sizes, approximate building operating schedule and other general information about building systems.

[8] In addition to basic accuracy and completeness of information factors that may complicate cost comparisons include differences in building operating hours, climate, building age, prevalence of computers and types of heating, cooling and ventilating systems.

Assessing Your District's Energy Saving Opportunities
Questions for District Facility Department Staff:

Energy Policy and Building Operations Procedures

1) Does the district have an "energy policy" or "procedure manual" of standard O&M practices that are intended to be actively applied in all schools?
2) If yes, when was this policy developed and last presented to O&M and Administrative staff?
3) In your opinion, are O&M staffs aware of this policy and actively adhering to its objectives?

Building Energy Information

4) Are annual district energy costs increasing or decreasing? Do we have an explanation?
5) Does the central office currently track the monthly energy consumption of all individual school buildings?
6) If yes, do we periodically compare the energy consumption of specific buildings and use this information to identify problems in specific schools?
7) If yes, is this information made available to principal and building operating staff at the individual schools?
8) How do energy costs per square foot at our schools compare to costs in other districts?

School Condition and Operations

9) What is the typical age and condition of school buildings?
10) What are the major problems in respect to school physical plants? (advanced age, poor system or temperature control, indoor air quality, staffing etc.)
11) Does the district have ready access to the "building profile" of all school facilities? (size, occupancy, heating fuel type, age etc.)
12) Does the central office currently have software or other capabilities to plan, track or schedule maintenance activities at individual schools, particularly for large systems such as heating and cooling systems?
13) Have recent energy audits been performed in schools? Were there any recommendations for changes in operations and maintenance practices?
14) Which schools, if any, have computerized energy management systems (EMS)? Are these systems working effectively? Are outside vendors providing good service? Does district and building staff know how to operate them to maximum advantage?
15) Can you briefly describe vacation and weekend shutdown procedures currently in place in the district? Are these applied in all schools?

O&M Staffing

16) What role, if any, do outside vendors or other public sector agencies play in building operations or maintenance? What is the quality of this service?
17) What level of training, if any, has been provided to custodial or maintenance staff that is relevant to energy cost management?
18) Can you identify any specific training needs that would enhance staff's ability to manage energy costs at individual schools?
19) Does the district recognize or otherwise reward staff or individual schools for improvements in operating costs at specific facilities?

Questions for O&M Staff at Specific School(s)

Energy Policy and Building Operations Procedures

1) Are you aware of a district-wide energy policy or list of standard building operating and maintenance procedures? Are custodial and maintenance staff at your school aware of this policy and actively adhere to its objectives?
2) What maintenance records do you keep? Of particular interest is the testing and maintenance of boilers, air handlers and other major building systems. Are these records provided to the central office?
3) What was the date of your last energy audit, boiler combustion test and tune-up, or other important actions related to energy conservation?

Building Energy Information

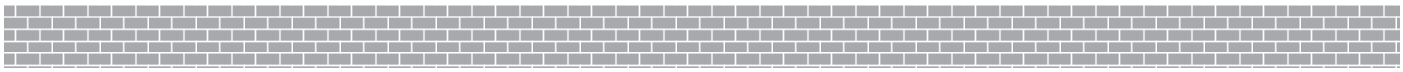
4) Are annual energy costs at your school increasing or decreasing? What are the reasons for these changes?
5) Are you provided with the monthly energy consumption or billing information for your school?
6) If yes, how do you use this information?
7) Do you know how energy costs at your school compare to costs in other district schools?

School Condition and Operations

8) What are the major problems in respect to the condition of your school physical plant? (IAQ, poor system or temperature control, staffing etc.)
9) How are maintenance decisions made? How does the central office plan, track or schedule maintenance activities at individual schools, particularly for large systems such as heating and cooling systems?
10) Are you aware of any recommendations for changes in O&M practices that have been made in energy audits or other sources?
11) Do you have any recommendations for reducing energy costs at your school?
12) Does your school have a computerized energy management system (EMS)? Is it working effectively? Which building systems does it control? Does your staff know how to operate it effectively?
13) Can you briefly describe nighttime, vacation and weekend shutdown procedures currently in place in your school? Is there a written procedure available?
14) What are the current thermostat settings and nighttime temperature setbacks?
15) Are teachers, students and staff careful about turning off computers and other equipment when not in use?

O&M Staff Training

16) What training has been provided to your schools custodial or maintenance staff that is relevant to reducing energy costs in your school?
17) Can you identify any specific training needs that would enhance staff's ability to manage energy costs?



CHAPTER 4. NUTS AND BOLTS: PLANNING AND IMPLEMENTING AN O&M PROGRAM THAT FITS YOUR DISTRICT

Overview:

- Keep in mind that energy savings from O&M are not immediate.
- Support from senior staff is essential for a successful energy-efficient O&M program.
- Active involvement of all levels of district staff is a prerequisite for a successful O&M program.
- The new O&M program must be tailored to the culture and resources available to a particular school district.
- School-specific energy information is essential and should be distributed to building service staff.
- There are a variety of O&M program options including, Energy Tracking and Accounting, Voluntary Energy Awareness Program, Performance Contracting, and Quick Fix and Low-cost Strategies.
- School districts should adopt a district-wide energy policy.
- School districts must actively motivate facility staff members in ways that are financially and organizationally feasible.

4.1 Overview

The objective of Chapter 3 was to help you understand O&M as a cost reduction strategy, both in general and in respect to your own district. Now, assuming that you have decided that energy efficient O&M seems to offer promise, what are the next steps toward achieving these energy cost savings?

To answer that question, Chapter 4 focuses on beginning a collaborative process of working with the other staff necessary to move an O&M effort forward. The objective will be to broaden the involvement of other staff in investigating, planning, and implementing a district-wide O&M program that can achieve sizable energy efficiency and operating cost savings.

Chapter 4 assists you in "handing off" decision-making, planning, and implementation responsibilities. Based on O&M experiences in other districts, a sequential "team building" process is described by which, 1) Superintendents or senior staff are introduced to O&M cost management opportunities, 2) a broad-based district-wide energy planning committee is formed, and ultimately, 3) a single staff member is tasked with the day-to-day O&M implementation responsibilities.

An important note: A variety of school districts, professional organizations and other organizations have produced materials addressing the planning and implementation of specific school-based energy management programs. Much of this material is relevant and quite valuable.[1] Because of the ready availability of much of this material, this chapter will try to avoid a lengthy and redundant discussion of the specific materials in each of those resources.

Our objective is to provide the reader with an overview of the broader issues raised in the O&M "literature" as well as in the real-life school-based professional

Key Questions to Be Addressed in This Chapter

- Are senior administrators supportive of O&M enhancements?
- Should the district proceed with a new O&M effort?
- How should a new district O&M effort be structured?
- What are the roles of district and external staff?
- What resources are necessary for this effort?
- What are the keys to successful implementation and sustained success?

experiences of the authors and contributors to this Guidebook. We will identify the common strategies, which have proven successful in a variety of school settings. In addition, unlike the other resources available, Chapter 4 will try to provide the reader with a clearer understanding of the various staffing, program design and other options available to school administrators as they plan and implement the details of their district's O&M effort. With a more complete knowledge of all the options and alternatives, school administrators will be better able to design and implement an effort that is appropriate to, and successful in, their own district.

4.2 Senior Staff: Building an Initial Constituency—Testing the Waters.

In school district organizations, as in every organization, leadership from the top is critical. It is unlikely that widely dispersed custodians or principals will be actively interested in changing building energy management practices unless encouraged by the Superintendent, Board, or other senior administrators. In most cases, staff will be too busy "just keeping the car on the road" unless energy cost reduction through improved O&M becomes a high profile objective. Therefore, although their involvement does not have to be time-consuming, the importance of initial (and continuing) support from senior staff cannot be overemphasized.

In most districts, the place to start achieving top-level support for new initiatives is with the Superintendent. Although it may be tempting to take a more low profile approach, the failure to obtain the early "buy-in" and active support of the Superintendent has, in many cases, doomed prospects for changes in school O&M practices and associated operational cost savings.

Normally, Superintendents leave the details of day-to-day physical plant operations and expense management to facilities and business staff. However, although they may be reluctant to devote time to noncritical operational details, Superintendents are always vigilant about the erosion of district resources away from primary classroom objectives. Rising district energy costs, due in part to poor maintenance and operational practices, represent exactly that sort of drain on educational resources.

The key objective of a meeting with the Superintendent will be to provide her or him with the details of the recent fact-gathering summarized in Chapter 3 and to assess his or her interest in further investigation of O&M enhancements, preferably with the inclusion of other District staff.

Suggested Topics and Agenda of Initial Meeting:

- Review current district energy costs and trends;
- Describe general strategy of energy cost management through O&M;
- Describe fact-finding process and preliminary findings;
- Review possible next steps;
- Determine follow-up.

A focused discussion of preliminary O&M findings, as discussed in Chapter 3, will likely be of great interest and serve as a starting point for identifying any follow-up steps of interest to the Superintendent. Presenting the Superintendent with examples of the school-specific information collected and examples from other respected districts will help establish the legitimacy of the information gathering process and of your preliminary findings.

Familiarizing senior staff with the novel concept of O&M energy cost management should be a key objective. School district case studies, such as those included in Chapter 6, may serve as examples of what has been achieved in other district settings.

However, the objectives of the meeting should not be overly ambitious. Although a preliminary fact finding exercise has been completed, your district likely has many schools and numerous staff about which you have little or no information at this point. As a result, neither you nor the Superintendent will have enough information to make specific recommendations for change. Unless the preliminary O&M findings are extremely comprehensive and persuasive, a commitment to further investigation is likely the appropriate outcome of the meeting.

In the aftermath of this initial meeting, the reader may want to schedule follow-up meetings with the Superintendent or other senior staff. However, the inclusion of a wider spectrum of district staff in these initial discussions has been the approach that has been most successful with other school districts. As discussed below, the formation of a broad-based "energy committee," responsible to the Superintendent, will give the district the best chance to assess actual opportunities and make recommendations for a workable and appropriate O&M effort.

4.3 Nuts and Bolts: Planning a District-Wide O&M Program

The active involvement in an energy O&M program of all levels of district staff is a prerequisite for success. The most important immediate benefit of support from the district Superintendent is the ability to broaden the involvement, input, and participation of others. With the credibility lent by his or her support, the district will now be able to constitute a larger "task force" or energy committee of district staff, a group which will be the workhorse of further research and O&M program planning. The formation of a small, strong, persuasive, district-wide energy management committee appointed by, and responsible to, the Superintendent will be essential as the district moves forward.

Task force participation by custodial, maintenance, administrative, faculty, and other staff often provides these district colleagues a first taste of this type of collaboration. More importantly, it affords each stakeholder and functional group an opportunity to contribute their own unique expertise and perspective and to influence the details of the program actually developed by the committee. Not only does this multiparty participation increase the likelihood of a workable program, it also establishes necessary "buy in" from relevant parties.

In order to be effective, the membership of a broadbased school energy committee should include many of the following staff and outside parties:

- Superintendent or Representative
- Business Manager
- Facilities Department Representative
- Energy Program Lead Staff[2]
- School Board Representative
- Faculty Representative
- PTA or parent Representative
- Utility Company Representative(s)

Task Force: Primary Objectives

The first three items listed represent the completion and resolution of the information gathering process begun in Chapter 3. It is at this point that the Committee collects any final information and makes a recommendation on whether to proceed with the implementation of a district O&M effort. The final four steps involve the detailed planning of the new district program.

- Additional Data Collection
- Investigate Program Options
- Implementation Decision: Yes or No
- Development of District-Wide Energy Policy
- Commitment of Internal Resources and Staff
- Define Roles of Staff
- Training and Motivating Staff

- Director of Public Information
- Custodial Staff Representative
- Maintenance Staff Representative
- Engineer or Architect[3]

In the very early investigative stages, it may be more workable to limit committee membership to a few key staff.

4.4 Task Force: Collecting Additional Data

Unless an initial opportunity assessment was thoroughly convincing to all parties, it is likely that the district will require additional information prior to committing resources and making a decision in respect to O&M enhancements. In most cases, decision-makers will want further confirmation of the comparative energy performance of its schools in respect to other districts and a more technical confirmation of energy cost savings opportunities. In most cases, these information-gathering tasks can be delegated to members of the Task Force or staff in associated district departments. In some cases, the use of an outside consultant may be appropriate.

Specific information required may include more accurate and complete energy billing data, the confirmation of available external resources from utilities and others, and results from more detailed building audits or other issues. For example, the committee may choose to expand the facility assessment process begun by the earlier "walkthrough" surveys by targeting more schools or by increasing the technical scope using technical staff or outside utility or consultant engineers.

Naturally, a critical issue for the task force is to assess the availability of the district staff and financial resources necessary to support a new internal program. Although O&M cost management strategies are usually characterized as "no or low-cost," program staffing, minor building system repairs, and other program elements will require district resources. The magnitude of these resources will be a function of the size of the school district, the type of O&M program adopted, the current level of O&M practices, and expertise and the current condition of district school facilities. However, the near term objective for the task force is not to establish a fixed budget or allocation of staff time, but to determine, in general, if likely operational cost savings would justify a commitment of district financial and staff resources to a new O&M initiative.

A final consideration that may be relevant is the identification of any regulatory or legal constraints that may impinge upon the district's ability to design or implement a new O&M effort. One example of this would be a determination if state regulations impair a district's ability to utilize a performance contracting arrangement to implement O&M enhancements. A review of labor agreements with custodial or maintenance staff may sometimes also be appropriate. The task force may also investigate the implications of facility O&M improvement on state capital reimbursement formulas. A final item might be to determine the relevance of an O&M planning process to any state requirements for periodic school infrastructure plans.[4]

4.5 Task Force: Investigating Program Options

In order to be successful, a new O&M program must be tailored to the culture and resources available to a particular school district. In the United States, there are more than 14,800 public K–12 school districts in rural, suburban and urban settings. Among other characteristics, they are highly diverse in terms of school size, facility age and condition, financial condition, growth rate, and the role of organized labor.

O&M Program Options:

- Energy tracking and accounting
- Voluntary energy awareness program
- Performance contracting
- Quick fix and low-cost

One of the lessons learned by hard experience is that one district's success with a particular program design does not guarantee that program's success in another district. This is particularly true if the school districts are substantially different in terms of organizational culture. Although it is tempting to try to duplicate success, the district task force should be skeptical of simply adopting "carbon copy" program designs from other districts. Without carefully assessing the "fit" of a particular program the district may end up devoting time and money to a program that fails because it is not suitable to the needs and resources of that district.

Based on our review of O&M efforts in U.S. schools, we have defined four basic program models. Although four separate program options have been listed, there can in fact be considerable overlap in individual program elements such as the use of training efforts, staff recognition, and the adoption of district energy policies.

Proposing a suitable program approach is a must.

Basic elements of the four general program categories are discussed below. In particular, we have emphasized the comparative costs, achievable cost savings, and likely staffing requirements associated with each option. In addition, we have estimated the prospects for long-term and sustained O&M energy savings as opposed to onetime savings that quickly erode because of inherent program limitations.

The authors defined the categories based on input from reviewers and the range of programs in the field. The basic organizing element was an attempt to distinguish programs on the basis of effort and resources required by the school districts themselves. For example, Energy Tracking and Accounting programs require the most effort and resources, while Quick Fix and Low Cast require the least.

1) Energy Tracking and Accounting

- Program Costs: High
- Achievable Savings: High
- Sustainability of Cost Savings: Good, if appropriate staff resources are committed

Energy Tracking and Accounting

- Most comprehensive and Extensive program option
- Collects monthly energy data for all facilities
- Permits on-going comparison of buildings
- Uses energy data to track building performance and identify problems
- Estimates actual savings achievement using building baselines
- Produces savings by identifying billing errors
- May be expanded to include water and sewerage

- Energy Cost Tracking: Yes
- Staffing Requirement: In-house, new staff required

Overview

Energy Tracking and Accounting (ETA) is the most comprehensive and frequently discussed O&M program option. The primary distinguishing feature is the careful collection, recording and tracking of monthly energy costs in ALL school district facilities. Once collected and analyzed, this information allows district staff to effectively compare energy performance across all district schools and to identify problems at individual facilities. While it normally requires the most staff resources, ETA also offers the most opportunity to target O&M savings opportunities at individual schools.

At the core of the ETA effort is the effective use of a computer-based software application to collect and manage monthly energy data from all district buildings. The use of dedicated energy accounting software allows district administrators and building staff to identify changes in consumption and to track and forecast operating costs.[6] If conscientiously used, the software can be an effective management tool that provides the capability to:

- Track monthly energy bills for electric, fuel oil, propane and natural gas;
- Produce graphic summaries of facility energy use that effectively communicate energy performance to district staff;
- Estimate achieved operational savings based on "baseline" costs;
- Identify changes in monthly or seasonal energy consumption due to billing errors, control malfunctions and equipment deterioration;
- Track other resource costs such as telephone, water, sewerage, etc.;
- Enables simple creation and evaluation of utility usage and cost budgets.

There are several variants of ETA programs, some of which entail a significant role for utilities or Performance Contractors. In some cases, utilities have pro-

Utility Report Cards

Electric Per Day ORANGE COUNTY PUBLIC SCHOOLS April 2004

	Consumption (kWh/day)			Cost ($/day)			Efficiency (Btu/sq ft/day)		
School Type	Current Period	Previous Period	Percent Change	Current Period	Previous Period	Percent Change	Current Period	Previous Period	Percent Change
Regular Primary School	178,511	196,783	-9%	$13,644	$13,510	1%	143	158	-9%
Regular Middle School	126,616	139,891	-9%	$9,363	$9,334	0%	144	159	-9%
Regular High School	168,955	177,172	-5%	$12,211	$11,464	7%	162	170	-5%
Special Other	6,095	6,933	-12%	$442	$462	-4%	137	156	-12%
Vocational High School	6,333	7,225	-12%	$498	$510	-2%	114	130	-12%
Grand Total ORANGE COUNTY PUBLIC SCHOOLS	**486,510**	**528,044**	**-8%**	**$36,158**	**$35,280**	**2%**	**149**	**162**	**-8%**

Source: http://www.utilityreportcards.com/reports/urc.php

vided substantial support to district ETA programs and even provided contractual guarantees of O&M energy savings. The Resource Conservation Manager (RCM) program mentioned above is an ETA-based program, which in addition to energy, tracks other resource costs including water, sewage charges, and solid waste disposal fees.[7] The case studies in Chapter 6 provide several examples of energy tracking and accounting programs.

Staffing Requirements

Although ETA-based programs have the potential to produce the most cost savings, they can also be the most staff intensive. In addition to managing specific staff training, facility repair and maintenance projects, this type of program requires significant staff resources to collect, organize, and analyze monthly billing data from individual school facilities.

It is common practice to dedicate a full-time staff position to ETA for districts larger than 500,000 square feet. Part time staff may be appropriate for smaller districts. Districts larger than 1,500,000 feet may require additional staff support.

ETA Programs: Pros and Cons

✓ Pro: Largest upside in terms of potential savings.
✓ Pro: Provides ability to identify large billing errors.[8]
✓ Pro: Provides continual tracking of building performance.
✓ Pro: Quantified savings estimates can serve as basis for progress assessment or staff recognition.
✓ Pro: Can be a useful tool for planning and budgeting purposes.

✖ Con: Higher costs due to increased staff and data responsibilities.
✖ Con: Determination of school baselines can be problematic.[9]
✖ Con: Calculation of savings can be complex and time-consuming.[10]

"Although you can't catch everything, there are obvious things that come up that can be easily spotted if someone is taking the time to do it. In four years on the job, I've caught $35,000 in billing errors."
- Van Der Like, Energy Management Specialist, Marion County Public Schools, Florida

2) Voluntary Energy Awareness

- Program Costs: Low
- Achievable Savings: Moderate
- Sustainability of Cost Savings: Requires persistent effort
- Energy Cost Tracking: Yes for some
- Staffing Requirements: Existing staff

Overview

Unlike ETA programs, Voluntary Energy Awareness (VEA) programs do not typically rely on close tracking and analysis of school-specific energy costs and consumption. Instead, they operate on the premise that increasing the general energy awareness of faculty, staff and students will result in voluntary changes in behavior and reductions in energy consumption. A familiar example of this approach is the affixing of "Please Turn Off The Lights" stickers to lighting switch plates in bathrooms and other intermittently used school areas.

VEA programs have an "educational" approach to energy in which the development and presentation of energy related curricula and training materials plays the central role. Energy efficiency modules are frequently incorporated into classroom

curricula, often leading to the expectation of energy savings at home as well as school. Although the primary focus is usually on faculty and students in the classroom VEA programs can also include staff training and other program elements such as district energy policies.

In general, VEA programs are relatively simple to implement. School districts have ready access to a wide variety of curricular and awareness materials already developed by government agencies and nonprofit organizations. Since the program is not dependent on analysis of "hard energy data" or repair of defective building systems, program costs are relatively low. However, the lack of energy cost tracking and accountability means that energy savings are more limited and may erode quickly with the departure of key staff or the arrival of new classroom priorities.

Staffing Requirements

Normally, existing district staff design and implement a VEA effort, often with the assistance of students. Temporary outside consultants or staff may be required if more technical material is presented to custodial or maintenance staff.

VEA Pros and Cons

✓ Pros: Low-cost and rapid implementation.
✓ Pros: Uses existing staff.
✓ Pros: Provides educational content to students.

✖ Cons: Likely energy savings are limited.
✖ Cons: Behavior changes and savings may be short lived.
✖ Cons: Cannot assess progress or estimate savings.

3) Shared Savings and Performance Contracting

Performance Contracting

- Energy savings are "guaranteed" by ESCO
- Portion of energy savings retained by vendor
- ESCO provides experienced school technical and program support
- Little or no first cost to district
- Multiyear contractual commitment required

- Program Costs: Low to high
- Achievable Savings: Moderate to high
- Sustainability of Cost Savings: Good if consistent effort
- Energy Cost Tracking: Yes
- Staffing Requirements: Dependent on contract terms

Overview

As summarized in Chapter 3, performance contracting entails a contractual arrangement under which a performance contractor (sometimes referred to as an Energy Services Company, or ESCO) provides specific energy services to a school system in exchange for a proportion of the resulting energy savings. Because the performance contractor earns its return from future energy savings, the direct cost for school districts is limited. In addition, the contract will stipulate a specific level of savings that will be guaranteed by the performance contractor.

Shared savings is a general term that describes this approach, under which the energy savings are "shared" between the client and the performance contractor. The calculation of project savings by performance contractors can be complex and can include estimations of other factors such as "load creep," which is an increase

in school energy consumption that takes place as mechanical systems become less efficient as they age.

Dave Petersen, Assistant Director of Administrative and Operations Services at Fairfax County Public Schools, Virginia says, "School districts interested in using a performance contractor should contact one or more school districts that have successfully used a performance contractor to get a roadmap to success. There are many good performance contractors out there, but also some that are not so good. Follow a success story. Do not reinvent the wheel." In addition, Doug Lewis, Superintendent of Business Assistance, MAPA Council, states that schools may also want to implement a clearly defined request for proposals (RFP) process to eliminate questionable performance contractors. Schools should take their time and do their homework before selecting a performance contractor.

Although contractual terms vary, in general, a O&M-qualified performance contractor can provide a school district with most of the skills and services required to develop and implement a new O&M effort. For example, performance contractor staff typically provide staff training, technical building assessment, energy cost tracking and assistance in identifying specific energy savings opportunities.[12] The ready availability of experienced performance contractor staff familiar with school operations can permit a district to more rapidly start benefiting from its share of O&M cost savings.

"Using an ESCO, Haverhill Schools got a quick start at O&M improvements and successfully saved $200,000 the first year."
-Roger Young, Assistant Superintended of the Manchester Essex Regional School District, Massachusetts

Staffing

Depending on specific contract terms, full-time energy management staff is either provided by the performance contractor or the staff function is provided by an employee of the school district. Normally, the role of the performance contractor is to provide staff training and training materials, technical assistance and be responsible for energy cost tracking.

Normally, existing school custodial and maintenance staff are responsible for making the repairs and implementing the actual O&M changes identified by the program.

Performance Contractor Pros and Cons

Of all the approaches to O&M programs, the use of performance contractors arouses the most controversy and heated opinion.

- ✓ Pro: Zero or limited initial costs.
- ✓ Pro: Guaranteed savings.
- ✓ Pro: Experience and expertise.

Advocates argue that performance contractor staff expertise and experience with schools can represent a critical resource lacking in their district. They point out that performance contractors can play an important role in building initial O&M momentum and may be the appropriate choice for small or resource-poor districts or for those lacking in staff expertise or initiative. Finally, they argue that a "share" of savings is better than no savings at all.

- ✖ Con: Contractual complexities with outside vendor.
- ✖ Con: High ultimate costs and reduced energy savings.

Critics argue that performance contractors siphon off district energy savings and are vehement that most districts are fully capable of implementing equally effective O&M efforts without the costs and contractual complications of working with a performance contractor. They also allege cases of questionable marketing techniques and manipulations of energy savings calculations that benefit the performance contractor.[13]

4) Quick Fix and Low-cost

Quick Fix and Low-cost

- Identify poorest schools
- Address typical and most glaring problems with rapid payback
- Operational and scheduling changes
- Requires repair budget
- Limited program lifetime

- Program Costs: Low to Moderate
- Achievable Savings: Low to Moderate
- Sustainability of Cost Savings: Difficult
- Energy Cost Tracking: No
- Program Staffing Requirements: Existing Staff

Overview

A quick fix/low-cost program has neither an educational focus nor does it rely on systematic tracking of building energy consumption. Rather, it relies on the identification and repair of simple building problems, in many cases problems which are long-standing because of persistently deferred maintenance.

Implementing this type of O&M program reflects a district's commitment to make physical plant repairs and modifications that are moderate in cost and likely have a short energy savings payback. Many potential projects of this type can be readily identified by building staff, equipment vendors or outside consultants. In addition, O&M program manuals typically identify a variety of generic quick fix and rapid payback opportunities.

A brief selection of projects of this type might include:

- Repair window and door glass and weatherstripping;
- Reduce excessive light levels by careful delamping;
- Clean and repair chilled water plants or package units;
- Combustion testing and boilers tuneups;
- Repair leaking steam traps;
- Repair pipe and vessel insulation for steam and hot water distribution lines;
- Institute night and weekend temperature setbacks;
- Eliminate 24/7 operation of exhaust fan and vending machines;
- Replace ALL incandescent light bulbs with equivalent compact fluorescent bulbs;
- Establish district-wide vacation shut down procedures;
- Repair malfunctioning dampers on unit ventilators.

Clearly, there are labor and materials costs associated with the projects listed above, costs that must be covered by capital or operating budgets. However, in most cases the expenses associated with these changes will be recouped in energy cost savings in two years or less.

Staffing

In many cases, repairs can be completed by existing staff custodians and maintenance staff. However, outside vendors may be required for some tasks if a rapid repair timeline is required.

Quick Fix Pros and Cons:

✓ Pro: Less staff-intensive than ETA programs.
✓ Pro: Existing O&M staff may be sufficient.

✖ Con: Cannot estimate actual savings.
✖ Con: Program may be limited to one-time savings.
✖ Con: Real costs for repairs and modifications.

4.6 Task Force: Developing a Program Recommendation

Based on its review of O&M program options and other information collected to date, committee members now have the ability to make an informed recommendation for action. In its recommendations to the school board or Superintendent, the members of the group will need to answer the questions listed on page 30. Of course, the key question is whether the likely cost savings from improved facility O&M are sufficient to justify a further district investment in staff and financial resources. If so, the task force should recommend what type of program would be most feasible for this district and be broadly supported by staff.

As the district committee reviews possible next steps, it should also keep in mind the alternatives to full scale and immediate O&M program implementation. While the authors of this Guidebook might favor a full scale and aggressive program, current district resources may be inadequate for that scale of effort. Alternatively, timing may not be workable because of staff turnover or other pressing physical plant issues.

However, district energy committees should continue to take advantage of the accomplishment already achieved. The recently collected information about the conditions of physical plant has great value because of its currency, as do the assessments of staff expertise and prevalent building management practices. Also of tremendous value is the committee's unique collaboration between blue collar and administrative staff. This sort of collaboration may be difficult to replicate. If the members of the committee have discovered that building maintenance, operational practices and energy efficiency are poor, the present may be the unique opportunity to make some progress, if only incrementally.

Understanding O&M Issues

- Identifying sources of outside assistance
- Understanding the broad technical opportunities
- Understanding likely pitfalls to revitalized O&M programs

4.7 Task Force: Planning a Detailed Program

If its recommendations are approved, the task of the district committee will shift from investigation to that of detailed O&M program planning. The committee will then have the following planning responsibilities:

- Defining a district-wide energy policy;
- Developing a program staff and budget;
- Recognizing and monitoring staff members.

4.7.1 Defining a District-Wide Energy Policy

The single most important energy cost management tool is a well conceived district energy policy that defines clear expectations for building performance. Without visible, clearly defined objectives and district-wide operational stan-

Energy Mission Statement-Broad Objectives

- Formalizes support by senior administrators and elected officials
- Supports inclusion and teamwork of all staff
- Addresses training needs of staff
- Addresses life cycle cost objectives
- Defines broad targets for cost and building performance
- Defines principles of school or staff recognition
- Defines informational and reporting objectives
- Anticipates program review and refinement

dards, administrators will have great difficulty improving practices in a multi-school district. As such, the development of this policy must be a high priority.

Members of the committee and district staff may want to review some of the numerous school district energy policies are available on the Internet, in print and from other sources.

Actually, there are two distinct types of school policies. The first, often described as a "mission statement," should be the first priority for completion.[14] This a high visibility document that emphasizes the serious and continuing commitment of the board and senior administrators to improved management of facilities and energy costs. These policies should also outline key elements of the new O&M initiative.

It must be emphasized that the single most important element of an energy policy is NOT content, but visibility. A well conceived and comprehensive policy that only gathers dust in file cabinets is a complete waste of district staff time and resources. Whatever the content or scope of your district policy, it must be a visible and "living" administrative tool that becomes familiar to staff and is taken SERIOUSLY.

A final item, not often included in district policies, is the issue of broadly defining a criterion for spending district monies on the many repairs and improvements likely to be identified in an O&M program. In the private sector, this is defined as the "hurdle rate" or minimum return on investment required for a specific project. Similarly, it may be useful for the district to set a broad target project "payback" criteria of one to three years. Ultimately, this type of guidance will allow the O&M program manager to more readily pursue repair or modification projects meeting the stated financial criteria.

See Apendix C for examples of district-wide energy savings.

4.7.2 Developing a Program Staff and Budget

The process of developing a good district energy policy encourages committee members to think more pragmatically about the administrative and logistical details of the O&M program under development. For example, as the committee discusses specific objectives achievable with the new O&M initiative, the magnitude of required staffing and other resources will become more apparent.

In addition, when moving forward with the detailed planning of program staffing and budgets, committee members should keep in mind an important theme emphasized in this Guidebook**: Do not reinvent the wheel.** Assistance from other districts with specific O&M program experience will greatly minimize the effort of estimating costs and defining staffing responsibilities.

Staffing Issues

Unless the district uses a performance contractor, which can provide a dedicated staff, all programs will require the selection of an energy "manager" to provide day-to-day administrative leadership. In addition, with the possible exception of voluntary energy awareness efforts, all programs will require active participation by building staff.

The scale of program to be implemented and the size of the school district will be the biggest drivers of the level of staffing required. The expected level and pace of facility repairs and modification is another. In addition, overall program design (e.g., on-site visits versus email campaign) will impact staffing.

The required qualifications of the program manager will also vary with the type of program. In particular, since an energy tracking program depends heavily on the use of software, a moderate level of computer skills is essential. A higher level of technical skills may be useful but not essential. However, the ability to work effectively with staff at all levels is central—training, writing, presentation and general communication skills are probably more important than detailed knowledge of boiler or HVAC systems. See Chapter 6 for examples of how several school districts have defined job qualifications and responsibilities for O&M program managers.

In selecting a program manager, districts must decide whether to seek outside expertise or to select an existing employee. In some cases, districts have made this decision based on organizational convenience. In some instances, this was not a wise decision. For example, several districts familiar to the authors designated staff technicians, electricians, or other trade people to manage their new O&M initiatives. Unfortunately, some of these individuals did not have, or could not develop, the communication, organizational or computer skills necessary for O&M program effectiveness.[15] It is important to keep in mind the importance of working with and communicating to district staff; this is primarily a management, not a technical position.

Nevertheless, there are a number of advantages to selecting an existing district employee, particularly if a well qualified individual is available. In particular, specific familiarity with district facilities is of great value, as is a working relationship with administrators and building staff. On the other hand, there is the danger that a reassigned employee will carry over some of his or her existing responsibilities, reducing their actual O&M program availability considerably. In addition, significant new and unrelated tasks have sometimes been assigned to designated "full-time" O&M program managers, displacing the core responsibilities originally defined by the district. This type of "mission slippage" of existing employees has frequently been a serious impediment to O&M success. If your district does choose an internal candidate, specific O&M program progress milestones should be defined and carefully monitored by administrators or the district energy committee.

Because of the problems of "mission slippage" or the limited availability of internal expertise, many districts have selected program managers from outside the district organization. While usually hired as a new district employee, in some cases the O&M program manager has actually joined the payroll of the sponsoring utility or other organization.[16]

Selecting An O&M Manager

	Inside Hire	Outside Hire
Familiarity with District	Yes	No
"Mission Slippage"	Yes	No
Broad Candidate Pool	No	Yes
Experience with Other Districts	Possibly	Likely

"In 2000 when a mid-sized East Coast school district hired an O&M program manager to implement a software based energy accounting (ETA) program. Although generally supported by the Superintendent and facilities department, the program had no separate budget allocation. As a result, although sizable and indisputable O&M opportunities were identified, the program manager did not have sufficient "clout" to obtain district funding for necessary staff training or small scale repairs. Without a clear source of program funding, facility problems could be identified but cost savings could not be achieved. Without savings, the district could not justify continuation of the program."
- Hale Powell, HPowell Energy Associates

There appear to be two chief advantages of hiring from outside. First, the district will likely have access to a more broadly qualified group of candidates. Second, a new employee specifically hired for O&M responsibilities may be better able to maintain a high level of focus on the program objectives for which she or he was hired.

In weighing the benefits of "inside" versus "outside" placement, it has often been suggested that a former or retired district faculty member or administrator might best combine the advantages of both. Because of their local knowledge of facilities and staff, retired principals or other administrators have sometimes been successful choices for districts beginning new O&M initiatives.

Budget Issues

It is important to identify the new O&M effort as an independent line item in the O&M budget. Without its own separate and identifiable budget, it is unlikely that the new effort will be able support program core activities such as staff training, obtaining essential consulting services, or funding the repair or modification of energy-related building systems.

As emphasized above, the level of budgeted O&M program costs will depend on district size and other factors. Costs for an "energy awareness" program in a small district will be quite low while those of a full-scale and aggressive energy tracking and accounting program will be much higher, particularly if accompanied by aggressive but low-cost repair and modification efforts. The level of involvement and assistance of local utilities and other parties can also be a major factor in determining district costs.

The largest single component of most programs will be the salary costs for the program manager. In addition, other costs may include:

- Office expenses, software, computer, etc.;
- Training and limited travel for program manager;
- Use of outside consultants and vendors;
- Training expenses for custodial and maintenance staff;
- Small-scale building repairs and modifications.

Although many factors affect actual O&M program costs, the following table provides the authors' best estimates of annual expenses. The expense ranges listed reflect estimated costs per square foot of school facilities. As the committee refines and adapts these estimates, it should keep in mind that a successful O&M program will typically achieve savings of between $.06 and $.30 per square foot of annual utility costs, depending on program type, aggressiveness of changes and the state of current O&M practices and condition of physical plant. Note that first year costs may be somewhat higher if the district purchases software or program equipment or contracts for initial consulting assistance. Costs will be less if substantial assistance is provided by utilities or other parties.

4.7.3 Recognizing and Motivating Staff Members

In Chapter 3, the Guidebook reviews some of the challenges and pitfalls commonly encountered by school O&M initiatives. Prominent among these is the lack of staff incentives or other forms of recognition for successful efforts to manage

Estimated Annual O&M Program Costs Per Square Foot of Physical Plant			
Program Type	**Staffing and Training**	**Repairs and Modifications**	**Total Costs**
Energy Accounting	$.03 to $.08	$.01 to $.07	$.05 to $.15
Energy Awareness	$.00 to $.02	$.01 to $.07	$.01 to $.10
Performance Contract	$.00 to $.05	$.01 to $.07	$.02 to $.013
Quick Fix/ Low Cost	$.00 to $.02	$.01 to $.07	$.02 to $.09

school energy costs. **Unless districts answer the question: "What's in it for me?" school staff may perceive the new O&M program as just another district mandate that they will gradually come to ignore.**

In most cases, a "top-down" centralized and mandatory approach to O&M will not be successful, particularly in the long term. In part, this is the inevitable result of changing district priorities and senior administrative staff. While energy cost control may briefly engage a Superintendent's attention, it will never compete with priorities such as raising test scores. Alternatively, energy costs may temporarily decline, producing less interest in cost control. In addition, particularly in larger districts, energy managers or senior staff have a very limited ability to monitor or enforce "requirements" at multiple schools.

Establishing incentives or providing specific recognition for district staff is a very challenging proposition in many school systems. In some settings the idea of incentives or rewards based on staff initiative seems quite alien and has often been quickly rejected as completely infeasible. On the other hand, some districts have been quite successful. Clearly, there can be many complications stemming from the nature of labor agreements, job descriptions or existing budget structures. In some districts there has been concern expressed about the potential for favoritism or staff divisiveness resulting from the recognition of specific staff for O&M activities.

Whatever the obstacles, somehow the district has to find a mechanism by which widely dispersed school staff can be motivated to increase their skills and to more proactively manage operational costs. Otherwise, staff interest and attention will likely diminish quickly with time, and program cost savings will not be obtained. The more important question is **how does a district actively motivate its decentralized facility staff in ways that are financially and organizationally feasible?**

The authors of this guidebook have worked with a number of school districts to try to identify successful approaches to motivating staff. There is no single and simple recognition strategy that fits all districts. However, given the importance of staff motivation, U.S. school districts have implemented a variety of strategies to recognize and reward high performing schools and staff. The key to success has usually been the development of a more creative strategy, one that rewards performance but represents a low-cost burden to the district.

Staff Recognition and Motivation

- Training is statement of staff value
- Staff performance evaluations
- Energy cost savings shared with high performing facilities
- Low-cost rewards and public recognition

In general, schools have used two distinct philosophies in respect to incentives or rewards. One is primarily directed at recognizing or rewarding individual staff initiative in identifying energy waste or proposing solutions to energy management issues in their schools. The other approach is to reward the successful school itself, providing incentives that broadly reward administrators, faculty and building staff, all of whom contributed to improved management of their school energy use.

Staff Incentives and Recognition

Recognition strategies are most appropriate for school-based administrative and O&M staff. Clearly, as the direct operators of school plants, motivating custodial and maintenance staff has been the highest priority for most districts. However, some districts have also implemented recognition systems for principals and other school administrators because of their role in the oversight of school staff and building operations. In general, it appears that the awarding of financial incentives to individual staff is unworkable in most settings. Instead, districts have identified the four general approaches described below, all of which entail minimal district costs:

- **Public Recognition —** Custodial and maintenance staff often feel "invisible" or undervalued by district organizations. Recognition in local media or the public presentation of achievement awards can be quite effective in acknowledging staff contributions. Sometimes these awards have been combined with the incentives listed below.

- **Performance Evaluations —** Some school systems have chosen to motivate staff by including a specific energy management element in the annual staff evaluation process. For example, evaluations of principals in the Haverhill, Massachusetts district include an assessment of progress made in managing school energy costs. Evaluation of O&M staff can include similar features as well. Evaluations can also reflect staff attendance at technical trainings or expanded energy systems expertise.

- **Low-cost "Perks" —** Some districts have had considerable success obtaining low-cost staff "perks" from local businesses or utilities. Items such as gift certificates, restaurant meals or customized apparel have been used to reward outstanding staff.

- **Training Opportunities —** Supporting attendance at technical training is both an effective reward and a means of increasing staff energy expertise and professionalism. Successful completion of staff training also has the potential to reduce dependence on services provided by outside vendors. A wide variety of training programs are available which address building systems and O&M management techniques.[17]

School Incentives

In lieu of recognition of specific staff, many systems have opted to more broadly recognize the progress and achievements of individual schools. For ETA-based programs, this recognition is commonly awarded on the basis of annual energy savings attributed to specific schools. In other districts, school awards are not "savings-based" but made on the basis of specific O&M program efforts successfully completed by school staff. See the Montgomery County, Maryland case

study, which incorporates both approaches, in Chapter 6 for an example of this latter approach.[18]

Incentives for schools can either be financial or non-financial. In a typical financial arrangement, 10% to 30% of estimated school energy savings would be made available to augment school discretionary spending. For example, if a school saved $10,000 in energy costs, $1,000 to $3,000 could be spent on additional school resources or projects selected by staff, sometimes with the input of students.

Other school incentives can involve district purchase of specific resources or equipment of particular interest to individual schools. Examples might include updated cleaning, audiovisual or sports equipment.

4.8 At Last: Implementing the Program

In a sense, the actual implementation of new school O&M initiatives is the easy part. This is particularly true if the district has selected a well qualified program manager and the program details reflect a broad consensus of energy committee members and other staff. As with the production of new automobiles or other products, good program planning and "engineering" is critical. Assembly is fairly straightforward if all the parts are designed to fit well together. Similarly, actual O&M program implementation is easier if the district has adopted an O&M program that is both suitable to its own organizational culture and resources and which effectively anticipates the common program challenges detailed in Chapter 3.

During the transition from planning to implementation, external resources will be of great value. By this point, the district has become familiar with a great number of reference materials, guidebooks and staff from utilities and other school systems, which are available to provide detailed guidance on implementation issues. We encourage the district and new O&M program manager to utilize these resources extensively as the new program gains momentum.

The *School District Energy Manual, RCM Resource Wise,* and other references provide good ideas and excellent detail on specific steps toward a full O&M program rollout. The authors of this Guidebook see limited value in repeating this detailed material here. As opposed to the "cookbook" or proscriptive approach of other resources, **our objective is retrospective – to emphasize the critical issues common to multiple school initiatives and to provide districts with the highlights of implementation strategies that have actually been effective in real world school settings.**

Based on professional in-school experience as well as review of program references, guidebook authors have identified a typical "critical path" for the first 12 months of program implementation. Although the O&M program manager will have primary day to day responsibility for these milestones, regular reporting to and involvement by senior district managers is essential. In particular, the district energy committee can provide crucial resources, feedback and support to the energy manager in the early months. Since they are the source of the program's detailed planning and "vision", the on-going involvement of committee members will help ensure that the program achieves its planned objectives.

A summary of the six critical factors for successful implementation, particularly during the first six months of program rollout, is given below, is given below.

Critical Path: O&M Program Implementation

- Training and orientation of program manager
- Develop twelve-month implementation plan
- Establish and maintain program visibility
- Collect and distribute energy performance information
- Conduct initial O&M staff training
- Develop detailed building procedures manual/shutdown procedures
- Define baseline performance if appropriate
- Prioritize school facilities
- Implement repair and Modification projects at priority schools
- On-going oversight and modification of program.

4.8.1 Critical Factor #1: Program Visibility and Progress Reporting

The district organization chart typically lists O&M programs as an element of the district facilities department. Nevertheless, it is critically important that the program and program manager be visible to the Superintendent, school board and other staff. The periodic reporting of program objectives and progress is essential to sustain staff interest and to develop a broad constituency of support throughout the district organization. To achieve these objectives, O&M programs have successfully used periodic program newsletters, school board presentations, websites and other "outreach" strategies.[19] Responses and feedback from staff have also often identified key points of contact within individual schools or other district departments who are supportive and can contribute to the O&M mission.

The anticipation of staff concerns is also an important element of program outreach. In particular, some staff will inevitably associate "energy conservation" with reduced occupant comfort, regardless of how large the monetary savings may be. Communicating actual program objectives and benefits is essential to alleviate such concerns, as is emphasizing the broad involvement of district staff in the planning and implementation of the O&M program.

In addition to internal outreach, school programs have frequently been successful in generating broader public interest by means of newspaper and other media coverage. Taxpayers and the public will generally be interested in your district's efforts to improve efficiency and reduce operating costs.

Without developing visibility and achieving broad support from staff, senior administrators and elected officials, the new O&M program will be very vulnerable to budget cuts, changing district priorities and staff turnover. In addition, there is a high probability of as "mission slippage" as described above unless administrators outside the facilities group are enthusiastic about the program's progress in reducing operational costs.

4.8.2 Critical Factor #2: Energy Savings

In communicating the objective of reduced operating costs, it is important to emphasize that energy savings from O&M are not immediate. As opposed to the installation of new high efficiency lighting or HVAC systems, O&M energy savings are not the product of a one-time capital investment. Developing staff expertise and new management tools takes time as does changing habitual practices of building maintenance and operation. However, some degree of energy awareness typically generates as immediate 1 to 3% operational savings.

Particularly for full-scale programs in large districts, energy savings will not be conspicuous until some time after district staff is trained and clear expectations and objectives are articulated. Depending on program type, this is usually a matter of months. With the possible exception of small and simple programs, full O&M savings impacts may not be realized for six to twelve months.

4.8.3 Critical Factor #3: Distribution of Information

Distribution of school-specific energy information to building staff is essential and should be a high organization priority. It is common sense that building staff and administrators can only effectively manage their buildings if they have

ready access to their building's energy cost information. Without this information, staff will be unable to identify progress or deterioration of their buildings energy performance.

Nevertheless, the authors have observed a number of school districts that have been reluctant to distribute this information, denying principals and custodial staff an important management tool. A number of reasons, some quite legitimate, have been cited to explain this hesitation. Among them have been the lack of either well organized billing data or staff with adequate computer skills. Sometimes the problem has been a lack of confidence in the energy information or even a desire to avoid embarrassing staff at "low performing" schools.

The program manager or energy committee must develop resources to confront these problems. Clerical and program staff must be trained to adequately organize and manage this key management information. Administrators must stress the importance of cross-functional communication to O&M program success. Perhaps the most important element common to all successful school O&M efforts has been the dispersal of energy cost information to staff at individual schools. Without regular energy cost information, principals and custodial staff are entirely unable to assess the performance of the buildings they are charged with operating. Without this information, sizable cost savings are unlikely.

4.8.4 Critical Factor #4: Course Changes and Program Flexibility

The objective of the program planning effort completed by the district energy committee was to design a program reflecting broad staff consensus – a program with a high chance of success because of its good fit with district resources and staff needs.

No program is perfect; however, and provisions must be made to address inevitable problems and to make "tweaks" in the program. Two points are important in this regard. First, problems can only be addressed if they are identified and reported. School experience has shown the importance of the establishment of clear program milestones and regular program reporting to school boards, Superintendents, or the district energy committee.[20] Secondly, when possible, program changes should reflect the input of all affected staff.

4.8.5 Critical Factor #5: External Support

This Guidebook has repeatedly stressed the importance of obtaining outside support from utilities, local business and other organizations. A major element of the planning process completed by the energy committee was the identification of potential sources of this support.

The first year of program rollout is a good time for the program manager to redouble these efforts. As the effort moves forward, specific needs for technical and other assistance with become clearer. The detailed program plan developed by the district, similar to a "business plan," can provide credibility in efforts to obtain external assistance.

4.8.6 Critical Factor #6: Detailed Procedures Manual

Building Systems: Standard Operations and Procedures

- Heating/cooling temperatures and hot water
- Ventilation control & exhaust fans
- Off hour building scheduling
- Lighting—illumination levels and lighting control
- Control of computers, vending machines and other plug-connected loads
- Vacation and nighttime shutdown procedures
- Scheduled maintenance and record keeping
- Energy system repair—work orders and administrative process

Early in the planning process, the district committee should develop an energy policy that provides the outlines of the O&M program and defines broad cost and performance objectives. To supplement that effort the program manager will need to develop a much more detailed and technical reference that provides specific guidance to building staff.

The objective of a procedures manual is to define standardized building management practices that are to be employed by O&M staff at all school facilities. Without this detailed guidance, building practices such as shutdown procedures or equipment tuneup schedules will continue to be haphazard. The shaded text box includes key elements to be addressed.

Of particular note is the importance of establishing procedures to minimize energy use during unoccupied periods or at times when school space is utilized by community groups during after-hour periods. Experience indicates that the latter issue, building "scheduling," is a growing problem as schools are increasing used by outside organizations. This rise in after-hours usage presents unique challenges to the district including energy cost reimbursement, minimizing energy use in unoccupied building "zones," impact on district budgets, the establishment of appropriate rental rates and other issues.

4.9 Implementing the Program: A Final Word

The ultimate objective of the new O&M initiative is the achievement of very specific and "hard" objectives, both technical and financial. The school district wants to improve the energy efficiency, longevity, and reliability of building systems such as boilers, unit ventilators, and air distribution systems. In the process, the district hopes to achieve energy cost savings of 5% to 20%.

Ironically, "people skills" are essential to achieving these goals. Boiled down, the key ingredients to success are the successful education of district staff and their effective motivation to change prevalent building operating and maintenance practices. As such, the program can only be effective if district administrators and O&M program staff can effectively communicate the benefits of better building management and persuade building staff to actively contribute and cooperate.

Without question, the program manager will, in the early months, encounter building systems, that are very poorly controlled or maintained, usually incurring a large energy cost penalty for the district. However, as emphasized in Chapter 3, **the worst mistakes the manager can make are to assume that current O&M practices result from incompetence and are the product of poorly performing custodial and maintenance staff.** Much larger factors are almost certainly at play, including diminished budgets, inadequate training and the lack of sustained, clear expectations from senior administrators.

To effectively educate and motivate staff, it is essential for the program manager to keep these larger factors in mind. **Blaming custodial or maintenance staff for poor current practices is a misdiagnosis of the problem and will undermine chances for success.** The program manager must keep in mind that a working and respectful partnership with custodial and maintenance staff is absolutely critical.

[1] See Appendix A

[2] In most cases, this individual should be selected by the district after program details have been approved and finalized.

[3] The utility representative may also be able to play this technical role.

[4] A number of states currently require periodic submission of district infrastructure and facility plans. These plans typically address the condition of school physical plants and the anticipated need for renovations and/or improved maintenance.

[5] Multiple factors contributed to poor program progress in these settings. Many of the program "challenges" discussed in Chapter 3 were significant obstacles. Prominent among these were the inadequate distribution of energy information to staff, a lack of program involvement and leadership from senior district staff and inadequate time commitment by the program lead.

[6] See Appendix A for information concerning energy accounting software products and features.

[7] Originally developed in Oregon in the 1990s, RCM programs are now in place in California, the Pacific Northwest and New England. RCM efforts tend to rely heavily on utility assistance, particularly from electric utilities.

[8] See Marion School District case study in Chapter 6 for an example of savings as the result of identified billing errors.

[9] In theory, baselines are used as a means of estimating actual savings at individual schools. In turn, these estimates are used as indicators of success and as the basis for performance incentives and recognition for successful school administrators and facility staff. In practice, the establishment of baselines is often (but not always) a difficult, prolonged and imprecise process.

[10] In some ETA school programs the calculation of school-specific savings has become prohibitively time consuming. As a result, these districts have chosen to adopt other means of rewarding program progress at specific schools.

[11] The majority of performance contractors focus almost entirely on capital intensive projects, not O&M. Since the requisite skills are quite different, when selecting an performance contractor it is crucial to confirm strong O&M expertise and experience.

[12] Most performance contracting based O&M projects use energy accounting software to track energy costs and identify savings opportunities. Thus, these performance contractor projects are actually another variant of the ETA approach described earlier.

[13] As a specific example of this "manipulation" critics claim that energy savings estimates are inflated due to the artificially high annual energy cost baselines assumed by the performance contractor.

[14] The second "policy" is actually a standardized building procedures manual with more technical content appropriate for facilities, custodial and maintenance staff. Because of its detail, it is probably best developed later.

[15] This is not to suggest that trades people are inherently unqualified for the program manager role. The important point is that although technical skills are a plus, communication, organizational and management skills are essential.

[16] This arrangement sometimes allows districts to select the best qualified candidate while avoiding time consuming and burdensome compliance with district hiring procedures. In most, but not all cases, the district has directly reimbursed the sponsoring utility for salary expenses.

[17] A few of these offerings are provided by the BOC training program mentioned above, the Association of Energy Engineers (AEE) and Schooldude.com.

[18] Because of the difficulty of estimating school-specific savings, some districts have abandoned the "savings based" approach and adopted an "effort-based" strategy. Montgomery County is a case in point.

[19] To save time and expense, O&M program managers should consider customizing existing newsletters and other program outreach materials developed in other settings.

[20] Specific milestones will vary with program type. Typical examples might include distribution of school energy data, completion of custodial training, or the prioritization of schools needing O&M improvements.

CHAPTER 5. TECHNICAL OPPORTUNITIES FOR ENERGY EFFICIENCY IMPROVEMENT

Overview: Energy efficient O&M activities and procurements discussed in Chapter 5:

- Lighting Strategies
  - Schools can save anywhere from 8% to 20% of lighting energy by simply turning off lights in unoccupied rooms.
  - Periodic cleaning of lamps and light fixtures can save up to 15% of lighting energy.
- Computers and Office Equipment
  - Energy Star monitors have a low-power sleep mode that only uses between 2 to 10 watts.
  - Energy Star printers can save a school $25 per year.
  - Energy Star copiers can achieve savings of 40% compared to standard models.
- Building Envelope
  - All doors and windows should be inspected periodically for air leaks.
  - The building should be inspected periodically for water leaks.
- Heating, Ventilation, and Air Conditioning
  - Proper boiler maintenance can lead to energy savings of 10 to 20%.
  - Regular maintenance of the air conditioning system maintains optimal cooling performance and saves money and energy.
- Water Heating
  - Periodic maintenance on the hot water system can keep it operating efficiently and extend the life of the system.
  - Timers can be installed to shut off electric hot water tanks during periods when the building is unoccupied.
- Kitchen
  - Schools can reduce energy consumption by preheating ovens for no more than 15 minutes before use.
- Swimming Pools
  - Pool covers can save as much as 50 to 70% in energy, 30 to 50% in make-up water, and 35 to 60% in chemicals
- Vending Machines
  - An energy control device for vending machines can save as much as 47% with a payback of less than 2 years.

5.1 Overview

Previous chapters have described how to successfully plan, develop, and implement an energy-efficient O&M program. This chapter provides you with technical strategies that are most valuable to O&M maintenance personnel. A section of this chapter is also dedicated to a discussion of portable (relocatable) classrooms.

5.2 School Energy Use Profile

School energy costs are associated with the operation of a variety of equipment. Although lighting and space conditioning improvements typically represent the largest opportunities for savings, better management of other "end uses" will also produce sizable cost savings to your district.

Energy End-Use Issues

- School energy end-use is very sensitive to climate region and conditions.
- Heating, cooling, and lighting usually combine for the majority of energy consumption by schools, and represent the largest opportunities for savings.

On average, space conditioning, i.e., heating and cooling, account for the majority of school energy end-use. Water heating and lighting are the next biggest energy consumers for schools. The figure below depicts the national average for school energy end-use.

National Average of School Energy End-Use					
Climate	**Heating**	**Cooling**	**Lighting**	**Hot Water**	**Misc.**
Cold and Humid	40	12	30	11	7
Cool and Humid	23	30	30	10	7
Cool and Dry	32	21	30	10	7
Temperate and Humid	14	41	30	8	7
Temperate and Mixed	30	23	30	10	7
Hot and Humid	18	35	30	10	7
Hot and Dry	16	38	29	10	7

Ref: Energy Design Guidelines for High Performance Schools, U.S. DOE, 2002.

These energy use numbers are very dependant on climate region. In fact, a Florida Solar Energy Center (FSEC) survey (FSEC-CR-951-97) showed that cooling accounted for 43% of total energy consumption in one school, whereas some northern schools have no air conditioning at all.

Energy Consumption and Load Data

"Trying to get reasonably timely consumption data for a large number of schools from bills in a deregulated electricity environment is an exercise in frustration. We opted for a system that allows us to view, over the internet, daily consumption in each school. An additional benefit of that is that building service staff, teachers and students can also access the information, providing instant feedback on their conservation strategies."
-Jeffrey Price, Montgomery County Public Schools

Gas and electric utilities can collect metered energy consumption data for each individual school in your district. At a minimum, this information reflects the monthly kilowatt hours (electric) or thousand cubic feet (gas) consumed in the prior month. Utilities also assist in "cleaning" this monthly data and providing it in electronic form for school district use and analysis.

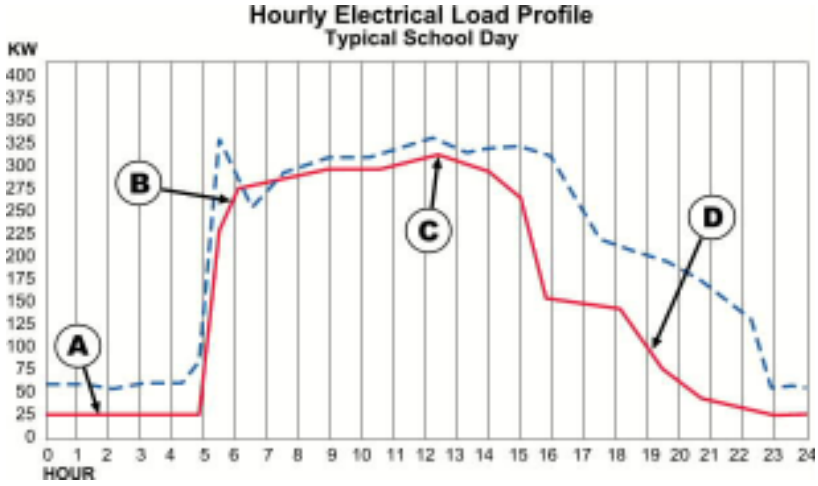
In addition to monthly electric "energy" data, metering at large schools frequently includes hourly "demand" or "interval" data. This information can be extremely useful in assessing building performance and energy consumption on a daily basis. Utilities will often assist in the analysis of school "load profiles."

Keep in mind that end-use allocation does not necessarily correlate with the prevalence of O&M opportunities. Although it is useful to show how school facilities typically utilize energy, actual energy- and cost-saving strategies depend on a variety of issues, including equipment condition. Some school districts have made great progress in energy and cost savings, but many school districts are overlooking major opportunities for additional savings simply because they are not aware of them. This guidebook is intended to help you identify the best opportunities for your school district.

The following graph, provided by Marion County Public Schools, Florida, indicates a typical mid-sized school electrical use pattern that could be found while monitoring any given school day.

Where Can Savings Be Found?

If you could see how your facility uses energy during the day (on an hourly basis), you might find a pattern like that shown below. The explanations below point to places to look for potential energy savings.



Blue Line (dash) - This indicates a typical electrical use pattern (load profile) that could be found while monitoring any given school day.

Red Line - This indicates a modified electrical use pattern after analyzing the blue line and looking into why the pattern exists. The red line is a more optimized consumption pattern that saves energy. The analysis is broken down in 4 areas.

A. Base load during non-operational hours - In this case we might find unnecessary equipment, lights, or fans running all night long.

B. Startup of HVAC - In this case we might find too much equipment starting at the same time creating an unnecessary peak load (possibly raising the demand charge).

C. Peak load shedding - In this case we might find equipment running that doesn't need to run at this time of day (also raising the demand charge). Some equipment can be scheduled to run during non-peak hours of the day.

D. After class time operations - In this case we might find that too many lights, HVAC systems, or other equipment are still running after students and teachers have left. This area constitutes the most promising area for energy conservation.

In this realistic example, the potential savings for one school day is over $50.00 (850 KWH x $0.064 KWH). This equates to over $9,000 per year for this school (180 school days x $50).

Source: http://www.marion.k12.fl.us/dept/emg/7steps/where-found1.htm

5.3 Examples of O&M Strategies

Before getting into technical details, it is important to make clear who does what. The tables in this section list a few operations and maintenance strategies for

O&M Strategies

- Low cost O&M lighting improvements are primarily the product of improved control, mostly by means of eliminating unnecessary usage.
- Depending on the boiler system's condition and current operation, energy savings strategies can result in savings of 10% to 30%.
- There are several low-to-moderate-cost energy saving strategies for water heating, including enforcing strict nighttime and vacation shutdown or temperature setback procedures during these periods.

various technology areas, each starting with low/no cost procedures (zero or very short payback of less than 6 months) and ending with moderate cost strategies (pay backs in the range of two to three years). Of course, actual payback varies with energy cost and hours of operation. The designation of authority is crucial to the successful implementation of energy saving strategies into operations and maintenance procedures. O&M staff must be granted the authority to carry out energy efficiency strategies such as shutting off equipment after hours. These procedures and schedules must be developed and implemented by cognizant managers including, O&M staff, principals, faculty, and information technology specialists.

Energy saving strategies can be categorized as:

1) Equipment control. Limiting equipment operation exclusively to occupied hours and to building areas actually requiring heating, lighting, computers, etc. Adequate provisions and scheduling for weekend and vacation shutdown procedures.
2) Scheduled maintenance. Reinstate required maintenance procedures for filters, boiler feedwater, equipment lubrication, etc.
3) Simple repairs. Low-cost repairs that can be completed by in-house staff. Examples include steam pipe insulation, exterior weatherstripping, etc.
4) Equipment tune-ups and calibration. Periodic tune-ups and calibrations can extend the life of school facility equipment as well as ensure proper operation.

For some energy systems, all four strategies can be used. For example, the efficient operation of a steam boiler system can be enhanced by utilizing some of the strategies listed below.

Example: O&M Energy Savings Strategies
Steam Boiler

Category	O&M Measure	Required Resources	Payback
Control	Vacation Shutdown & Thermostat Setback	Internal Staff, Low Cost	< 6 moths
Maintenance	Chemical Treatment of Feedwater	Contract Vendor, Moderate Cost	2 years
Repairs	Install Pipe Insulation, Repair Steam Traps	Internal Staff, Moderate Cost	1 year
Tune-up	Combustion Efficiency Testing and Adjustment	Contract Vendor, Annual Testing	< 1 year

Depending on the system's condition and current operation, savings of 10% to 30% are achievable. Low cost O&M lighting improvements, in contrast, are primarily the product of improved control, mostly by means of eliminating unnecessary usage.[1] The following tables compare O&M lighting and hot water energy savings strategies.

Example: O&M Energy Savings Strategies Lighting			
Category	**O&M Measure**	**Required Resources**	**Payback**
Control	Occupancy Sensor	Internal or External Staff, Moderate Cost	< 3 years
Control	Bi-Level or Zone Switching	Internal or External Staff, Moderate Cost	< 3 years
Control	Exterior Photocell Install or Repair	Internal or External Staff, Moderate Cost	< 3 years
Control	Strict Nighttime and Vacation Shutdown	Internal Staff, Low Cost	< 6 months
Maintenance	Selective Delamping Where Illumination Is Excessive	Internal Staff, Low Cost	< 1 year
Maintenance	Replace All Remaining Incandescents With Compact Fluorescents	Internal Staff, Low Cost	< 1 year

Example: O&M Energy Savings Strategies Hot Water			
Category	**O&M Measure**	**Required Resources**	**Payback**
Control	Strict Nighttime and Vacation Shutdown or Setback	Internal or External Staff, Low Cost	< 6 months
Control	Adjust Water Temperature to Lower Legal Limit	Internal or External Staff, Low Cost	< 6 months
Repair	Repair Hot Water Leaks	Internal or External Staff, Moderate Cost	1 to 2 years
Repair	Install or Repair Pipe Insulation	Internal Staff, Low Cost	< 6 months

In addition to the examples above, this chapter identifies strategies to reduce unnecessary energy consumption by computers, kitchen equipment, vending machines, air handlers, hot water boilers, swimming pools, and other major systems throughout your district.

5.4 Lighting

Lighting strategies present the easiest opportunities to modify energy consumption without any major expense. Simple and cheap strategies are switching off lights when not in use, delamping, and cleaning lamps, diffusers, and fixtures. A more expensive lighting strategy is periodic group replacement of lamps, or relamping. This strategy can keep the lighting system operating near peak output and efficiency. Schools can also install automatic controls such as occupancy sensors, time controls, photosensor controls, and dimmers.

Electricity use comprises approximately 80% to 90% of the annual cost, and between 65% and 85% of the life cycle cost of a lighting system. The entire lighting system includes lamps, ballasts, fixtures, and controls that help provide

Lighting Strategies

- Energy comprises approximately 80% to 90% of the annual cost, and between 65% and 85% of the life cycle cost of a lighting system.
- Lighting strategies present the easiest opportunities to modify energy consumption without any major expense.
- Simply turning off lights in unoccupied rooms can save schools anywhere from 8% to 20% of lighting energy.
- Carefully planned delamping of general overhead lighting can save schools 25–50% of lighting energy.
- Schools should consider replacing lamps once they reach 70% of their life expectancy.
- Lamps, diffusers, and light fixtures should be cleaned periodically to maintain proper lighting levels.
- Automatic lighting controls are retrofits that offer significant energy savings with short payback periods.

the proper illumination levels throughout the building. Items such as windows, skylights, and interior building surfaces all interact with lighting systems.

5.4.1 Manual Light Switch (Turn Them Off)

Schools in your district can save a lot on their electricity bills by simply turning off lights in unoccupied rooms. Significant savings from turning off fluorescent lights can be achieved with minimal aggravation or inconvenience to the user. Pacific Gas and Electric estimates that up to 8 to 20% of lighting energy can be saved by simply turning off lights in unoccupied rooms.

The entire school can participate in this effort. Organized student light patrols work very well with elementary students. Students can patrol the school and shut off lights in unoccupied rooms throughout the building. They can also leave post-it notes as reminders to students and staff to turn off the lights as they leave the room.

At night, most of the lights, excluding the security lights and exit signs, should be turned off. During the morning hours, building service staff should delay turning on the lights in vacant parts of the building until people arrive. This will allow your schools to reduce energy bills without causing any inconvenience.

To read more about energy savings with fluorescent lighting, visit: http://lightingdesignlab.com/

5.4.2 Keep Them Clean

Even in a relatively clean environment such as a school, dirt and dust can reduce the amount of output from lamps by as much as 15 percent a year. You can increase lighting output levels by periodically cleaning the light bulbs and fixtures (tube and luminaire) with a dry cloth. Most normal maintenance procedures call for annual cleaning of light fixtures. However, depending on room conditions, more frequent cleanings may be required. Over time, diffusers will need to be replaced. Diffusers are the plastic covers over the lamps, and over time they can turn yellow/brown and significantly reduce the light output.

5.4.3 Window Blinds and Window Film

Window blinds and window films can be used to reduce the amount of solar heat loss or gain depending upon the season. Window blinds can be closed during the warmer months to prevent against excessive solar heating. Additionally, the blinds can be opened during the colder months to allow solar heating to warm the classroom. This strategy can save on your heating and cooling bills. During the colder months, you can benefit from the lighting and heating of natural daylighting. However, there are tradeoffs between savings on your cooling bills and increasing costs on your lighting bills during the warmer months when the blinds are closed.

You can install window film to help reduce solar heat gain in the summer. The film will also cut down on annoying glare, but at the same time will reduce the amount of available daylight. Proper installation is critical for durability and aesthetics.[2]

"Many facilities professionals believe there are a number of myths surrounding lighting system operation that tend to get in the way of energy and cost savings."

"For example, there is the belief that continuously operating fluorescent lights is cheaper than turning them off for brief periods of time. Actually, turning off fluorescent lights saves energy, extends overall lamp life and reduces replacement costs. Turning off one T-8 fluorescent tube for ½ hour each day saves enough money in energy over the life of the tube to pay for the tube."

"A second, related myth holds that lights shouldn't be turned off because it shortens lamp life and increases maintenance costs. Actually, fluorescent lamps will run more hours when operated continuously, but they will last for many more years if they are turned off when not in use. Although switching shortens the average rated life of fluorescent lamps, it extends calendar life – the time between lamp changes, including the time the lamp is off. Since lamp changes are based on calendar life, the average rated life should be of little concern to maintenance managers."

"For example, T-8 lamps operated continuously result in a rated lamp life of 34,000 hours, a calendar life of 3.9 years. Turning them off for 12 hours each day decreases the average rated lamp life to 30,000 yours but extends the calendar life to 6.8 years. This means the relamping interval increases from 3.9 years to 6.8 years, reducing maintenance labor costs." John L. Fetters, "Taking Control of Lighting."

Source: www.facilitiesnet.com/MS/Aug03/aug03lighting.shtml

5.4.4 Exit Signs

Chances are your school has several exit signs, which must be on at all times. New exit signs that use light-emitting diodes (LED) have earned the Energy Star label. LED exit signs use about 5% of the energy used by incandescents and 20% of the energy used by compact fluorescents. An Energy Star LED exit sign can last 25 years without lamp replacement, compared to less than one year for an incandescent. The payback period for a new Energy Star LED exit sign is less than one year. Exit sign retrofits are inexpensive and easily implemented.

5.4.5 Delamping

Delamping is the process of removing fluorescent lamps from a light fixture. It is a quick and easy way to achieve significant savings on your utility bills, when current illumination levels are excessive. It is easy to do, and it does not cost you a thing. In some cases, installation of reflectors may also be combined with delamping. According to Pacific Gas and Electric, you could save 25-50% of lighting energy by delamping general overhead lighting.[3]

How to properly delamp a light fixture depends on the technology implemented at your school. If your school has T-12 lighting (larger diameter bulbs, four per fixture), you must remove the lamps in pairs, either inboard or outboard. If your school has T-8 lighting (smaller diameter; two, three or four lamps per fixture), you can remove any lamp in order to reduce light output.

The best places to consider delamping are:

- near windows,
- doors and corners,

"Lighting systems perform best when they are maintained at regular intervals. Group relamping is a maintenance strategy aimed at maximizing lighting system performance and maintenance economy by changing out all lamps at regular intervals, as opposed to relamping only when lamps have burned out. In the long run, group relamping reduces the cost of maintaining lighting systems through simple economy of scale. Furthermore, relamping luminaries at regular intervals maintains light levels and lighting quality according to design intent and establishes good lighting maintenance procedures. For cost effectiveness, group relamping should be combined with luminaire cleaning and troubleshooting. Lamps used with dimming ballasts should be properly seasoned prior to being dimmed."

Source: (National Best Practices Manual For Building High Performance Schools, p 162)

- over computers and televisions,
- near skylights, and
- corridors off the main hall.

There are several things to keep in mind when it comes to delamping. You should never compromise health, safety, and security to save on your energy bills. Follow the recommended light levels established by the Illuminating Engineering Society of North America. Their rule of thumb is that you should not delamp a fixture if in doing so there will be fewer than two 4-foot lamps for every 64 square feet. In addition, do not remove lamps from fixtures that are still under warranty. Delamping could void your warranty if something were to happen to the fixture.

For more information on the subject of delamping, visit http://www.iesna.org/

5.4.6 Relamping

Typically, a fluorescent system will perform at 80% or less of its original useful light output after several years of operation, a drastic reduction in performance with no associated reduction in cost. Maintenance in the form of periodic cleaning and relamping will keep the system operating near peak performance.

The initial equipment and installation costs of lamps and ballasts represent only 4% to 6% of the annual cost of operating a lighting system. Labor to clean and change lamps and ballasts represents 8 to 12%. The rest, 82 to 88%, is electricity cost to operate the system. A regular maintenance program can reduce lumen depreciation as much as 25 to 50%.[5]

5.4.7 Automatic Lighting Controls

Occupancy Sensors

Occupancy sensors utilize motion detectors to turn off lights in unoccupied rooms or spaces. They are most effective in areas that are intermittently occupied such as the teachers lounge, staff restrooms, and storage areas. Occupancy sensors utilize two principal technologies, passive infrared and ultrasonic. Passive infrared sensors sense occupancy by detecting body heat, while ultrasonic sensors use volumetric detectors and react to broadcast sounds that are above the range of human hearing. To avoid false shutoffs, you may want to install a sensor that

utilizes both of these technologies. These sensors feature two adjustments, delay and sensitivity. They must be properly adjusted to achieve the optimum compromise between energy savings and appropriate function.

A recent study conducted by the Florida Solar Energy Center, in two Florida elementary schools, produced mixed results. In one school, installing occupancy sensors achieved 11% savings with a payback of 3.6 years. The other school, however, did not see any savings. Savings were absent for the second school because an aggressive energy efficiency strategy was already in place. While occupancy sensors are relatively cheap and offer savings on your electric bill, a successful student light patrol program can achieve similar savings without any upfront costs. In order to be sustainable over a period of years, a faculty or staff member must champion student-involved activities.

Time Controls and Photosensor Controls

Time controls, via preprogrammed scheduling, allow you to save energy by reducing the amount of time the lights are operating. Time controls make good sense for areas of the building that have predictable occupancy hours. Some of the best locations for time controls are offices, libraries, auditoriums, certain classrooms, and exteriors. These automatic controls can be programmed, and you do not have to worry about physically turning lights off, for example, at the end of the day when the building is vacant. However, you must be vigilant and monitor lights to make sure that they are turned off when not needed.

Photosensor controls detect the daylight illumination levels in a room or area. A signal is sent to a control that either dims or switches the lights off in bright daylight conditions. Calibration of these controls is very important. If you are planning on changing the room in any way (paint, new carpet, additional desks, etc.), do so before you calibrate the photosensor.

Dimming Ballasts

Dimming ballasts are very effective in very well lit areas of the school. They can dramatically affect both the energy use of a lighting system and the usability of the lighting when the classroom is being utilized for audio/visual or computer presentations. Dimming ballasts permit both manual dimming as well as automatic dimming. Teachers can adjust the lighting to their desired level and override the automatic dimming which responds to daylighting levels in the room. Although dimming ballasts are most appropriate to new school design, retrofits are applicable to certain situations.

Daylighting

Daylighting can be effective and energy-efficient in nearly all school areas, including classrooms, cafeterias, offices, shops, gyms, pools, corridors, locker rooms, and study halls. On days when the natural light is sufficient to illuminate a classroom, the overhead fluorescent lighting can be turned off. This practice could result in generous savings on your energy bill. Another benefit to daylighting is that by turning off the lights when they are not needed, the life of the electric lighting system is extended and maintenance costs are reduced.

5.4.8 Lighting Retrofits

Some schools still employ the older T-12 lighting technology. By switching from T-12 lighting to more efficient T-8 lighting with electronic ballasts, you can save as much as 20 to 30% of lighting energy. Super T-8 lamps, with reduced-power ballasts, save an additional 15 to 20%. High-intensity T-5 flourescents, with an electronic ballast, can save almost half of electricity consumption compared to metal halide with a magnetic ballast.

Note that lighting retrofits are a procurement issue and a major renovation. For example, the payback period for switching from T-12 to Super T-8 lighting with electronic ballasts may be 3 years or more, depending on electricity cost and home of operation.[6]

5.5 Computers and Office Equipment

Computer and Office Equipment Strategies

- The computer monitor typically consumes 2/3 of the total energy used by the system.
- Energy Star printers can achieve a savings of $25 per year in electricity compared to standard models.
- Energy Star copiers can achieve a savings of 40% in electricity compared to standard models.

Similar to lighting retrofits, computers and office equipment are more of a procurement issue than operations and maintenance issues.

Although instructional and office equipment is normally controlled by the staff using it, the O&M staff can play an important role in shutting off equipment at the end of the day, at agreed-to terms. Everyone needs to know what to do, and they must be given the authority to carry out the proper energy saving strategies. The majority of office equipment, including printers, copiers, and fax machines are all Energy Star compliant.

5.5.1 Personal computers

The average school computer is used for only a few hours per day, but is usually left on for a much longer time. Even if computers are turned off during nights and weekends, at least half the energy they consume could still be wasted due to continuous operation during the school day. A simple and effective way to reduce energy use and costs is to shut the computer off when it is not needed for an extensive period of time. Energy Star computers are equipped with power management features, but these must be set properly to minimize inconvenience while saving as much energy as possible. In some cases, the computer is left on continuously for network services or remote access, but even in these cases, the monitor can safely be shut off.

The monitor typically consumes 2/3 of the total energy used by the system. The Energy Star Monitor Power Management Program provides free software to automatically place active monitors into a low-power sleep mode (2 to 10 watts) through local area network.

For more information on this subject, visit
http://www.energystar.gov/index.cfm?c= monitors.pr_monitors.

5.5.2 Printers

Individual printers should be turned off when the school is closed. Printers that need to be operating constantly because they are connected to a network can still profit from an Energy Star power-down feature, with savings in the range of $25 per year.

5.5.3 Copiers

Copiers should be turned off when they will not be used for extended periods of time, such as during long holiday breaks. In addition, make sure that the Energy Star power management features are activated on your copier. You should carefully follow the manufacturer's directions. There are tradeoffs between the energy savings, and having to wait for the copier to warm up from the Energy Star low-power mode. However, most of the new Energy Star copiers warm up much more quickly than previous models.

The electric power requirement of a photocopier when copying may range from under 100 watts for a small, low-speed unit to more than one kilowatt for a large, high-speed unit, although standby power is somewhat less. For a large photocopier that uses several thousand kilowatt-hours per year (costing several hundred dollars) when operating continuously, considerable savings can be realized simply by shutting it off when the school is closed.

Energy Star copiers can achieve energy savings of 40% in electricity compared to standard models. They are equipped with automatic controls to reduce their power consumption during periods of inactivity and to shut off the power after a further elapsed time interval. The time delays triggering these automatic controls should be set at the shortest time that balances the user convenience of quick machine response against the waiting time required for warm-up to occur.

For a medium speed copier, EPA estimates a savings of $25 per year when powered down to low power after 15 minutes of inactivity and to "auto-off" mode (actually still consuming 5–20 watts) after 90 minutes or less.[7]

For more information, visit
http://www.energystar.gov index.cfm?c=copiers.pr_copiers.

5.6 Building Envelope

The best way to have an efficient building is to design and construct it that way, but that is a rare opportunity. Unfortunately, retrofits can be complex and expensive, although always worth evaluating. Here we will consider only those options that are necessary for health and safety, or that are low in cost.

The most obvious approach is to monitor doors and windows, which affect energy use as well as security. All doors and windows should be closed when the air conditioning or heating system is operating. An additional strategy is to maintain the integrity of the building envelope by finding and repairing leaks. You should make sure that doors and windows close tightly. It is also a good idea to check the caulking and weatherstripping for leaks. Caulking and weatherstripping help minimize air infiltration and can effectively reduce energy waste.

Water leaks are a particular concern not just because of their resulting deterioration of building materials, but because of mold contamination and growth, a major health problem in schools today. In fact, water damage to building envelope is second only to inadequate outdoor air ventilation as a frequently reported building-related indoor air quality problem. Moisture could come from leaks in building roof, walls, or windows, from plumbing, or from condensation on cool surfaces such as pipes and air ducts.[8]

Building Envelope Strategies

- Close doors and windows when the air conditioning or heating system is operating.
- Make sure that doors and windows close tightly.
- Check the caulking and weatherstripping for leaks.
- Water damage to building envelope is second only to inadequate outdoor air ventilation as a frequently reported building-related indoor air quality problem.

Two simple energy-saving strategies that O & M staff can do are:

1) Temperature control in the building – Make sure thermostats are set properly and controls are operating. During the heating season, a quick but effective check can be done just by walking around looking for open windows. (Or just make last sentence into a box or highlight?)
2) Unblocking air flow—Pacific Gas & Electric estimates that the simple step of clearing books and papers off the tops of unit ventilators could save 10% of heating and cooling energy.

Energy Reduction Action Plan for Schools, *www.pge.com/rebates/123_reduction_plans/schools/*

Charlene W. Bayer et al., *Causes of Indoor Air Quality Problems in Schools*, Oak Ridge National Laboratory, ORNL/M-6633/R1, May 2000, p.5.

5.7 Heating, Ventilating, and Air Conditioning (HVAC)

Space conditioning (heating, cooling, and ventilation) uses more than half the energy consumed in school buildings. It is a major target for significant energy savings, much of which can be achieved at little cost. Scheduled maintenance on HVAC units included cleaning burners and air conditioner coils, replacing and cleaning air filters and checking ducts and pipe insulation for damage. Detailed procedures for HVAC maintenance are not listed here but can be found in equipment manuals.[9] By conducting general, periodic maintenance, you can extend the life of your HVAC equipment.

5.7.1 Controls

Some successful school districts have established policies and procedures for maintaining temperature settings. ASBO International's *School District Energy Manual* (p.7) states that many school districts use 68 degrees for heating and 78 for cooling in classrooms. Others may choose more moderate levels. Montgomery County, MD Public Schools sets temperatures at 70 degrees heating and 76 cooling. In addition, you should check proper operation of thermostats and calibrate temperature setpoints at least twice a year.

Programmable thermostats, with a cost premium of $50 to $200, are highly cost-effective. Where an energy management system is not used for temperature control, a programmable thermostat installed in a room can increase energy savings as well as enhance comfort. However, they must be programmed and maintained properly, which requires training of the teachers or other staff who will be using them.

A central Energy Management System (EMS) can be a great benefit or a major problem for your district. The main point to remember is that it is not a "set-it-and-forget-it" system. Building O&M personnel need to be trained in its use, and adequate communication must be maintained between central staff and building operators. System scheduling needs to be updated according to building use. The system should be recalibrated every 6-12 months.[10]

5.7.2 Heating

In most climates, the boiler is usually the largest single piece of energy-using equipment in the school building. O&M personnel need to be continually reminded of that fact. It is always a best practice to keep detailed energy use and maintenance records. Although sophisticated software is available to analyze energy consumption, simple comparisons can also be useful, such as comparisons with similar school buildings and season-to-season comparisons, normalized for heating degree days.

Saving the invoices from service calls usually will not provide a detailed history on your boiler. For one thing, the carbon-copy invoices tend to fade over the years. In addition, the technician might have abbreviated certain information that won't make sense in the future. Maintaining a notebook is a better strategy than sorting through old service invoices. Notes that are prepared when the information is fresh

can be very useful for future service calls. For example, service records and fuel consumption records can show patterns that indicate problems or verify that the boiler is functioning smoothly.

Scheduled maintenance should be performed at least annually. Boiler inspection is essential for safe and efficient operation. Proper maintenance can lead to energy savings of 10 to 20%, reduced emissions, extended equipment life, and increased building occupant comfort.[11] A qualified technician should perform boiler maintenance. However, certain things such as checking for leaks or looking for damaged or missing insulation, can be performed by your O&M staff.

Boilers should be inspected quarterly for safety as well as efficiency. The U.S. Department of Energy, Federal Energy Management Program (FEMP) on-line manual recommends that combustion efficiency be measured and recorded at least once a month during the heating season. Boilers also require other routine maintenance, such as checking feedwater, which will not be discussed here. For more details, see the boiler manufacturer's operating manual or a standard reference text.

Operations and Maintenance Best Practices Guide, Chapter 7.2, at *www.eere.energy.gov/femp/operations_mainenance/om_best_practices_guidebook.cfm*

Steam heating systems are no longer common in new schools but are still common in older schools in cold climates. These systems have certain specific O&M needs, which will not be discussed here. Of these, steam trap maintenance is one of the most crucial, because just one malfunctioning steam trap can waste thousands of dollars a year. See the *FEMP, Operations and Maintenance Best Practices Guide*, Chapter 7.3 for more information.

5.7.3 Air Conditioning

Regular maintenance of air conditioning systems maintains optimal cooling performance and saves energy. The most common causes of degraded performance are:

- Dirty filters and fans;
- Improper belt alignment and adjustment;
- Air leaks in equipment cabinets and ducts;
- Improper air damper operation;
- Dirty condenser and evaporator coils;
- Improper refrigerant charge.

Most of the maintenance recommendations apply to all types of air conditioning systems found in schools, including package systems and classroom unit ventilators. Central chillers and cooling towers require additional maintenance not discussed here.

See the ASBO International, *School District Energy Manual*, pp. 13-14; and the U.S. Department of Energy, Federal Energy Management Program, *Operations and Maintenance Best Practices: A Guide to Achieving Operational Efficiency*, December 2002, available at *www.eere.energy.gov/femp/operations_mainenance/om_best_practices_guidebook.cfm*

Dirty air filters increase static pressure, and hence reduce fan motor power, and reduce airflow through the system. You should inspect and replace all filters on a regular calendar schedule, as recommended by the equipment manufacturer, typically between one to three months. The frequency should be increased under severe operating conditions or when the economizer cycle is being used.

The filter's resistance to air flow increases as it gets dirtier. Measuring the pressure drop across the filter is a convenient way of determining when it should be changed, commonly when the static pressure increases by 0.5 inches of water.[12] For systems not manufactured with pressure taps, their installation is a simple job requiring a few dollars' worth of hardware. A complete air pressure testing kit with a dial gauge may cost about $70.[13]

Fan

Fans typically operate trouble-free for several years with minimal maintenance required. This can allow O & M staff to develop a false sense of security, which usually results in maintenance neglect and eventual failure of the fan. Some of the steps that you can periodically take to prolong fan life are; 1) clean the fan blades, 2) inspect the bearings, 3) adjust/change belts, 4) check fan current.

Fan blades should be inspected at least once a year. Cleaning the fan blades is generally a time-consuming, but worthwhile and beneficial process. Small fans can take and hour or more to clean properly, while larger fans can take considerably longer. Although most newer fans have sealed self-lubricating bearings, older units may require periodic lubrication every three to six months. Bearings should be inspected for excessive noise, vibration, or heat, which are common signs of impending failure.

Periodic cleaning and servicing enables fans to maintain a high efficiency and prevent excessive energy waste. For more information, please see the following resources:

Mike Rogers, "Top-Level HVAC Maintenance," FacilitiesNet Maintenance Solutions, October 2003. www.facilitiesnet.com/ms/oct03/oct03HVAC.shtml

School District Energy Manual, Association of School Business Officials International, 1997, p. 16.

Energy-Efficient Operations and Maintenance Strategies for Packaged HVAC Systems, May 1997. www.pge.com/003_save_energy/003c_edu_train/pec/info_resource/pdf/ONM4HVAC.PDF

Efficient Packaged HVAC Systems for Commercial Facilities, Pacific Gas and Electric Company, May 1997. http://www.pge.com/003_save_energy/003c_edu_train/pec/info_resource/pdf/PACKHVAC.PDF

Air Leaks

Leaks in the HVAC equipment cabinet and/or ductwork waste conditioned air, reducing system efficiency and occupant comfort. Annual checkups should include inspecting all access panels and gaskets, particularly on the supply-air side, where pressure is higher. Losing only 200 cfm from a 10-ton rooftop unit cuts cooling and air-flow capacity by about 5% and wastes more than $100 per year in energy costs.

Damper and Economizer

One of the most common problems with HVAC systems is improperly operating, or leaking, outside air dampers, which can affect not only energy efficiency but also indoor air quality throughout your facilities. If stuck open, they overload the cooling coil with hot outside air; if stuck closed, they lose the opportunity for free cooling. Cleaning and lubricating moveable surfaces and checking actuator movement and setpoint should be done every three to six months. It takes only a few minutes of work, costing probably less than $10 if the technician is already there. If this maintenance causes a five-ton compressor to operate only 20 hours less, the energy savings (at $0.10 per kWh) repays the additional labor cost.[14]

Heat Exchange Coils

Dirty condenser and evaporator coils reduce cooling capacity and make the compressor work harder and longer. Cleaning the condenser coil is one of the most cost-effective maintenance steps that can be done on the HVAC systems. A dirty coil that raises condensing temperature from 95° to 105°F cuts cooling capacity 7% and increases power consumption 10%, with a net compressor efficiency reduction of 16%. In a 10-ton unit operating 1000 hours per year this wastes about $120 per year in electricity costs. You can clean the condenser coil in about an hour, for a cost of about $50, resulting in a payback of 2 to 3 months.[15]

A dirty evaporator coil reduces air flow and degrades heat-transfer efficiency. Although the evaporator coil should stay fairly clean with good air filtration, it should be inspected at least once a year and cleaned as required.

Refrigerant Charge and Compressor Operation

Improper refrigerant charge reduces compressor efficiency. In an overcharged system the compressor works harder to overcome increased head pressure. In an undercharged system the evaporator does not have enough refrigerant and cooling capacity is lost. Either condition may be due to improper charging, but insufficient refrigerant is usually due to a leak, for which repair costs may range widely.

Compressors are checked by measuring the current draw and by analyzing the oil to see if moisture or acid are present. Inexpensive temperature indicator tapes may be used to measure case temperature, a frequent precursor of compressor failure.

5.7.4 Ventilation

Adequate ventilation is an essential part of maintaining a healthy and comfortable building environment. ASHRAE Standard 62 prescribes the amount of outdoor air

required for various types of indoor air spaces. For classrooms, the current standard, 62-2001, requires 15 cubic feet per minute per occupant.

Besides fan power, a considerable amount of energy can be required to bring this outside air to the proper temperature and to control humidity. Therefore, ventilation levels should be reduced as far as possible, consistent with code and health standards. During the heating season, unoccupied areas should not be ventilated (with the exception of special areas such as boiler and mechanical rooms, pools, or rooms with caustic chemicals).[16]

In the cooling season, good ventilation strategy is essential for humidity control.[17] Use of the air conditioning system to control mold is complex: It can lower humidity, but its effectiveness depends on many factors such as run-cycle duration. During low load periods, such as when the building is unoccupied, the latent heat performance of most air conditioning systems is poor, so they do not remove much moisture.

For more information on ventilation levels, please see:

1) *IAQ Tools for Schools Kit—IAQ Coordinator's Guide, Appendix H- Mold and Moisture.* www.epa.gov/iaq.schools/.

2) *Florida Solar Energy Center, "Priorities for Commercial Buildings,"* www.fsec.ucf.edu/bldg/commercial/priorities/.

5.8 Water Heating

Water Heating Strategies

- The hot water system should be checked periodically for leaks.
- The burners of gas- or oil-fired water heaters should be tested annually.
- Fixtures should be flushed periodically to prevent bacteria growth.
- Storage-type hot water tanks should be flushed annually.

Periodic maintenance on your hot water systems can keep them operating efficiently. Keep in mind that a water leak is also an energy leak. It costs money not only to heat water but also to pump it throughout the facility. The burners of gas- or oil-fired water heaters should be tested and adjusted on an annual basis.[18] It is also a good idea to periodically flush the fixtures with very hot water to control bacteria growth.

Storage-type water heater tanks should be flushed out annually to remove sediments that reduce heat-transfer efficiency. The burners of gas-fired or oil-fired water heaters should be tuned up at least once a year. "Demand" (tankless/instantaneous) water heaters eliminate stand-by losses, but deliver a continuing flow of hot water once activated. These water heaters do not run out of hot water as a storage water heater can.

For more information on "demand water heaters," visit www.eere.energy.gov/ and type "demand water heaters" into the search box.

You should set the thermostat at the lowest acceptable temperature, because the hotter the water temperature the faster you lose energy through the pipes and storage tank.[19] You should also locate water heaters near the point of main use. Installing a booster water heater for the kitchen, where higher water temperatures are required for dishwashing, is also a good idea. However, booster water heaters can rack up costs and should be monitored closely. Insulating the hot water pipes and storage tank will help to retain the heat. In addition, insulation on a cold water pipe will help prevent condensation from forming.

Obstacles to Revitalized O&M

A pool cover system placed on an indoor pool in Chesaning Union Middle School, Michigan, cut the pool's energy costs in half just 8-months after installation. Annual savings are estimated at $9,000. The district purchased an inexpensive bubble, or solar, cover that resulted in a payback period of 3 months. Now that the benefits of a cover have proven themselves, when the cheaper model wears out, the district will invest in a longer lasting model using the savings. The school observed several other benefits in addition to the energy savings, including:

- Reduced cleaning time by preventing dirt and debris from falling into the pool;
- Decreased humidity;
- Reduced water loss by roughly 65 percent;
- Reduced chemical use due reduced water loss; and
- Prevention of structural erosion of building.

Your district may want to consider the possibility of adding a timer to shut off electric water heaters during periods when the building is unoccupied. These timers also control the hot water recirculation pump. Prices for recirculating system timers range from $40 to $50, and have a payback period of 2 to 5 years.

If a boiler is used for both space heating and domestic hot water, it is probably operating at low efficiency much of the year. From the fuel consumed when space heating is not required, you can estimate the annual energy cost of using the boiler for domestic water heating. Compare that to the energy cost to operating individual water heating alternatives.

5.9 Kitchen equipment and operations

There are several opportunities for energy savings in school kitchens. You should keep refrigerator coils clean and free of obstructions. When possible, delay turning on appliances such as ovens, vent hoods, warmers, and mixers. You can reduce your energy consumption by as much as 60% by reducing the amount of operating time of the different appliances in your kitchen.

All ovens should reach their desired heating level within 15 minutes. There is no reason to preheat your oven for longer than fifteen minutes.

Only operate your hood fans when the stoves are in use. The hood fan draws large volumes of room air that has been air-conditioned or heated and exhausts it outside, which could send energy bills through the roof.

Kitchen and Operations Strategies

- Use fan hood only when cooking.
- Pre-heat ovens no more than 15 minutes prior to use.
- Bleach clean with warm water.
- Keep refrigerator coils clean and free of obstructions.
- Only use lights that are needed, when they are needed.
- Shutdown equipment not utilized during vacation periods.

5.10 Swimming pools

The annual energy cost of maintaining an indoor pool can exceed $20,000.[20] Daily use of a pool cover is probably the single greatest energy management technique for pools. Pool covers reduce the need to heat make-up water, and the reduced humidity means less energy for ventilating and conditioning the intake air. Energy savings of 50–70% are possible, along with 30–50% in make-up water and 35–60% in chemicals.

Swimming Pool Strategies

- The annual cost of maintaining an indoor pool can exceed $20,000.
- Water evaporation accounts for approximately 70% of energy lost for indoor and outdoor pools.
- Energy savings of 50-70% are possible with pool covers.
- Chesaning Union Middle School reduced pool energy costs by half in just 8 months with the implementation of a pool cover system.

Maintenance staff say that no real effort is required as the covers glide easily across the pool surface, and are reeled in to remove. Maintenance personnel reel the covers in the morning, while lifeguards cover the pool at night. Other energy-saving practices include maintaining correct water temperature control, nighttime setback, and proper filter cleaning to reduce the energy needed to heat make-up water.

A former U.S. DOE program called Reduce Swimming Pool Energy Costs (RSPEC) promoted energy efficient pool operation. Although the program has ended, information is still provided at www.eere.energy.gov/rspec.

5.11 Vending machines

Vending machines, operating continuously, may use 2500 to 4000 kWh/yr, or $200 to $350 at average U.S. rates. Your district may consider installing energy control devices on vending machines. A commercially available energy control device for refrigerated vending machines consists of an infrared occupancy sensor combined with a controller that senses room temperature and powers up the machine when needed to keep the products cool. Savings average 47%, with a payback of less than 2 years. The device is now in use in hundreds of schools, some financed through local utilities. For example, in the Moscow, Idaho School District each device saves about 1500 kWh/yr, averaging $75 per year for each vending machine.[21] Some beverage wholesalers are willing to install these controllers in schools at no additional charge.

Vending Machine Strategies

- Vending machines can cost a school from $200 to $350 (each) a year to operate continuously.
- Energy control devices for vending machines average a savings of 47% with a payback of less than 3 years.

Vending machines are also equipped with fluorescent lamps that help advertise the name brand of the product being sold. A simple, no-cost strategy is to turn off the lights or delamp the vending machine during periods of no occupancy, or to permanently remove the lamps. Vending companies tend to believe that removing the lamps from the machines will reduce sales. Therefore, vending companies may not be willing to remove the lamps from their machines. Alternatively, schools could upgrade the vending machine lighting from T-12 to T-8. This could save about 1000 kWh per year.[22]

Putting Energy Into Profits—Energy Star Small Business Guide, Environmental Protection Agency, December 1997.

5.12 Other Special Equipment (Laminators, Kilns, and Shop Machines)

Special Equipment Strategies

- Turn off laminators, kilns, and shop machines when not in use.
- Operate laminators, kilns, and shop machines during off-peak hours if possible.

Laminators, kilns, and shop machines should be turned off when not in use. You can also reduce the "demand charge" by scheduling the operation of these "heavy appliances" before or after the usual peak hours of 12 to 4 pm. In addition, automatic timers can be installed and programmed to turn equipment on and off at the beginning and end of desired periods throughout the school day.

5.13 Portable (Relocatable) Classrooms

Approximately one third, or 36 percent, of the schools participating in the 1999 National Center for Education Services, "Survey on the Condition of Public School Facilities," stated that they use portable classrooms to alleviate overcrowding. Of those schools, 9% also utilize portable classrooms for other purposes, such as offices for administration and resource personnel. In addition, the Modular

Building Institute estimates that more than 385,000 portable classrooms are in use in the U.S.

The operating cost must be part of the decision criteria when thinking about purchasing a portable classroom. Because their use is generally thought of as temporary, portable classrooms are often leased or purchased on the basis of lowest initial cost rather than operating cost. In actuality, portable classrooms are often used for years and experience escalating operating costs.

Portable classroom energy consumption varies across different regional climate conditions. Because they are usually all-electric, portable classrooms located in heating climates may have higher energy costs than conventional classrooms, typically by a factor of 2. On the other hand, a Florida Solar Energy Center study showed that, on average, portable classrooms used 10,840 kWh per year or 30 kWh per day, similar to conventional classrooms in Florida, which has a cooling-dominant climate.

For more information, visit http://www.mbinet.org/web/magazine/rebuild04_02.html

Florida Solar Energy Center, *Energy Efficiency for Florida Educational Facilities: The 1996 Energy Survey of Florida Schools.*

Florida Solar Energy Center simulations estimated that they could reduce the annual energy requirement of a conventional portable classroom by 44 to 48 % through a combination of improvements, such as:

- T-8 lighting with electronic ballasts;
- Occupancy-based controls for lighting and air-conditioning;
- High-efficiency heat pump with enthalpy recovery ventilation.

For hot, cooling-dominated climates, measures to reduce lighting and its heat generation showed greatest potential. In cold climates, insulation and duct air leakage control is most important. Heat pumps should be evaluated as an alternative to electric resistance heat.

You should replace the air filter at least every 3 to 6 months, ideally replacing the standard 1-inch thick filter with a 2-inch filter. Periodic (at least annual) maintenance on the HVAC system, including safety checks of the fusible links in the resistance heating system is strongly recommended. Programmable thermostats, with proper training and monitoring of use, can also reduce the annual energy requirement of portable classrooms.

The benefits of a lighting upgrade (T-8 lamps with electronic ballasts) are similar to those in conventional buildings. Because of the more remote location of portables, there might be a stronger argument for the use of lighting controls.

Portable Equipment Strategies

- The Modular Building Institute reports that 385,000 portable classrooms are in operation in the U.S.
- School districts must include the operating cost as part of the decision criteria when thinking about purchasing a portable classroom.
- Measures to reduce lighting and its heat generation showed greatest potential for energy savings in cooling-dominated climates.
- Measures to reduce duct air leakage showed the greatest potential for energy savings in heating-dominated climates.

[1] Note there are other, higher cost strategies to reduce lighting costs. These include, among others, retrofit/replacement of inefficient lighting fixtures and the installation of daylight dimming systems. In some regions, utility financial incentives may be available to reduce district costs on these installations.

[2] David Barista, "Sun Block," Building Design and Construction, December 2003.

[3] Energy Reduction Action Plan for Schools,

http://www.pge.com/123/123conserve_schools.shtml

[4] www.energyusernews.com/CDA/Article_Information/Fundamentals_Item/0,2637,8197,00.html

[5] Gord King, A Worthy Investment, High Performance Schools, American School and University (April 1, 2003).

[6] For more information, see *Putting Energy into Profits,* The Energy Star Guide for Small Business at http://www.rebuild.org/news/guides.asp. Also, see the *National Best Practices Manual For Building High Performance Schools* lamp applications guidelines at http://www.eere.energy.gov/buildings/schools/design.cfm and Commercial Lighting Retrofits: A Briefing Report for Program Implementers, http://www.aceee.org/pubs/a032full.pdf

[7] EnergyStar Website, Copier Information:

http://www.energystar.gov/index.cfm?c=copiers.pr_copiers.

[8] Charlene W. Bayer et al., *Causes of Indoor Air Quality Problems in Schools*, Oak Ridge National Laboratory, ORNL/M-6633/R1, May 2000, p.5.

[9] Useful checklists can be found in references such as Association of School Business Officials (ASBO) International's *School District Energy Manual* (pp 12-16), which also includes guidelines/procedures for specialist service staff or outside contractors (pp 40-44).

[10] U.S. Department of Energy, Rebuild America EnergySmart Schools Programs: *National Best Practices Manual for Building High Performance Schools,* pages 298.

[11] U.S. Department of Energy, Rebuild America EnergySmart Schools Programs: *National Best Practices Manual for Building High Performance Schools,* pages 295.

[12] *1999 ASHRAE Systems and Equipment Handbook, Chapter 24.*

[13] Pacific Gas and Electric Company, "Energy-Efficient Operations and Maintenance Strategies for Packaged HVAC Systems," May 1997.

www.pge.com/003_save_energy/003c_edu_train/pec/info_resource/pdf/ONM4HVAC.PDF.

[14] Environmental Protection Agency, *Putting Energy Into Profits – Energy Star Small Business Guide*, December 1997.

[15] Environmental Protection Agency, *Putting Energy Into Profits – Energy Star Small Business Guide*, December 1997.

[16] Association of School Business Officials International, *School District Energy Manual*, 1998.

[17] The Environmental Protection Agency has developed a School Advanced Ventilation Engineering Software (SAVES) that contains an Indoor Humidity Assessment Software Tool (IHAT) as well as an Energy Recovery Ventilation (ERV) Financial Assessment Software Tool, http://www.epa.gov/iaq/schooldesign/saves.html.

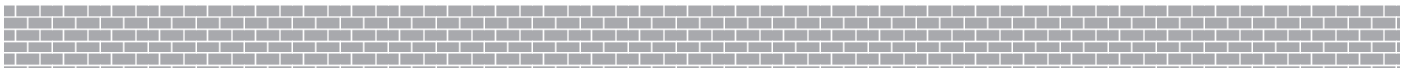
[18] Environmental Protection Agency*, Putting Energy Into Profits – Energy Star Small Business Guide*, December 1997.

[19] Environmental Protection Agency*, Putting Energy Into Profits – Energy Star Small Business Guide*, December 1997, page 58.

[20] Florida Solar Energy Center, FSEC-CR-951-97.

[21] Pacific Northwest National Laboratory, *Energy Savings in Refrigerated Vending Machines*, http://www.pnl.gov/ima-seroenergy/bulletins/documents/refrigerated_vending_machine.pdf

[22] Environmental Protection Agency, *Putting Energy Into Profits – Energy Star Small Business Guide*, December 1997.



CHAPTER 6. CASE STUDIES

Overview:

- Belding Area Schools—Belding, Michigan
- Kent School District—Kent, Washington
- Marion County Public Schools—Marion, Florida
- Montgomery County Public Schools—Rockville, Maryland
- Rochester City School District—Rochester City, New York
- Tracy School District—Tracy, California

6.1 Case Study Overview

The case studies in this chapter provide experience-based observations and "real life" approaches to which school district staff can relate. There are two types of case studies included: organizational and technical.

Organizational Best Practice Case Studies of O&M energy management programs demonstrate how school districts have adopted, developed and implemented O&M energy management policies and programs. These are the lessons learned and advice given by people who have experienced it first hand. Some of their programs may not be the best or most advanced O&M energy management programs in the country, and in some cases they may be just beginning to expand into O&M. Yet these case studies reveal what district employees working in energy management have learned from their experiences. As stated by William Schrauben (of Belding Area Schools, Michigan), "Some of the best information is derived from people who are in the same situation. We have much too heavy a load in our society today to try to solve problems new to us, but already solved elsewhere."

Technical Best Practice Case Studies are organized by O&M area. Each section reviews the O&M best practices that should be conducted in schools and discusses them in terms of tasks, activities (elements of an energy management program), and strategies. Additionally, each subsection provides short case study overviews of a few specific O&M activities, demonstrating the cost-effectiveness of O&M activities and potential energy savings. Unfortunately, most district facilities staff are too busy and often lack the equipment needed to track energy savings from specific O&M procedures. A few school district technical case studies were identified and included in the manual with some savings data. However, non-school district related technical case studies from the Department of Energy are included to help make the case that O&M procedures will save money.

6.2 ORGANIZATIONAL CASE STUDIES

6.2.1 Belding Area Schools—Belding, Michigan

Enrollment: 2,500
Number of Schools: 7
Building Square Footage: 438,540
Locale: Small Town/Rural

Belding Area Schools Operational and Maintenance Energy Savings Activities

Operations

- Night setback controls for heating and cooling
- Outside temperature setbacks and shut down for boilers
- Computerized Energy Management System
- Photo cells and timers on outside light fixtures for controlled scheduling
- Economy setting on (cooling) HVAC
- Scheduling and low temperature setting for all domestic hot water heaters
- Lowered light levels to recommended levels
- Installed occupancy light sensors in all rooms in secondary building and some non-classrooms areas at elementary buildings

Maintenance

- Filter replacements on a work order schedule
- Performed Yearly
  - Calibrate all thermostats
  - Tune up boilers
  - Flush of vacuum HVAC coils

Belding Area School District is an outstanding example of how long term energy programs can be sustained. With a goal of operating as efficiently as possible while maintaining an educational environment suitable for learning, their energy management program dates back to the early 1970s. At the time, there was no overall program to standardize operation of each building; therefore each building was operated the way the person in charge of it ran it. Instead of preventative maintenance, staff was performing reactive maintenance to failures and breakdowns.

Program Formation

According to Bob Schrauben, Director of Facilities in the Belding Area School District, there were two main driving forces that helped convince the district's Board of Education to invest in and commit to an O&M energy management program. One of those driving forces was having someone to be the champion for the program. At Belding, that champion was John Bowers, former Director of Operations for the school district, and presently an educational building facilities management consultant. According to Schrauben, Bowers has a "passion to do things right." He initiated many of the facility department's programs and procedures. The other driving force was the potential savings.

The district Board of Education adopted an energy usage policy that limited temperature settings in buildings, which allowed the facilities department to set a standard for the operation of all buildings in the district, and required each building had to be maintained and operated the same. The board expanded the policy by specifying how new buildings would be built and how repairs would be made with energy usage in mind.

To ensure that the district maintained what they had, before doing anything new, annual preventative maintenance (PM) was placed as a priority ahead of all other special projects that occurred during the summer and school breaks. To emphasize the priorities of PM and energy efficiency, maintenance and custodial schedules were created to follow specific timelines throughout the school year and summer break (see Appendix B for maintenance schedules, and Appendix C for operational schedules). All PM, repairs, and services, and a thorough check of the HVAC equipment, are completed the first month school is out for the summer before any other work is done. All equipment is tested and operated to confirm that it is ready for the start of school each fall.

Elements of the O&M Energy Management Program

Energy Management System—The facilities department recognized the need for energy load data to identify what affects their energy costs and the efficiencies of each building. If energy bills are increasing they need to identify the cause. To facilitate the gathering and managing of this information, the district installed energy management systems on five of their schools. These systems allow the facilities department to control the operation of lighting and equipment by shutting them off when they are not needed - resulting in a great deal of savings. The system also saves labor time by enabling them to diagnose problems from a central location and expedite addressing the problem.

Schrauben believes that in the past, hourly electrical load profiles were used, but he now utilizes the utility companies for periodic audits of district energy usage

and rate structures. In Michigan, most utility companies do these audits as a service at no charge, upon request. These audits assure Schrauben that the district is in the proper rate structure for each individual building. In one instance the audit determined that the district could consolidate four different sites to get a better rate because they were considered to be adjoining properties all owned by the district. While the bills were kept separate, the overall utility rate improved.

***Operational and Maintenance Components*—**The district went through many changes in O&M. These activities are listed on the previous page. Additional energy-efficiency related activities are listed in the text box at the right. Another operational strategy dealt with domestic hot water. Domestic hot water is restricted only to the kitchen for cleaning and sanitizing, to showers in athletic facilities, and then it is scheduled when needed for other events. Hand-washing and custodial cleaning use selected soaps and cleaners that are compatible with cold water, to reduce hot water demand.

***Communication*—**The facilities department discovered that implementing an energy management program can be difficult, regardless of how large the savings could be. People are resistant to change, particularly if they think it might affect their level of comfort. To alleviate such concerns, it was imperative to communicate the reasons and facts behind the changes to those who would be affected by them.

***Staff Training*—**In addition to maintenance/custodial training mandated by the state in regards to safety, the district facilities department participates in regional facilities groups that offer yearly seminars directed at maintenance and custodial staff. The seminars not only provide staff an opportunity to learn, but also offer the opportunity to network with people working in similar positions in districts throughout the state.

Indicators of Success

- Successful Building Operation: The facilities department takes pride in the fact that they have not had to close any of their buildings or cancel school due to mechanical failures in the 30 years the policies and procedures have been in place.
- Energy Reduction: 1992–93 retrofits with T-8 lamps and ballasts showed a 25 percent reduction in electrical costs the following year.
- Cost Savings: When compared to the state average, Belding is saving approximately $178,000 a year in per square foot energy costs.

Next Steps

Schrauben indicates that they are in the process of placing their PM on a web-based site that should enable them to assign and manage their PM work even more effectively.

Other Maintenance and Retrofit Activities

- Insulated all buildings (inside above ceiling or when roofs were replaced)
- Window retrofits on older buildings
- Replaced all fluorescent light fixtures with T-8 bulbs and electronic ballast
- Replaced all incandescent light fixtures with fluorescent fixtures
- Replaced all electrical motors over 5 hp with energy-efficient motors
- Installed frequency drive controls on major air handlers

6.2.2 Kent School District—Kent, Washington

Enrollment: 26,000
Number of Schools: 40
Building Square Footage: 3,219,788
Locale: Urban Fringe of Large City

BEST PRACTICES: Belding Area Schools

- Someone to champion the cause to help convince the School Board to commit to the program.
- School Board commitment: Energy Usage Policy - Energy is listed a priority, preventative maintenance comes first!
- Willingness by the Board to be proactive in the care and upkeep of the facilities.
- Consistency of all buildings in procedures to accomplish tasks.
- Organized checklists and schedules for operations and maintenance.
- Periodic reporting of results to the Board helps keep them informed of progress, therefore maintaining Board support.
- Custodial and maintenance staff training, and taking pride in what they do.
- Networking! Learn from what others are doing.
- Address the concerns of those affected by changes.

The story of the formation of the Kent School District (KSD) Resource Conservation Program (RCP) provides insight into the organizational processes required to obtain, develop and implement an O&M energy management program. Beginning with a formal district commitment and top-level support, the KSD case study describes not only how the district came to form a program, but also the different elements of the program that helped make it successful. These elements include the role of students and teachers as key participants and resources to carry out and enforce operational tasks, and an incentive program to help motivate these participants, as well as O&M staff. Lastly, the KSD case reveals the importance of persistence and accountability.

Program Formation

KSD had been committed to conservation for many years. The district understood it as the right thing to do, but also knew that it would save the district money. It made sense: use less energy, spend less money. However, nothing was enforced, or measured. As a result, the district was not reaching its full potential to reduce energy waste. In 1993, KSD formally made a commitment to conservation in the district strategic plan. In doing so, it established goals and performance indicators to document efficiency and cost-effective utilization of energy. KSD was then able to establish a formal program for resource conservation, which included energy, water, and waste. First, a detailed policy and a list of procedures were drafted to support the new strategic plan, followed by an implementation plan that identified specific indicators. At about the same time the strategic plan was adopted, KSD decided to write a comprehensive statement supporting the new strategic plan: KSD Utilities Conservation Policy #6810, (page 25) adopted in September 1994. Subsequent events included the board approval of the conserva-

KSD Program Timeline

1993	• Strategic Plan
1994	• Conservation Policy
	• Comprehensive Statement
1995	• Program Approved
1996	• Hired Conservation Specialist
	• Set up Accounting System
	• Establish Program Framework
1997	• Incentive Plan Approved
1998	• First Incentive Awarded

tion plan, hiring of the program coordinator, establishment of a resource accounting system, and the committee's construction of the program's framework and fundamentals.

Lori Moen was hired as the Resource Conservation Specialist at Kent School District in 1996. Her mission, as she summarizes, is to:

Educate, motivate, and assist KSD staff and students in reducing, reusing, recycling, and recapturing our valuable resources in order to lessen environmental impact and reallocate tax-based funds from utilities to schools.

Elements of the O&M Energy Management Program

***Gathering Energy Consumption Data*—**In the first year of the Resource Conservation Program, Moen organized her efforts, particularly in gathering energy data to establish a five-year average baseline for each site. According to Moen, "If you don't start with good data, you can't provide believable feedback. It is critical to spend time getting organized and making sure your energy data is relatively clean and accurate." Service problems and billing errors, such as over-billing by utility companies, were reconciled to allow building energy performance to be properly evaluated. In the case of KSD, Moen has caught over $300,000 worth of billing errors since 1996.

***Commissioning*—**KSD has always been proactive about installing efficient equipment, particularly in new buildings, which have been constructed at a rate of approximately one a year for the last 20 years. Maintenance has also been proactive about commissioning the new buildings. However, one of the lessons Moen has learned is that it does not matter how new the equipment is, or the building that it is in. "Efficient equipment is only as efficient as it's operated." This was learned when a district technician commissioned a few of the newer schools piece by piece, discovering improperly installed equipment and several other errors. The buildings are now running 30 percent more efficiently. While Moen cannot say that other factors did not influence the increased efficiency, she is fairly confident that most of the savings can be attributed to the careful commissioning process.

Staff and Training—Maintenance staff and custodians receive training, both in-house training and sometimes contracted through programs such as Building Operators Certification programs. In particular, they receive training for the operation and maintenance of all new equipment. Building operation, by and large, is the responsibility of custodians. Custodial supervisors schedule timelines for when systems should be on and off and set temperature guidelines. These are building-specific tasks, and they have been in place for a long time. The custodial staff is also responsible for preventative maintenance duties, using checklists to guide them. Both the custodial supervisor and the principals reinforce these duties, and Moen constantly sends out reminders through various channels.

***Communication: Constantly Reminding Everyone*—**Moen is persistent in regularly sending staff and building occupants reminders and checklists for upcoming shutdowns (vacations, extended breaks, daily and weekends). Everyone receives these via email, notes in the district paper, and flyers. She also emphasizes the importance of communicating positive reinforcement – if you let people know that their actions have a bigger impact, and you provide that reinforcement, they will continue to do what they are asked. In pursuit of this, she distributes

Guidelines for Kent School District RCP Incentive Plan

- Incentives are awarded twice a year
- Only the utility services that can be influenced by building occupants will be monitored for savings
- To be eligible the school has to open for at least 1 year, and must generate resource savings
- Schools will compete against their own historical utility consumption
- Each school that ends a six month period with accrued savings will receive an incentive
- Approximately 50% of the school's cost avoidance will be returned
- Requests can be submitted for adjustments in baseline
- Incentive program will be evaluated after 2 years

promotional success stories and lets everyone know what others are doing and how much everyone has saved. She also ranks the schools so everyone can see if they are above or below the average. This is positive reinforcement to those ranked high, and motivation for those not doing so well.

***Awareness: High Five for Saving Energy*—**On February 1, 2001, KSD expanded the energy program to include the students and teachers in an aggressive district-wide campaign to save energy. The goal was to reduce energy consumption in the district buildings by 10% and to achieve a 100% participation rate from staff and students. To accomplish this goal, KSD created the "High Five for Saving Energy." "High Five" is a list of five operational things everyone can do to save energy in their schools.[1]

1) Heat offices and classrooms to 68ºF.
2) Keep doors and windows closed.
3) Turn lights off in unoccupied spaces.
4) Shut computers down at night and turn monitors off when not in use.
5) Let the sun shine in.

These five actions are simple, straightforward, and effective. Moen points out that if each person takes responsibility for their energy use and does just these five things to conserve, the district will more than meet its goal. To launch this effort, a 15-minute informational and motivational video was played at every school in the district. In a demonstration of her commitment and support of the program, the district Superintendent allotted this time at every school. This display of top-level support made it clear to everyone that this effort was important.

RCP Incentive Program

Rule 1
✓ 50% of the district's total avoided cost savings up to $50,000, but...

Rule 2
✓ No more than $2,000 times the number of contributing schools, and...

Rule 3
✓ No less than $500 times the number of contributing schools.

Early in the process (1997), the Utilities Conservation Steering Committee was formed to create an incentive program (detailed on the left) to recognize and reward schools for successful conservation programs. The incentive program has been active over the past five years, and has returned over $300,000 directly to the schools. This figure is a calculated percentage of a school's total resource savings, including energy, water and garbage. In addition to these rules, Moen accounts for rate increases, known construction or maintenance errors, and billing errors. She believes that the incentive program gives upper level support some validity, and Moen has observed many schools go above and beyond to achieve these savings.

Indicators of Success

- *Cost Savings:*
  - In its first 11 months (2001), the "High Five for Saving Energy" campaign saved over $191,000.
  - Returned $300,000 in reward money to the schools in 5 years, representing a portion of total district savings.
  - Returned $300,000 in billing errors back to the district.

BEST PRACTICES: KSD Resource Conservation Program

- Formalized District Commitment: Strategic Plan & Conservation Policy
- Top-level support from the Superintendent
- Incentive program to reward savings
- Using all district resources: students and teachers in the "High Five for Saving Energy" awareness program
- Frequent reminders
- Staff training
- Persistence and Accountability
- Checklists and schedules

- *Energy Savings:*
  - Electric consumption has been reduced by 8.5% and gas consumption by 11.4%, resulting in savings of over 2 million kWh of electricity, and 42,000 therms of natural gas.
  - Savings is enough to power 200 single family homes for a year, and to prevent 325,000 pounds of carbon dioxide emissions.

- *Benchmarking:* When Moen compares KSD building energy use to state and national school energy and utility use statistics, KSD buildings are almost always more efficient.

Next Steps

Moen says her next step is to develop a one-page building operation guideline directed at all building occupants, not just maintenance, in order to "step it up a notch." The guideline will explain daily room operation, including heating and lighting.

6.2.3 Marion County Public Schools—Ocala, Florida

Enrollment: 48,000
Number of Schools: 48
Building Square Footage: 5,824,635
Locale: Rural

Marion County Public Schools (MCPS) operates a successful energy management program that produces significant savings. The MCPS energy management program faced many obstacles, and this case study details how the energy manager overcame them. The result is a case study that not only identifies common barriers, but also strategies to overcome these barriers. Additionally, it identifies key elements necessary for an effective O&M energy management program. The process of forming a program can often involve an evaluation and assessment of what is not working and/or what is missing from the program that is preventing it from maximizing savings.

Program Formation

Five years ago an "energy consulting firm" approached an MCPS board member proposing to work with the district. This got the School Board thinking that saving energy would be a good idea. The board did its homework first, visiting two

neighboring school districts—one working with an outside consultant, and one doing it in-house. Seeing how these two districts developed an energy management program that translated in financial savings sold the board on starting a program of their own. The board decided it could be done within the district and hired Robert Van Der Like to manage the program.

Van Der Like spent his first year learning the system and gathering past energy billing information to establish a baseline. Over the next few years, skepticism over the energy program's potential grew. Van Der Like identified two reasons for this. First, newly elected board members were unfamiliar with the research that had been done, and second, the board member that spearheaded the program began asking why they weren't saving the amount estimated by the consultant. Van Der Like pointed out a few reasons why the program hadn't met the board's expectations:

1. **They were comparing apples and oranges.** Savings were calculated in two different ways. Van Der Like realized that the consultant calculated their projected savings to account for load creep, which can add up over time. For example, he noted that one of the high school's energy consumption was flat—it wasn't going up, but it wasn't going down either. To the casual observer, one is inclined to think that consumption has to go down to indicate that savings have occurred. However, over the past half-decade, schools have increasingly added computers and other energy-intensive appliance loads. Mechanical systems age every year, becoming less efficient. This is load creep. The school's consumption should have increased, but the energy savings program offset that increase, which means the high school had actually saved energy. Van Der Like hadn't accounted for that. The fact that the school did take action to save energy was verified with a lighting survey. Lighting occupancy sensors were put in place to measure light usage, and showed that there were very few times when lights were on and the classrooms were unoccupied, suggesting that the message was getting out.

   The Solution: Van Der Like recalculated his numbers using a load creep factor and was able to show that by taking load creep into account the actual savings were not far off their original projection. The rest of the shortfall could be attributed to the next two problems identified by Van Der Like—the voluntary nature of the program, and the lack of accountability.

Comparison of Energy Savings at Marion County

	Actual savings calculated	Estimated consultants savings based on the business plan goal of 5% per year over the next three years
SY 2000-2001	$169,000	$225,000
SY 2001-2002	$207,000	$450,000
SY 2002-2003	$463,000	$675,000
Total savings to date (no adjustments)	$955,000	$1,350,000
Adjusted for load creep & increase in square footage (1-1.5%)	$1.2 million	
Consultant's estimated load creep (4%)		$2 million

Source: Personal correspondence with Rob Van Der Like, October 28, 2003.

2. **The program was voluntary.** Van Der Like, working alone, could not check to ensure all 48 schools were doing everything they were supposed to do. He asked principals in each school to be program champions and to help hold the staff accountable. But since the program had no top-level enforcement, it was viewed as voluntary. Since principals already have a full plate, voluntary programs do not make the cut. Unless they are institutionally connected to accomplishing savings, principals are not going to invest the time necessary to ensure that checklists, guidelines, and procedures of the program are followed.

   The Solution: Van Der Like's explanation of the obstacles presented by the program's voluntary nature led to the board integrating the energy management program into the district's 3-year business plan. The School Board established a goal to *reduce energy consumption by eliminating waste 5% compared to the baseline year*. Making the program a part of the district business plan helped move it from voluntary to mandatory. Van Der Like believes this was vital because it institutionalized the program and demonstrated the school board's commitment to ensuring that the principals keep it as a priority. Each principal has to write out a plan on how they will accomplish their goal.

3. **The district didn't hire the number of people needed to oversee the program of this size.** The consultant's proposal required the district hire two people for energy management to oversee the work for 48 schools. After four years the School Board had still not added the second person. Van Der Like believes that in order to reach potential savings the operational and maintenance checklists and shutdown procedures must be enforced - staff must be held accountable to their assigned tasks. Although the strategic plan made the program mandatory, it was still, in a sense, voluntary because there was insufficient staff to monitor and report its success.

   The Solution: Van Der Like made it clear to the board in the beginning of the business planning effort, that to get the increases in savings in the 2nd and 3rd years they would have to do more than just an energy awareness program. The next level of savings required an accountability program—that is, a program that not only provides information, checklists and procedures and ask that they are implemented, but rather ensures they are implemented. To get the accountability program, Van Der Like needed the district to hire one more person. Van Der Like and the board members visited another school district that had an energy accountability program. They saw that when that district cut energy management positions from three to one, the energy savings went down, and when they corrected themselves by refilling those positions, the savings went back up. By the end of the trip, School Board members were convinced of the need to allocate the resources to hire another program manager.

Elements of the O&M Energy Management Program

***Monitoring Energy Bills*—**Van Der Like reviews the school district's monthly electric bills. "Although you can't catch everything, there are obvious things that come up that can be easily spotted if someone is taking the time to do it," he notes. In his four years on the job he's caught $35,000 in billing errors. Yet the "mother of all billing errors" occurred recently. He noticed a school was using 10-15

BEST PRACTICES: Marion County Public Schools Energy Management Program

- Effectively identify the program's problems and shortfalls.
- Communicate with and convince the School Board of the necessary changes needed for the program.
- The formalized District Commitment
- Awareness program with schools sharing savings with the district
- Automated controls added (timers, programmable thermostats, EMS systems)

percent more energy than the next highest school but he couldn't determine the reason. Tests on the meter showed nothing. After Van Der Like pushed further, the utility company replaced the meter. A thorough inspection revealed a manufacturer's defect that caused it to read 25 percent higher usage than actual – for the past 11 years. The utility company gave the district a rebate check for $294,000! Van Der Like notes that while it is rare to be able to find such a huge error, it is possible. Multiple small errors can add up, too.

***Campus Operation Guides*—**The next level of savings, achieved through accountability, requires specific training and feedback. It takes more effort to investigate the specific loads for each school, know how they are controlled, set up a schedule, identify responsible individuals, train and encourage them, and continuously check to make sure they are successful. Van Der Like saw training as more than an opportunity to show the staff what and how to do it, but also a chance to explain why, and what impact that action has. It also gives them a sense of empowerment. For example, Van Der Like says that it is important when you are training, to tell how much is being saved, in addition to just telling them what to do. Van Der Like says that many custodians already know where energy savings can be found, but they sometimes feel they are not allowed to get involved with that aspect of school business. An accountability program helps to empower them to take action without "fear of reprisal." Custodians taking the initiative to recommend changes that will save energy are recognized and praised.

Indicators of Success

- Obtaining a formal district commitment by getting the School Board to commit to saving energy in the district's business plan;
- Hiring a second person to assist Van Der Like in managing the program;
- Beginning an accountability program; and
- Savings: Marion County Public Schools saving the district $1.2 million over the first four years of the program (adjusted for load creep).

Next Steps

Due to Van Der Like's successful lobbying of the School Board, the program is currently transitioning into an accountability program. The district has hired a second energy management specialist to aid Van Der Like in overseeing the district's 48 schools.

Van Der Like also plans to begin having staff read the meters twice a week - the beginning of the day on Monday, and the end of the day on Friday to give energy

data for the workweek and the weekend. Weekly summaries will allow them to establish an average (seasonal) daily use which could become a benchmark for comparing future data results. Also, it can be an early warning that something is wrong as automated controls can malfunction. Weekly readings will increase detection of these types of problems. Otherwise it will go unnoticed until the bill comes, and by then possibly wasting $800 to $2,000 in energy use. It's the same concept as a water leak. If noticed early and promptly addressed, it will show a minimum increase on the bill. If the leak goes unnoticed, the next bill will be hundreds of dollars more than normal.

6.2.4 Montgomery County Public Schools—Rockville, Maryland

Enrollment: 139,000
Number of Schools: 191
Building Square Footage: 19,784,189
Locale: Major suburb of Washington, DC

Of all the case studies in this manual, Montgomery County Public Schools presents perhaps the best history of a school system committed on a long-term basis to energy management through improved O&M. The school system's philosophy is to seek out and invest in all technologies and policies that provide life-cycle cost benefits and that enhance student and staff comfort and productivity. The school system has tracked energy consumption in its facilities for over 25 years. A school facilities resource conservation plan is filed every year with Montgomery County Department of Environmental Protection. Systematic lighting retrofits, strategic investment in new HVAC technologies and energy management systems have all been part of the overall plan to control energy costs.

Coupled with the strong focus on technical improvements in the buildings, is a school-based energy awareness and education program ongoing since 1992. Even with computer-controlled operation of much of the mechanical equipment, school officials believe there is still a large portion of energy use that is directly impacted by building occupant behavior.

The SERT program (School Eco-Response Team) provides monetary incentives to teams of administrative staff, teachers, students and building services staff to reduce energy consumption in their facility. The program has evolved in many of its details over the last decade but support from MCPS top-level administration has been unwavering.

SERT Program Formation

The SERT program was originally envisioned by the Superintendent and Board of Education. Sean Gallagher in the Department of Facilities Management was charged with planning and implementing the program. Gallagher viewed the program as an opportunity to engage students in hands-on learning centered around real issues. Top school officials, including the Superintendent and Director of Facilities Management, all made strong presentations in support of the voluntary program. SERT started with a pilot of 30 schools in 1992–93 and 1993–94. Baselines were developed, comprised of an average of the three prior years' consumption, and savings were measured using the FASER energy accounting system. Schools were promised 50% of the savings resulting from changed occupant behavior, and checks were distributed to principals at end-of-year

ceremonies. The funds could be used for whatever purpose the principal deemed important. Schools received technical assistance and on-site visits and they also received alternating bimonthly energy reports and newsletters. The program proved popular and more schools joined.

By 1995, with the shape of the program well established, the program was turned over to outside contractor administration. The mid-nineties marked the years of greatest success for the program. By 1995, 166 schools, representing 93% of MCPS schools, were participating in the program. Their actions succeeded in reducing energy costs by $700,000, of which $350,000 was returned to the schools. This figure exceeded the program's goal for the year by over $100,000. Typical savings for the SERT schools in this period ranged from 10 to 15%. Some schools were wildly successful and received rebate checks worth tens of thousands of dollars.

Montgomery County in the late 90s was a fast-growing and changing school system. The district was hard-pressed just to keep up with the demand for space. New construction, renovation and portables all became part of necessary but time-consuming adjustments to the baselines. At the same time, problems emerged with the commercial software and technical support for determining savings. MCPS was adding Energy Management Systems at a rapid rate to more schools throughout the period and program managers found it was difficult to differentiate savings achieved by the central control system from site-based energy conservation results.

By 2002, MCPS officials found they were spending considerably more on contracted administration of the program, maintenance of the baseline and evaluation of savings, than they were getting back in actual avoided costs. They decided to improve operational efficiency by automating the program and eliminating contractor visits to the schools. SERT schools were encouraged to enroll on-line and to file an electronic "report card" on their progress mid-year. There were no more energy consumption reports provided to the schools. Rebates were radically reduced in size and were based on self-reported activities of the schools, not verified by a third party.

The move to automate the program proved premature. By 2002, participation in SERT had dropped to only 38 schools and many schools were confused about whether they were in or out of the program, or what was expected of them. A county-wide initiative to promote recycling for many schools became the chief focus of the SERT program, rather than the energy-saving focus that had been the original impetus.

Schools did not respond well initially to the automated system. Contractor time had to be spent on helping school personnel find the forms on line and fill them out. Schools missed the personal touch that came with the on-site visits and there was less involvement from teachers. The program essentially was mothballed for some months, while MCPS officials decided what direction they wanted it to go.

By 2000, Sean Gallagher had been promoted to Assistant Director of the Division of Facilities Planning and Management. He hired Ron Balon, an energy expert with the County, to head the Energy Resources Team at the school system. Another critical staff position of Energy Analyst was filled by Jeffrey Price, the former energy manager at Cornell University, who moved to the area and was immediately hired to review utility consumption data. Price was instrumental in

helping the system benchmark its schools using EPA's Energy Star program. He also coordinated with the local electric utility to get the largest schools into a program which provides real time electric load data, in 15 minute increments.

Late in 2002, MCPS started the process of bringing the SERT program "in-house." In January 2003, Gallagher and Balon hired a Green Schools Program Manager (position shared by Anja Caldwell and Karen Anderson) to specifically support the SERT program; to develop a more comprehensive Green Schools program based on the Alliance to Save Energy's national Green Schools program; and to initiate a green building strategy for all new school construction. The idea was to link a growing energy efficiency awareness and student activities to core instructional goals and project-based learning.

Elements of the O&M Energy Management Program—SERT and Green Schools

One of the first initiatives was to restore school interest in the SERT program. Meetings were held with schools geographically located in the same cluster. These informal focus-group type sessions provided a chance for the schools to vent their frustrations and provided vital feedback to the Energy Resources Team.

"We were looking for a program that would leverage the strong environmental interests of our students, staff and community," explained Sean Gallagher, Assistant Director of the Department of Facilities. "Our new concept was to build this program from the ground up, while retaining support from our top policymakers."

MCPS decided in 2003 to make the SERT program mandatory for all schools. A memo from Chief Operating Officer Larry Bowers informed all principals of the change and established a 5% overall energy savings goal for the 2003–2004 school year. There was no resistance from the schools, a fact that Gallagher attributes to SERT's acceptance in the schools for over a decade.

To publicize the new regulations, well-attended SERT meetings with new curriculum materials and checklists were held at multiple locations for elementary, middle and high schools. The SERT Resource Guide manual was revised, distributed, and posted on the website. Schools that achieved annual 10% electrical savings or more and that had a good record of student involvement would be eligible for $2500 awards at the end of the year. Monthly consumption data for the prior and current year was posted on the SERT website and also mailed to SERT captains and principals. Schools that found themselves in the "bottom third" of the ranking (Btu/sq/ft) were urged to step up their efforts.

The Green Schools program kicked off in the summer of 2003 as a pilot program open to ten high school or middle schools. Before acceptance into the program, these schools were asked to describe in an application signed by their principal how they felt the Green Schools resource efficiency program would fit with and contribute to their school's instructional goals and programs. Teachers of participating schools received training on an environmental issue investigation curriculum and were provided with professional quality energy analysis tools for students to use in tracking building energy use and identifying opportunities to save. Later in the fall, teams of teachers, students, building services staff, and even a few parents, participated in a one-day training session that provided them an opportunity to develop their individualized plan for saving energy, integrating energy into the curriculum, and educating the entire school community.

Each of the ten pilot Green Schools will receive 40% of the identified kWh savings, up to a maximum of $5000. Each school in the second year of the program is expected to mentor a neighborhood elementary school and teach the younger students about resource conservation.

Students in the Green Schools program in this first year researched specific opportunities for saving energy; i.e., network control of computer monitors, installation of sensors for lighting controls in restrooms and other less-used areas, weatherstripping and other measures to reduce infiltration, reduced use by vending machines and much more.

As a further step, Green Schools program managers plan to work with MCPS vocational-technical education and carpentry/construction programs to provide training for student weatherization action teams (SWAT) that could be dispatched to schools to carry out specific energy-saving retrofit projects identified by Green Schools teams.

Early savings results look promising. Electrical costs for the system in the first part of fiscal year 03/04 are down by 10%, over $500,000 of avoided costs. Therefore, school planners feel it is easiest to look at kWh consumption to measure effectiveness of SERT and Green School, because electrical use (lighting, computers, appliances) can be affected by building occupants, while natural gas use (weather, thermostat settings) is largely outside their control.

Additional Elements of the O&M Energy Management Program

Managing Energy Use in Portables—In fiscal year 03/04, MCPS will have over 600 relocatable classrooms (portables). These classrooms are a major cause of concern as they are electrically heated and cost three times as much per square foot to operate as permanent facilities. Portables added in fiscal year 02/03 alone equal the utility impact of five new middle schools. To address the long-term situation, the Superintendent has requested a budget that would dramatically reduce the number of portables system-wide. Meanwhile, to better manage the load, MCPS has joined with the Applications Division of Carrier Electronics in a project that will allow Internet control of the manual thermostats in the portables. The first-of-its-kind application will allow the synchronization of heating and cooling schedules and setpoints at all portables in order to meet MCPS indoor temperature policy standards. The interface also supports a 24-hour "snowday" command, allowing the quick shutdown of portables when weather conditions dictate. "With these Internet-communicating thermostats, we have the opportunity for the first time to efficiently control very large numbers of small, randomly-located buildings," states Ron Balon, MCPS Energy Manager. "We are looking at a payback of just over a year." Using multiple contractors, the system expects to have the majority of controls installed by the end of the first quarter of 2004.

Energy Management Systems—MCPS has 170 school facilities controlled via EMS systems and has a team of technicians working with the 6 different EMS systems employed throughout the county. The technicians, however, have been overwhelmed just in dealing with major problems. It has been years since new staff has been added, while the numbers of schools with EMS has multiplied. To provide tighter and more proactive facility monitoring, three new positions have been requested. The new employees would be able to track utility anomalies, identify failed sensors, tighten scheduling and even look into advanced EMS strategies and diagnostics.

BEST PRACTICES: Montogmery County Public Schools System

- Development of a consistent awareness campaign—regularly broadcasting of information and reminders.
- Putting consumption information up on the website. Data grounds the program in reality and helps motivate schools into action.
- Support from top management.
- Building program from ground up. While upper management is supportive, the fact that the program is school-based and is designed and revised to accommodate school site concerns, makes it grassroots as much as top-down.
- Constant readiness to innovate. Over the years, the SERT program has been reshaped and kept fresh, so that building users do not tune out.

***Operations and Maintenance*—**MCPS has a policy requiring high-efficiency replacement equipment when replacing failed equipment. The incremental cost for the higher level of efficiency is considered small compared to the long-term benefits of reduced operating costs. Using interns, a summer study was conducted of lighting replacement types and timing and the result is likely to be standardization of procurement for a very limited number of high efficiency lamps.

The school system is considering the expansion of an ongoing pilot program for systematic team cleaning and making it from the system-wide standard practice. The expectation is that this will result in a cleaner building and will also reduce energy costs through planned lighting shut downs by approximately $350,000.

The Energy Resources Team has also urged that after school use be centralized at designated facilities or concentrated in one area of the school. While this is essential if the full benefits of systematic cleaning are to be realized, it is also politically difficult, as scheduled after school community use is determined by an independent board, not the school system. It is estimated that about 4–5% of the total utilities budget (or over $1 million) is attributable to community use of facilities.

Next Steps

MCPS is striving to be environmentally responsible in all aspects of new facility design and operation. The Green Schools Program Manager and the Director of O&M have collaborated in testing new technologies such as waterless urinals and all-in-one hand wash/dry units. As these devices prove practical through field tests, they will be written into procurement specs.

Ron Balon was successful in persuading MCPS management that Energy Management Systems should be standardized.

An analysis of the benefits of flat panel computer monitors by Ron Balon is providing the justification for promoting these in place of CRT monitors in the system's Global Access local area network program.

A rollout plan for the Green Schools program will require all MCPS secondary schools to mentor 1 or 2 local elementary schools.

The Energy Resource Department aims to have all secondary schools on a real-time data monitoring system by the start of 2005.

The Green Schools Program Manager is working with the Division of Construction to design a new elementary school that will achieve, at minimum, a LEED (US Green Building Council's Leadership in Energy and Environmental Design) Silver Level rating. An important part of this process is modifying the specifications for all future school construction to achieve similar benefits.

6.2.5 Rochester City, New York School District Case Study

Enrollment: 33,832
Number of Schools: 57 plus 2 administration buildings
Building Square Footage: 7,149,531
Locale: mid-sized city school district in Northeast

Sophisticated data acquisition and controls systems matched with resources invested in school building operators and occupants are proving a winning strategy for Rochester City School District (RCSD), an inner city system that has won awards for its excellent teaching while serving a student population where 80% qualify for free and reduced meals.

The Rochester City School District is committed to providing a comfortable and safe environment for both students and faculty, while actively managing their energy consumption. Like most urban districts, capital is scarce and the Rochester Facilities Department must make decisions based on funding and return on investment. Tom Keysa, Director of Educational Facilities, recognizing that energy conservation was important in managing ever increasing costs of utilities, added John Songer to his staff in 2001 to champion energy conservation.

Steam Loss Analysis and Repair

John Songer immediately identified the potential to increase occupant comfort and reduce energy consumption by simply replacing failed steam traps and valves in twenty schools. Songer proposed a 3-year initiative that started with looking at steam trap failures in the 15 worst case schools. By 2004, all of the steam schools will have been evaluated and steam trap problems rectified. The net cost avoidance is estimated at $500,000 annually.

Energy Performance Contract

The next milestone in Rochester School District's commitment to energy conservation was to structure an Energy Performance Contract that would be a cost-effective method of reducing energy consumption while realizing capital improvement.

Wendel Energy Services (WES) was selected after a competitive process. Scott Smith and Joseph DeFazio of WES were made part of Rochester School District's team to manage energy consumption and improve the school's environment. The performance contract, one of the largest school retrofits of its type in New York, is providing lighting upgrades, HVAC improvements, energy management system upgrades, motor replacements, and an educational initiative intended to raise the awareness of teachers and students about energy conservation. Some highlights of this scope of work are described in more detail below.

Student-Initiated Behavioral/Operational Savings

In 2003, RCSD incorporated the Alliance to Save Energy's Green Schools program into its multi-year, 21 million dollar performance contract. A small Green Schools pilot of four high schools and two elementary schools was designed to gauge effectiveness in reducing electricity costs as well as in engaging staff and students in energy conservation education.

As part of the Green Schools program, RCSD agreed to return 50% of savings from no-cost actions to the schools, to assist in furthering the program. Because it was easier for students, faculty and administration to control electricity, most schools developed programs for reducing operating hours on banks of lights, control of computer monitors, and replacement of aging and inefficient appliances. John Songer promised the Green Schools teams that if students documented their actions, he would award savings based on their reports, even if overall electric consumption did not reflect the conservation initiatives. Pulse heads on utility meters allow monitoring of school electrical consumption on a half-hour basis. "We have seen student activities resulting in measured savings as high as $200 per school day," reports Songer.

A small army of engineers, lighting and HVAC experts and energy specialists volunteered to help the school teams identify the best opportunities and calculate the savings. Using professional energy analysis tools (light meters, watt meters, infrared temperature sensors, etc.), the students collected data that supported their recommended efficiency measures. Teachers in classrooms with adequate daylighting were convinced by the student data analysis to leave the lights off when it is sunny outside. The student investigations then fed back to the performance contract—with recommendations to install individual circuits to control the bank of lights next to windows for many classrooms.

"We were excited to see the enthusiasm that this program developed and we were more than willing to design into our lighting upgrades the recommendations of the teachers and students," said Scott Smith of WES.

Lighting Upgrades

In addition to the recommendation made by the teachers and students to have the ability to shut off the lights nearest the window, lighting upgrades were designed according to the architecture of the buildings.

Over the years the School District installed T-8 lighting as part of their capital improvements program. This established a standard by which WES was able to design improvements that would incorporate the District's design preferences while achieving energy savings. In many schools, WES was able to install new ceilings as part of the lighting replacement scope. This work greatly improved the acoustical properties of the area while increasing light levels and reducing energy consumption.

Energy Management System (EMS)

RCSD operates the world's largest Andover Continuum System, an EMS that integrates data acquisition and control of 100% of all school facilities at one central location. WES expanded this system to control additional school buildings

and HVAC equipment, as well as incorporate new energy-efficient sequence of operations. Occupancy sensors and variable speed drives (VSD) were used to reduce the ventilation air supplied by the HVAC systems during unoccupied or low occupancy periods of the day. Carbon monoxide sensors are used in some HVAC systems to monitor the indoor air quality and initiate alarms should the levels exceed ASHRAE standards. This allows RCSD to save energy costs associated with ventilating the buildings without jeopardizing indoor air quality.

As weather conditions fluctuate, RCSD can adjust temperatures at all schools with just one keystroke. The system is preset to lower nighttime temperatures in the buildings as the outside temperature rises. For example, if outside temperatures are below 25 degrees F, the indoor temperature will be set at 65 degrees. If the outside reading is between 25 and 45 degrees F, the indoor temperature will be reduced down to 55 degrees. Most of the schools are programmed for night temperatures starting at 5 pm. Building custodians can perform short-term overrides to accommodate after school activities or community events. As these EMS upgrades were completed, occupant comfort levels increased.

As part of a proactive effort to rectify HVAC problems quickly, the Department of Facilities set up a system of on-call personnel, asking for regular facilities staff to work 2 hours overtime on a rotating schedule to check for problems identified by the Energy Management System. While this move has required extra staff time, it has more than paid for itself, in early identification and remediation (often overnight) of problems such as boilers that someone forgot to turn on or outdoor air temperature sensor failures. In many cases, schools that otherwise would have to be closed, were instead able to operate on a normal schedule. In addition, condensate return temperature sensors were installed on steam systems. This will assist RCSD in monitoring the condition of the recently replaced steam traps.

Custodian Training

Like many progressive school systems, Rochester recognizes that proper operation is key to maintaining control of energy cost and consumption. The District has a formal training program for all custodians, that either takes place on-site or at contractors' facilities. Training is usually 1–3 days and refresher training is required every three years. Even with this emphasis, Rochester wants to move forward with a stronger support system and professional development for building operators.

Retrocommissioning

Schools are constantly being modified to meet educational priorities. Computer labs are installed, classrooms carved up into other spaces and it is often hard for the HVAC and lighting systems to keep pace. On average, Rochester schools are over 62 years old, and equipment may not be running as it did when installed a decade earlier.

Accordingly, RCSD proposed a pilot program for retrocommissioning of four schools in 2003-2004. The New York Energy Research and Development Authority (NYSERDA) agreed to cost-share the $100,000 effort. Wendel Energy Services was selected to implement the program because of their expertise in the area and the knowledge of the buildings they gained through their performance contract. The point of the project, according to Thomas Keysa, Director of Facilities, is to determine, "How the HVAC systems are actually operating, as compared to the sequence of operations when the school was designed. We expect to identify

BEST PRACTICES: Rochester City School District

- Educating students and staff about benefits of natural lighting so that daylighting can be incorporated in all schools without electrical modifications.
- Tying behavioral modification to the performance contract to produce savings above the guaranteed amount.

significant deficiencies that can be corrected to produce savings for the system." Savings data are not available yet, but both NYSERDA and RCSD are optimistic.

Vending Machines

As schools become aware of all the diverse loads that contribute to energy consumption, many have struggled with the issue of vending machines. In many districts, hundreds of these machines are operating 24 hours/day, seven days/week. Vending machines can account for an astounding 6 or 7 percent of the entire electrical load of a building. RCSD decided to issue a Request for Proposals for re-establishing vending rights for the entire district. One company will be awarded the contract and all machines provided will come equipped or retrofitted with occupancy sensors that only turn on the machines' advertising lights when someone approaches. "We'll get a better deal from the supplier and they won't be offloading inefficient equipment on us," states Songer.

6.2.6 Tracy, California School District

Enrollment: 15,700
Number of Schools: 21
Building Square Footage: NA
Locale: Central Valley

Tracy School District might be considered large, but only when compared to many of its sister school systems in California's Central Valley. Located 20 miles from Stockton, the residential area has experienced rapid growth, but still maintains a small-town feel. Tracy is an example of what a smaller school district can accomplish, when close attention is paid to details of energy management and when there is openness to exploring new technologies and techniques that improve school operations.

Program Formation

Robert (Bob) Cosaro has been with Tracy since 1981. He has risen through the ranks and is now Director of Maintenance. The success of Tracy in controlling energy costs and integrating new ideas is largely due to Cosaro's hands-on management style. He visits all of his schools regularly and talks with students, staff, and parents whenever a building issue even starts to arise. He has kept the School Board briefed regularly.

In the early days of watching energy consumption, the program consisted largely of adding time clocks to every conceivable piece of equipment—AC units, heat pumps, exterior lighting, etc. Then photo cells were added to provide more precise control.

In the mid 80s, a more formalized approach to energy management was adopted. Strategic delamping was able to reduce lighting loads by 50% at one site and the district entered into its first energy performance contract, which replaced boilers with mini-boilers. A few years later, a second energy performance contract provided EMS to all the schools. The district's facilities staff headed up an in-house effort for the design, replacement and retrofit of lamps to T-8s.

But nothing illustrates the district's openness to new ideas like the Cool Roofs project. In the late 1980s, Cosaro became interested in the single-ply white membrane material that manufacturers claimed would save 30% on cooling costs. Cosaro personally subjected the material to all kinds of stress tests—from encouraging students to walk on it, to subjecting it to extreme heat. Impressed with the results, Cosaro agreed to formally test the product on one building. When the material met his exacting standards for durability, ease of maintenance and ease of installation, he began to specify it for more schools, until 75% of facilities in the district were equipped with cool roofs. As an early adopter of the technology, Cosaro widely shared his experience with other school districts and with all levels within the district. He had his board members climb up on ladders and actually touch a cool roof on a blistering summer day. After that, Cosaro said, he had no trouble persuading management that the technology was providing benefits to the district.

Elements of the O&M Energy Management Plan

Cosaro's philosophy combines frugal energy use with student/staff comfort. He is the first to advocate for students. "When looking at room conditions, I would caution anyone to first make sure all thermostats are calibrated properly to the mainframe computer," he states. "You can't depend on the EMS to give an accurate reading. And be sure to check the setpoint where the students are—not just where the thermostat is located."

Cosaro is a stickler for details. "One or two degrees really makes a difference," he notes. "In a classroom, 66 degrees is uncomfortable; 68 is usually perfectly fine." To maintain comfort, and maximum efficiency, Cosaro believes in rigorous preventative maintenance.

The Tracy maintenance schedule calls for monthly changes of 1" filters and every two months change of 2" filters. Coils are cleaned at least annually, and up to four times a year depending on the climate. Poorly maintained equipment costs money and reduces comfort to occupants. Cosaro has all custodians trained to date and sign the filters when they are installed. That way, if new staff comes on board, they can easily see when filters were last replaced.

Lighting is a major and continuing interest at Tracy. Motion sensors have been installed in all classrooms and on outside lighting. School staff are requested to keep lights off wherever possible, and the district has systematically upgraded lighting and delamped where possible.

No detail escapes Cosaro and his team. All computers are set to the sleep mode and monitors turned off. To control unwanted outside air, Cosaro met personally with Assistant Principals, urging them to develop a program to keep doors closed. He followed this up with widespread installation of door sensors that shut off the HVAC when doors are left open for a specified time period.

In a district the size of Tracy, small can be a benefit. Realizing that there had been an explosion of personal appliances in the classroom, Cosaro went personally to meet with groups of teaching staff and administrators to ask them to voluntarily remove all such appliances. Because there is the personal relationship and because it is clear that paying energy bills takes away funds that could be better used in the classroom, most teachers have complied.

Cosaro is also in charge of after-school community use of the buildings. The rapid population growth in Tracy has put pressure on the school system to provide recreational space, but Cosaro strictly manages date and times of events, insurance, and collection of fees for use.

Indicators of Success

"I truly believe that there is so much waste that our current district-wide goal of saving $150,000 per year, though no-cost conservation action, is very possible," states Bob. It appears he is right. As of January 2004, about halfway through the school year, the district had savings of $100,000.

Next Steps

Cosaro is currently working with EPA's San Francisco office to train students to become indoor air quality investigators. Students will use EPA's Tools for Schools and will collect data, analyze the results and make recommendations for remediation. The proactive approach to an issue that many school districts choose to ignore, is typical for Tracy.

Tracy was also an early participant in a program funded by California ratepayers called the School Energy Efficiency project. As part of that project, the district received energy audits on facilities while teachers were provided science- and literature-based curriculum on energy efficiency. Tracy has applied to be a demonstration site for the SEE project, which fits well with Cosaro's continued interest in new and better ways to serve students.

Looking down the road, Cosaro would like to see Tracy become more involved with the Consortium for High Performance Schools (CHPS) as he is a firm believer in natural daylight and fresh air.

CHAPTER 7. OPERATIONS AND MAINTENANCE REFERENCES AND RESOURCES

Overview:

- This chapter is intended to provide O&M staff and school business officials with an up-to-date list of various types of resources available to them, including operations and maintenance guides, energy management guides, technology-specific information, and training resources. Also included is a list of relevant organizations and programs with their Internet addresses.

7.1 Operations and Maintenance Guides and Manuals

1) Association of School Business Officials International, *School District Energy Manual,* 131 pages, 1998.

   Addresses many aspects of energy efficiency programs for schools, including conservation guidelines, the role of administration, and data collection. It also discusses technical topics such as energy management systems, operations and maintenance for energy conservation, HVAC controls, and preventive maintenance. Useful and informative checklists are found throughout the manual. For a free electronic copy (PDF) of this manual, visit the National Clearinghouse for Educational Facilities resource list at *http://www.edfacilities.org/rl/energy.cfm.*

2) Avista Utilities, *Resource Wise: A Manual for Managing School District Resources*, 1998.

   Prepared by a utility energy services team for school personnel implementing the Resource Management Program in the Northwest. It includes 16 chapters and 4 appendices on program organization and specific technical topics. For more information, visit *http://www.avistacorp.com/.*

3) Federal Energy Management Program, *Operations and Maintenance Best Practices-A Guide to Achieving Operational Efficiency*, December 2002.

   Highlights O&M programs targeting energy efficiency for a highly diverse portfolio of Federal buildings, with much information applicable to schools. It consists of nine chapters that cover various topics, including O&M management issues, computerized maintenance management systems, the different types of maintenance programs, maintenance technologies for common equipment, promising or future O&M technologies, and steps for initiating an operational efficiency program. To download a free electronic copy (PDF) of this guide, visit *www.eere.energy.gov/femp/pdfs/omguide_frontmatter.pdf.*

4) Office of the Legislative Auditor-State of Minnesota, *A Best Practices Review: Preventative Maintenance for Local Government Buildings*, 132 pages, April 2000.

Identifies seven strategic practices for effectively managing preventive maintenance of school district, city, and county buildings. It defines preventative maintenance, discusses its value, and recommends best practices that schools districts and local governments should take to achieve preventive maintenance goals. The review also describes obstacles that local governments believe limit their ability to effectively perform preventative maintenance and gives examples of Minnesota schools districts that utilize preventative maintenance. To obtain a free electronic copy (PDF) of this best practices review, visit *http://www.auditor.leg.state.mn.us/PED/bp/pe0006.htm.*

5) School Facilities Maintenance Task Force, in collaboration with the National Forum on Education Statistics and the Association of School Business Officials International, *Planning Guide for Maintaining School Facilities*, 170 pages, February 2003.

   Provides practical advice on a range of O&M topics, although not energy focused, including how to do a facilities audit to know what you have, planning for maintenance that will ensure smooth operations and avoid costly surprises, managing staff and contractors, and evaluating maintenance efforts. To download a free electronic copy (PDF) of this planning guide, visit *http://www.nces.ed.gov/pubs2003/2003347.pdf.*

6) U.S. Department of Energy, Rebuild America EnergySmart Schools Program, *National Best Practices Manual For Building High Performance Schools*, 450 pages, July 2002.

   Developed specifically for architects and engineers who are responsible for designing or retrofitting schools, and for the project managers who work with the design teams. The manual is organized into 10 chapters covering important design disciplines and goals, such as site design, energy-efficient building shell, daylighting and windows, lighting and electrical systems, mechanical and ventilation systems, renewable energy systems, and resource-efficient building products. Each guideline includes a summary of O&M issues. An additional chapter addresses commissioning and maintenance practices in general. For a free electronic copy (PDF) of this report, visit the U.S. Department of Energy, Building Technologies Program publication website at *http://www.eere.energy.gov/buildings/documents/.*

7.2 Additional Operations and Maintenance Manuals and Technical Guides

1) American Society of Heating, Refrigeration and Air-Conditioning Engineers, *ASHRAE Guideline 4: Preparation of Operating and Maintenance Documentation for Building Systems*, 1993.

   Applicable to HVAC&R systems but can also be used for other building systems. This guideline presents a comprehensive and systematic approach to the preparation of accurate, relevant, and timely O&M documentation to effectively support the development and management of O&M programs in buildings. To purchase an electronic copy (PDF) of this document, visit *http://webstore.ansi.org/ansidocstore/product.asp?sku=ASHRAE+Gdl+4-1993*.

2) Association of School Business Officials International, *Maintenance & Operations Solutions: Meeting the Challenge of Improving School Facilities*, 16 pages, 1995.

   Addresses three specific areas: maintenance and operations solutions, financing school facilities, and technology solutions for schools. To purchase a print copy of this document, visit the ASBO publications website at *http://asbointl.org/Publications/PublicationsOnline/index.asp?s=0&bid=944*.

3) National Center for Education Statistics, *Facilities Information Management: A Guide for State and Local Education Agencies*, July 2003.

   Discusses how to design and maintain an information system. Focuses on the condition, design, use, management, and financing of elementary/secondary education facilities. It includes commonly used measures, data elements, and a list of additional resources for the practitioner. For a free electronic copy of this guide, visit *http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2003400.*

4) National Association of State Boards of Education, *Building Our Future: Making School Facilities Ready for the 21st Century*, 28 pages, 1996.

   Highlights the efforts of a number of schools, districts, states and private corporations that are creating innovative ways to produce high quality school infrastructure. This report also makes recommendations for creating a system of comprehensive strategic planning that will support the creation of high quality learning environments for all children. To order a copy of this document, visit *http://www.nasbe.org/* or contact the National Association of State Boards of Education, at 800-220-5183.

5) Portland Energy Conservation, Inc., *O&M Assessments: Enhancing Energy-Efficient Operation*, 31 pages, September 1999.

   Provides information on how to plan and conduct building O&M audits orchestrate the O&M process, when outside consultants should be used, how to manage outside consultant and in-house technical work. To obtain a free electronic (PDF) version of this document, visit *http://www.peci.org/om/* and scroll down until you see the document.

6) Portland Energy Conservation, Inc. and Oak Ridge National Laboratory, *A Practical Guide for Commissioning Existing Buildings*, 67 pages, April 1999.

   Describes the three fundamental components of an organization's energy management program as (1) efficient purchasing - purchasing energy at the lowest available unit cost, (2) efficient operation - operating the equipment that consumes energy as efficiently as possible, and (3) efficient equipment - upgrading or replacing existing equipment with more energy-efficient versions whenever it is cost-effective to do so. For a free electronic (PDF) version of this document, visit *http://eber.ed.ornl.gov/commercialproducts/retrocx.htm*.

7) U.S. Department of Energy, Federal Energy Management Program, *Greening Federal Facilities Second Edition: An Energy, Environmental and Economic Resource Guide for Federal Facilities Managers*, 201 pages, May 2001.

   Designed to increase energy and resource efficiency, cut waste, and improve the performance of Federal buildings and facilities. This guide highlights practical actions that facility managers, planners, and design and construction staff can take to save energy and money, improve the comfort and productivity of employees, and benefit the environment. To obtain a free electronic (PDF) version of this document, visit *http://www.eere.energy.gov/femp/pdfs/29267-0.pdf*.

8) U.S. Department of Energy Federal Energy Management Program, prepared by Portland Energy Conservation, Inc., *Guidelines for Incorporating Commissioning into Energy Savings Performance Contracts*, 24 pages, October 2000.

   Discusses energy savings performance contracts guidelines and the important issues related to commissioning performance contract projects. It provides a description of the basic commissioning and performance contractors process, then discusses the issues surrounding commissioning and M&V, and finally provides specific guidance for integrating commissioning into performance contract projects. For a free electronic (PDF) version of this document, visit *http://www.peci.org/cx/guidelinev5.pdf*.

9) U.S. Department of Energy Rebuild America Guide Series, *Building Commissioning: The Key to Quality Assurance*, 77p., 1999.

   Designed to help building owners and retrofit project managers understand and successfully oversee the commissioning process for energy-efficient retrofits in existing buildings. To obtain a free electronic (PDF) version of this document, visit *http://www.rebuild.org/attachments/guidebooks/commissioningguide.pdf*.

10) U.S. Environmental Protection Agency and the U.S. Department of Energy, *Putting the "O" Back in O&M: Best Practices in Preventive Operations, Tracking, and Scheduling*, 33 pages, September 1999.

    Addresses continual schedule optimization and provides staff with methods to assess day-to-day operation of major plant equipment. The document also emphasizes enhancing O&M plans to give equal weight to operational issues. For a free electronic copy of this document, visit *http://www.peci.org/om/putoback.pdf*.

7.3 Energy Management Guides

1) Environmental Protection Agency, Energy Star Program, *Guidelines for Energy Management*, 36 pages.

   Offers strategy guidelines for energy management with tools and resources based on successful practices of ENERGY STAR partners. Visit *http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index* and click on the Download Guidelines for Energy Management link for a free electronic copy of this document.

2) Portland Energy Conservation, Inc., *Energy Management Systems: A Practical Guide*, 80 pages, October 1997.

   Covers the following topics: evaluating an existing EMS; specifying and selecting a new EMS; commissioning new EMS; service contracts for EMS; strategies for optimizations; using EMS for operational diagnostics; non-energy control applications; sample control specification language; and using spreadsheets for graphing and analyzing trend data. To obtain a free electronic (PDF) version of this document, visit *http://www.peci.org/om/* and scroll down until you see the listing for this document.

7.4 Technology Specific Resources

1) Environmental Protection Agency, *The Lighting Upgrade Manual, 7th Edition*, February 1995.

   Discusses every phase of the lighting upgrade process: organizing staff, setting goals, surveying facilities, evaluating lighting systems, financing upgrades, planning projects, requesting bids, disposing lamps and ballasts, maintaining lighting systems, and reporting project results. It consists of a series of individual pamphlets and marked tabs to separate and identify the documents, provides comprehensive technical information about lighting technologies and controls. For a free electronic (PDF) version of this document, visit *http://www.edfacilities.org/rl/lighting.cfm* and scroll down until you see the listing for this document.

2) National Clearinghouse for Educational Facilities, *Lighting for Schools*, 6 pages, December 2001.

   Provides concise guidance on modern and effective lighting systems and design attributes, such as daylighting, which can be an effective and energy-efficient strategy for almost all school spaces. Presents information on lamp technology and lighting fixtures. Offers six steps that can result in a lighting system that will use far less energy than systems designed just a few years ago. To obtain a free electronic version (PDF) of this document, visit *http://www.edfacilities.org/pubs/lighting.pdf.*

3) Heschong, Lisa, "Daylighting and Human Performance," ASHRAE Journal, June 2002. See also California Energy Commission, PIER Program, New Buildings Institute, *Re-analysis Report - Daylighting in Schools, Additional Analysis*, 89 pages, February 2002.

   Summarizes research that found a statistical correlation between the amount of daylight in elementary school classrooms and the performance of students on standardized math and reading tests. To download files associated with this report, visit *http://www.newbuildings.org/pier/downloads*.

4) Watt Stopper, Inc., *Lighting Control Best Practice Guide: Schools*, 58 pages, 2002.

   Offers design, specification, and installation guidance for lighting control appropriate for K-12 educational facilities. It features applications that illustrate the best control practices for a variety of spaces, facilitating lighting

control design and application. Provided free by an equipment manufacturer, but most information is generally applicable. For an electronic version of this guide, visit *http://www.wattstopper.com/pdf/SchoolK12guide.pdf*.

7.5 Measuring Savings and Benchmarking

1) ENERGY STAR Portfolio Manager: *Assessing Building Performance.*

   Helps manage the energy performance of school district buildings. Buildings are given a score from 1-100 indicating the building's energy performance relative to other school district buildings. The tool is free to use and is Internet based. ENERGY STAR also offers on-line training on using the portfolio manager. For more information on the Portfolio Manage visit *http:// www.energystar.gov/index.cfm?c= evaluate_performance.bus_portfoliomanager*.

2) International Performance, *Measurement and Verification Protocol*, March 2002, Volumes I, II, and III.

   Standardizes procedures for quantifying energy savings. It states how energy use and cost savings will be assessed-two basic methods of monitoring the building's performance: (1) whole building monitoring-analyses of utility metering data for an entire building to generate indices on energy and power use comparable across a group of buildings; or (2) end-use monitoring-measurements of energy flows and/or power levels to identify the performance of individual systems (heating, cooling, lighting, etc.). To download copies of the Measurement and Verification Protocol, visit *http://www.ipmvp.org*.

3) Michigan School Business Officials, *Fourth Annual MSBO Facilities Benchmarking Report*, January 2004.

   Intended for use by business managers and facilities managers to compare their operational costs and practices to the universe of school districts in Michigan. Comparisons may also be made to each of the prior year's results to assess whether performance is improving or declining. For a free electronic (PDF) copy of this report, visit *http://www.msbo.org/services/facilities/Bench-03HowTo.pdf*.

7.6 Training Resources

1) Building Operator Certificate Program

   Sponsored by The Northwest Energy Efficiency Council (NEEC), the Building Operator Certification (BOC) is a growing national certification and professional development program for facilities operation and maintenance staff. BOC offers improved job skills in facility efficiency, and certifies individuals in energy and resource efficient operation of building systems. For more information on this program, visit *http://www.theboc.info*.

2) International Facility Management Association

   Offers a certification program for facility managers. Maintenance and operation management is one of eight competency areas evaluated to become a Certified Facility Manager. An "ideas exchange among facility managers"

section is also available on their site. For more information on this program, visit *http://www.ifma.org*.

3) SchoolDude.com

   Provides school facility managers with a wide variety of resources as well as on-line analytic and management tools including a utility tracking and analysis tool, technical data, and discussion groups. Visit *http://www.schooldude.com* or call 877-868-3833 for more information.

7.7 Additional Resources with Internet Addresses

1) Alliance to Save Energy
   http://www.ase.org

2) Association of Higher Education Facilities (APPA)
   http://www.appa.org/

3) Association of School Business Officials, International
   http://asbointl.org/index.asp

4) Collaborative for High Performance Schools (CHPS)
   http://www.chps.net/

5) Consortium for Energy Efficiency
   http://www.cee1.org/com/bldgs/schools.php3

6) Energy Star Program
   http://www.energystar.gov

7) FacilitiesNet
   http://www.facilitiesnet.com

8) Federal Energy Management Program
   http://www.eere.energy.gov/femp

9) National Association of State Energy Officials
   http://www.naseo.org/

10) National Clearinghouse for Educational Facilities
    http://www.edfacilities.com/

11) National School Plant Management Association
    http://nspma.org/

12) U.S. Department of Energy, EnergySmart Schools Website and Preventive Maintenance Checklist
    http://www.rebuild.org/sectors/ess/index.asp

APPENDIX A. IDENTIFYING OUTSIDE ASSISTANCE

Overview -

- Appendix A is a continuation of the discussion of ways of identifying outside assistance from Chapter 3.3.2.

A-1. O&M Program Assistance from Federal, State, and Government Agencies

- **Costs:** None
- **Technical Assistance:** Sometimes
- **Grants or Rebates:** No
- **Financing:** Unlikely
- **Training:** Unlikely
- **Staffing Provided:** No

As is all too familiar, budget cuts at both State and Federal levels have had a negative impact on the level of government assistance to schools. Nevertheless, certain types of support are still available and are worth investigating.

At the Federal level, several programs are available to provide assistance useful to O&M efforts. One example is the EPA's free Internet "benchmarking" tool, which offers administrators of K–12 schools the opportunity to assess their buildings' energy consumption and compare it to the performance of similar schools in the United States. Other Federal assistance is available through the US DOE Energy Smart Schools and Rebuild America programs. Although much of their focus is on new school construction, these programs can often provide training and other useful assistance appropriate to O&M efforts for existing schools. Also of particular value are O&M technical manuals produced by FEMP and other government agencies, as well as the informational resources available at DOE's information "clearinghouse."

Assistance at the state level is highly variable across regions of the U.S. and has been impacted by budget cuts. Nevertheless, state support is worth investigating. In some states technical staff have assisted school districts in assessing energy investment decisions based on estimates of facility "life cycle costs" or have developed operation and maintenance templates that can be customized for individual school districts. In others, state school reimbursement formulas may soon provide a financial incentive for districts with high O&M standards.

A-2. O&M Program Assistance from Consultants

- **Costs:** Moderate to High
- **Technical Assistance:** Yes
- **Grants or Rebates:** No
- **Financing:** No

- **Training:** Yes
- **Staffing Provided:** Yes

When support from the local utility, or other sources of low cost assistance, are insufficient, some districts have chosen to utilize outside consultants or vendors in limited and strategic ways. Costs must be carefully managed, but some districts have used this resource successfully to help "jump start" their new O&M efforts through targeted building audits and technical assessments. Note, however, that many energy consultants tend to focus primarily on capital-intensive equipment or system upgrades and may have minimal experience with a primarily low cost O&M focus. When assessing the qualifications of a consultant remember that practical experience with existing school building systems and O&M issues is probably more valuable that an engineering degree alone.

Assessment of building operations and estimation of potential savings is the most frequent role played by school O&M consultants. In addition, in some districts consultants have also played an important training role and have worked with custodial staff to design and deliver energy maintenance training customized to the specific needs of school staff. Consultants with more specific engineering expertise have also assisted schools in the "recommissioning" of major mechanical systems and the detailed analysis of utility and energy management system (EMS) data to detect abnormal energy consumption problems and detect equipment control malfunctions.

"A few technical audits at the outset performed by outside firms were useful in convincing senior administrators of the attractiveness of expanded O&M in our district."
-Roger Young, Assistant Superintendent of the Manchester Essex Regional School District, Massachusetts

A-3. O&M Program Assistance from Local and Non-Profit Sources

- **Costs:** Minimal or None
- **Technical Assistance:** Frequently
- **Grants or Rebates:** Unlikely
- **Financing:** Possible
- **Training:** Frequently
- **Staffing Provided:** No

Although their funding levels frequently reflect this fact, school systems are often the most broadly supported element of the public sector. Although the public may take exception to specific bond issues, the public generally wants their local schools to be successful and to use their tax dollars efficiently. Gaining access to volunteer or low cost local technical expertise and financial support is challenging but can be of substantial value, particularly for districts with scarce resources. Some ideas for sources of local assistance include:

- Corporate sponsorship of school–specific improvements;
- Pro bono partnerships with local engineering firms;
- Environmental group assistance;
- Professional associations (e.g. architects, engineers etc.);
- Student assistance from local engineering, technical or architectural schools.

In 2003 the Haverhill, MA school system obtained the support of the Boston Society of Architects. The professional society brought together a team of architects and engineers to assess the energy performance of some of the largest Haverhill schools.

In addition to local resources, in several regions of the U.S., the nonprofit Green Schools[1] program assists schools in enhancing energy cost management through improvements in district school operations and maintenance. By encouraging basic operational changes, Green Schools has achieved up to 25% savings in one year for an individual school. The Green Schools program is currently active in about 200 schools across the country.

The primary services provided by Green Schools are training to teams of staff, teachers and students and the design of specific programs to identify and implement low cost energy savings strategies. Support continues during a 12-month period in which each school is participating through meetings, planning sessions, and other instructional and promotional materials.

A-4. O&M Program Assistance from Energy Service Companies

- **Costs:** None (shared energy savings)
- **Technical Assistance:** Yes
- **Grants or Rebates:** No
- **Financing:** Yes
- **Training:** Yes
- **Staffing Provided:** Frequently

In a nutshell, performance contracting requires a school district to enter a contractual agreement with an outside energy service company (ESCO) under which the ESCO receives a specified percentage of ensuing energy savings. In return, the ESCO provides a school district with equipment, training, and a variety of technical and other services that both enable the district to track energy consumption and produce energy cost reductions. In addition, the ESCO typically guarantees a specific level of energy savings.

Although this varies with the individual contract terms, direct costs to the participating school districts are limited. It is estimated that approximately 500 U.S. school districts have participated in O&M-focused performance contracting arrangements. ESCO contract periods typically range from five to ten years.

Of all the various sources of external O&M assistance, the use of ESCOs arouses the most controversy and heated opinion. See Chapter 4.5.3 for a discussion of the pros and cons of performance contracting arrangements.

[1]Green Schools is a program of the Washington DC based Alliance to Save Energy. See *www.ASE.org*.

APPENDIX B. EXAMPLE DOCUMENT: SCHOOL DISTRICT O&M PROGRAM MANAGER QUALIFICATIONS, RESPONSIBILITIES, AND TASKS (Energy Tracking and Accounting Program)

Energy Efficient O&M Program Manager Qualifications

- Extremely strong technical expertise not a requirement.
- Strong interpersonal communication and persuasive skills, flexibility and creativity.
- Moderate level of computer and analysis skills.
- General understanding of the operation of school buildings.
- Experience in business, education or technical fields.
- Sometimes, a retired school employee or administrator.

Energy Efficient O&M Program Manager Performance Responsibilities

Task l. Gain top-level management commitment and support

- Establish a energy efficient O&M policy.
- Prepare a shared savings plan (incentives, etc.).

Task 2. Contact utility reps (water, gas and electric)

- Review incentive program offerings (rebates) and rate schedules.

Task 3. Organize resource accounting data

- Select commercial energy accounting software.
- Input billing data and analyze for billing errors and anomalies.
- Establish base year consumption for each facility.
- Determine facilities with greatest savings potential.

Task 4. Cultivate the support of facility operations and maintenance staff

- Arrange introductory meetings.
- Develop facility operation guidelines through a brainstorm process with staff.
- Schedule periodic meetings to help with program implementation.

Task 5. Develop School-Based Teams

- Establish teams (kitchen, maintenance and grounds staff, occupants and management).
- Use teams to develop and implement facility operations guidelines and other activities.

Task 6. Conduct conservation audits of facilities

- Target facilities with greatest savings potential.
- Perform pre-audit interviews with facility operators.
- Perform audits and develop a recommendations report.

Task 7. Provide training for all staff

- Provide energy efficiency awareness training to all relevant staff.

Task 8. Set facility-specific goals

- Set new goals annually based on audits performed and the commercial energy accounting software data.

Task 9. Provide incentives and recognition

- Establish methods of recognition (awards, newsletter announcements, etc.).

Task 10. Communicate programs status - program visibility

- Develop strategies to involve and inform the public and staff to keep the program visible.
- Provide monthly or quarterly reports to facility operators, administrators and others.

Task 11. Implement energy efficient O&M savings opportunities

- Identify low-cost/no-cost options.
- Estimate costs for any system modifications.
- Implement strategies.

Task 12. Communicate and reward program success

- Publicize resource and cost savings internally and externally.
- Approve success incentives to staff and students.

Sample Resource Conservation Management (RCM) Action Plan

Action Item	Participants	Time Frame
Gain top-level management commitment and support.		
Contact utility reps to review program offerings, rate schedules and billing histories.		
Gather and organize resource accounting data.		
Contact recyclers and county recycling coordinators.		
Cultivate the support of facility operations and maintenance staff.		
Develop RCM teams.		
Conduct RCM audits of facilities.		
Provide training for all staff.		
Set facility-specific goals.		
Conduct follow-up facility efficiency surveys.		
Provide incentives and recognition.		
Communicate program status.		

APPENDIX C. EXAMPLES OF SCHOOL ENERGY POLICY STATEMENT AND IMPLEMENTATION PLAN

Elements to Consider	
Element	**Explanation**
Program Mission Statement	Broad environmental and management objectives. Establishes support by senior administrators.
Energy Consumption Monitoring & Communications	Organization, on-going monitoring and distribution of facility-specific energy bills.
Energy Savings or Consumption Targets	Reasonably achievable savings targets for annual energy consumption/costs.
Staff Responsibilities & Training	Energy-related tasks for custodial, maintenance and administrative staff. Energy Manager if appropriate.
Staff or School Incentives/Recognition	Shared energy savings, formal or informal staff recognition etc.
Energy Program Communications	Internal and external progress reports and visibility.
Building Energy Assessments/Audits	Identification of poorly performing schools and likely opportunities.
Building Operating Guidelines	Vacation shutdown, temperature control, etc.
Purchasing & Procurement Guidelines	Efficiency standards for replacement equipment or minimum payback requirements.
Schedule for Program Planning/Revision	Anticipates need for on-going program oversight.

Establishing a school energy policy is a crucial initial step in the development of an energy-efficient O&M program, expressing the commitment of the school board and school administration to the principles of sound energy management. It should be a concise statement of overall goals, implementation strategies, and expected outcomes.

Although it should be reviewed periodically, the energy policy statement is intended to provide long-term guidance in carrying out the program. Specific operating procedures, which may be subject to change with other conditions, are best stated in a separate implementation plan.

C-1. Sample Energy Policy Statement, Texas School Performance Review

Recognizing our responsibility as Trustees of the Independent School District, we believe that every effort should be made to conserve energy and our natural resources. We also believe that this commitment will be beneficial to our students and taxpayers in prudent financial management and the saving of energy.

The fulfillment of this policy is the joint responsibility of the trustees, administrators, teachers, students and the support personnel. Cooperation shall be experienced on all levels for the success of this policy.

The District will maintain accurate records of energy consumption and cost of energy on a monthly basis. An energy audit will be conducted annually at each campus and recommendations will be made for updating the energy program. Energy conservation guidelines and procedures will be reviewed and accepted or rejected by the Board of Trustees. Information will be furnished to the media on the goals and progress of the Energy Conservation Program.

Source: http://www.window.state.tx.us/tspr/energy/policy.html

C-2. Energy Policy and Implementation Plan From a Large School District in Suburban Maryland

A. Purpose

To ensure that Montgomery County Public Schools pursues energy conservation efforts and practices that continue to preserve our natural resources while providing a safe and comfortable learning environment for all staff and students.

B. Issue

The nation is experiencing a depletion of its natural resources, which include crude oil, natural gas, and other energy sources. The Montgomery County Public Schools is committed to reducing its consumption of natural resources and still improving the quality of its educational programs. The Montgomery County Board of Education desires to work with other agencies of government and plan school system activities so that the learning environment of essential education programs is not curtailed or compromised.

C. Position

1) The superintendent of schools shall continue to establish procedures to ensure the conservation of natural resources by personnel at all levels of the school system, which shall include the following practices:

    a) Generation of a system wide annual resource conservation plan that outlines goals and objectives;
    b) Development of acceptable energy conservation guidelines as outlined in the resource conservation plan;
    c) Continued development and implementation of conservation programs;
    d) Performance of energy studies on all new MCPS construction;
    e) Monitoring the general operation and maintenance of all heating, ventilation, and air conditioning equipment;
    f) Procurement and consumption management of fossil fuels and electricity;
    g) Continuing reminders to staff and students of the need for conservation of all natural resources.

2) MCPS will participate in a coordinated effort by government authorities to establish appropriate resource conservation plans and utility price monitoring systems to ensure that public schools have adequate supplies of essential fuels and can obtain these at the best possible prices.

D. Desired Outcome

Create a healthy and comfortable learning environment while controlling energy consumption more efficiently and diverting the otherwise rising utility costs towards educational programs. Continue development of energy conservation efforts that proportionally reduce energy consumption in new and existing facilities.

E. Implementation Strategies

1) Should natural resources be insufficient to meet normal operating needs, the superintendent will develop further plans for the consideration of the Board of Education to conserve energy.
2) Copies of this policy and the annual resource conservation plan will be sent to appropriate school system and county government officials.

F. Review and Reporting

This policy will be reviewed on an on-going basis in accordance with the Board of Education's policy review process.

Policy History: Adopted by Resolution No. 654-73, November 13, 1973; amended by Resolution No. 285-97, May 13, 1997.

Source: http://www.mcps.k12.md.us/departments/facilities/greenschoolsfocus/ECA%20Energy%20Policy.pdf

C-3. Detailed Energy Policy and Implementation Plan From a Medium-Sized Dchool District in Massachusetts.

NOTE: The following example is for a specific school district in suburban Massachusetts. This energy policy and implementation plan provides a detailed account of the things that you can consider when developing your policy. However, each school is a special case with different needs, and you should tailor your own energy policy and implementation plan to address those needs.

Students and Staff of the Fall River School Department should be made aware of their responsibility regarding Environmental Stewardship. We must make efficient use of our natural resources. Procedures follow that reduce inefficiencies in the use of electricity, fossil fuels, water and reduce the production of solid waste. Our goal is to optimize the use of natural resources in the school on a daily basis yet maintain a comfortable learning environment.

This program is designed to reduce energy and natural resource consumption by a minimum of 10%. Implementation and success of this Resource Conservation Plan is a joint responsibility of administrators, teachers, students, and the community. Cooperation of each of us is essential for success.

This plan calls for a people-oriented approach to resource management based on the following considerations:

- Every employee and student is expected to contribute to the District's efforts to conserve energy and natural resources. Every person will be expected to be an "energy saver" as well as an "energy consumer."

- All unnecessary lighting in unoccupied areas must be turned off. Teachers and Custodians are asked to turn on lights only in the areas in which they are working. All lights will be turned off when teachers and students leave school. Custodians will turn on lights only in the immediate area in which they are working. Safety lighting will be held to the minimum level necessary for safe passage.

- Computers, copy machines, and all other office equipment are expected to be used at their most efficient level.

- The Custodian at each school or building will be responsible for complete and total shutdown of the facility when students are not present. A checklist of items to consider will be available.

- A school closure of two or more days will be viewed as an "energy conservation opportunity". The Custodian will be responsible for the complete and total shutdown of the school building when closed for weekends, and during extended vacation (winter break and spring break). A checklist of items to consider will be available.

- Heating and cooling levels guidelines are established as listed below.

Guidelines for Operating Lighting Equipment

1) Lights in classrooms should not be turned on unless definitely needed. In classrooms with lighting levels, the light can be adjusted to the task. Teachers are asked to make certain that lights are off when leaving the classroom, **even for a short period of time**.

2) Gymnasiums and multi-purpose rooms and cafeteria lights should not be left on unless they are being utilized, or going to be used within 15 minutes. High intensity discharge lighting (HID) will have to be considered on a per school basis.

3) All outside lights should be turned off during daylight hours. (adjust time clocks and check dusk dawn sensors).

4) Hallway and "commons" lighting should be turned off at the end of the instructional day.

5) Night Custodians should turn lights on only in their work area.

Guidelines for Operation of Heating, Ventilating and Air Conditioning (HVAC) Systems

A. General Guidelines:

1) HVAC systems should always be operated in the most economical and efficient way possible and only for the amount time required to provide the required climate for a specific activity. In the Fall, heating equipment will be

ready to be turned on by October 1st. All air conditioning will be turned off by November 1st. In the Spring, cooling equipment will be serviced and ready to be turned on April 1st. All heating equipment will be turned off by May 1st.

2) Custodians and the energy management systems technician should monitor weather reports. It is their responsibility to make adjustments to the HVAC control system time clocks and the district energy management system to compensate for changes in the weather, i.e., boilers and fans should start later when weather is warmer and earlier when weather is cold and windy. This adjustment is not required in buildings that have automatic optimization time control systems.

3) When the temperature is expected to change significantly over a weekend, clocks and the EMS should be adjusted to provide proper temperatures on Monday morning. This adjustment is not required in buildings that have automatic optimization time control systems.

4) Every opportunity to decrease HVAC system operating times should be considered by the Custodian and the systems technician. For example, the heating system requirements should be reduced on days of early dismissal, cancelled school, inclement weather days, and cancelled games and activities.

5) If below-freezing weather is predicted or occurs over a weekend, holiday or vacation period, the Custodian and the energy systems technician are responsible to verify that adequate minimal night low limit heating is being maintained to protect the building and contents.

B. School Days:

1) On regular school days, the HVAC system time clocks should be adjusted to provide the following temperatures from the time of teaching staff occupancy to the time of last class dismissal in the majority of classrooms in the buildings. Temperatures are measured four feet above floor level on either the wall opposite the heating unit or in the center of the room.

Classrooms (grades 4-12)	68-70 degrees F.
Classrooms (grades K-3)	68-70 degrees F.
Gymnasiums & Locker Rooms	65-70 degrees F.
Offices	68-70 degrees F.
School Shops	65-70 degrees F.
Halls	65-70 degrees F.
Kitchens & Cafeterias	65-70 degrees F.

2) Acceptable temperature deviation from set point is plus or minus 2 degrees F.

3) It is understood that Schools that were built before the year 2000 cannot control the balance of heat as well as the newer facilities. The temperatures stated shall be used as a guide.

4) Air-conditioned spaces shall not be cooled below 75 degrees.

5) After class or activity hours, all areas should be set back to a target night low limit setting of 60 degrees F. Outside night low limit sensors should be set so

as to provide an inside night low limit temperature of not more than 60 degrees F.

6) Close doors and windows during the winter and summer months.

7) Window blinds/drapes are to be closed at the end of each day.

C. School Vacation Days (Winter, Spring, Summer), Weekends and Holidays:

1) On vacation days, weekends and holidays when school is not in session, the entire building shall be operated on a target night low limit setting of 60 degrees F.

2) On workdays when school is not in session, the entire building shall be operated on a target night low limit setting of 60 degrees F. Outside night low limits sensors should be set so as to provide an inside night low limit temperature of not more than 60 degrees F. Variations for working staff comfort can be made via over-ride controls for specific zones and lengths of time, with temperature not to exceed 64 degrees F.

3) If offices are occupied by regularly assigned staff, zoning shall be used in lieu of operating the central heat plant. Maximum thermostat settings for zoned areas shall be the same as school day operation.

4) Normal heat and ventilation may be provided for scheduled activities and athletic contests. If possible, only the area of the activity should be heated and ventilated, and temperature maximums shall be the same as a regular school day.

5) All other energy uses must be approved in advance by the Director of Buildings & Grounds.

Guidelines for the Operation of Domestic Hot Water Heaters

A. School Days:

1) Thermostats for hot water heaters will be set so water temperature at all sinks will not exceed 110 degrees F.

2) Thermostats for hot water heaters that service kitchens will be set at 180 degrees F.

3) When available, time clocks will be set to provide for maximum efficiency.

B. Weekends and School Vacation Days:

1) Hot water heaters will be set on vacation setback.