# The SCORE and CitySmart Programs: Sustaining Investment in High Performance Buildings in Schools and Cities

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ABSTRACT

The definition of "sustainability" depends on who you ask. We define the sustainability of investing in energy efficiency this way:

The practice of selecting higher efficiency alternatives becomes sustainable once the purchaser understands that energy cost savings are invisible to the occupant, that the non-energy benefits (NEB) are more important than pure energy efficiency in creating a constituency that drives decision makers, and puts in place a decision-making process that actively pursues energy cost savings and non-energy benefits.

Since 2006, more than 185 educational organizations and municipal governments have participated in the SCORE^SM and CitySmart^SM energy efficiency programs offered by nine investor-owned utility companies in Arkansas and Texas. This paper will describe how the services provided by the programs have led to sustained efforts by participating organizations to save energy and improve occupant comfort through increased energy efficiency.

## INTRODUCTION

In this paper we first present how the programs' Energy Benchmarking and Master Planning processes lead to greater understanding of both current energy performance and the value of a long-term commitment to energy efficiency among school and city officials. This understanding has been instrumental in transforming the attitudes these officials often have regarding the importance of an ongoing focus on increasing efficiency.

Next, we describe how the financial and technical guidance provided by SCORE and CitySmart have helped schools and municipal governments save energy. Once opportunities have been identified through the benchmarking and master planning processes, the programs provide a range of support to facilitate project completion. Financial assistance includes educating participants on funding sources such as municipal leasing, state and federal loan mechanisms, Energy Efficiency and Conservation Block Grants, and private financing options. Technical assistance varies by partner need, but often includes identifying energy savings opportunities in existing buildings and providing equipment efficiency guidelines for new construction projects. The programs also offer direct financial incentives based on the amount of reduced peak electric demand each project yields. So far, the programs have paid over $3.3 million in incentives to help participating organizations offset project costs and resulted in over 23 megawatts of reduced peak demand and more than 76,000 megawatt-hours of reduced energy use.

Finally, we will discuss how the efficiency improvements schools and cities have made under the programs have led to increased occupant comfort through better lighting quality, more reliable air conditioning and heating, increased outdoor air intake, and better humidity control. The paper will address the types of benefits provided by these energy efficient systems, and will include case studies on participants' reactions to these benefits.

## ENERGY BENCHMARKING AND MASTER PLANNING

According to the EPA, nearly one-third of the energy used to run typical government buildings goes to waste through inefficient lighting, heating, cooling, and other energy-using systems. In the education sector, the money spent on energy in K-12 schools alone is twice what is spent on textbooks and computers combined.[i]

These statistics, combined with the aging building infrastructure in our schools, cities, counties and towns, offer a vast opportunity for energy efficiency through renovation and new construction. However, in the public sector, energy management is often given a low priority because of the misalignment or lack of the internal goals necessary to get disparate and sometimes competing departments to work together to drive energy efficiency.

Working with public sector organizations throughout Texas since early 2006, we have found a number of common barriers that inhibit the systematic evaluation, funding, and implementation of cost-effective energy efficiency measures. These barriers, discussed in further detail below, include lack of communication and internal goal alignment, lack of technical expertise and data, and lack of mechanisms to evaluate and fund higher efficiency options.

<u>Lack of Cross-Departmental Communication and Internal Goal Alignment</u>

In cities and school districts throughout Texas and Arkansas, we have found that the greatest single factor inhibiting public sector energy efficiency is not funding or technical expertise, but whether the organization has senior level, cross-departmental commitment to using energy efficiently. Our experience is that more often than not, departments within these public sector organizations operate as individual silos and do not effectively set or communicate energy efficiency goals across departments. These organizations are usually budget- and first-cost-driven, with little or no alignment of budgetary or energy performance goals across departmental lines.

<u>Lack of Technical Expertise and Data</u>

In the vast majority of the public sector entities we work with, there is no single person responsible for energy efficiency and energy performance. Our program partners tell us this is because personnel resources are stretched thin, so staff has multiple responsibilities. As a result, it is difficult for internal staff to dedicate the time necessary to effectively analyze energy use and cost data, report on the performance of their buildings, take corrective action as needed, and keep up with changes in technology that can improve the energy efficiency of their organizations.

<u>Lack of Mechanisms to Evaluate and Fund Higher Efficiency Options</u>

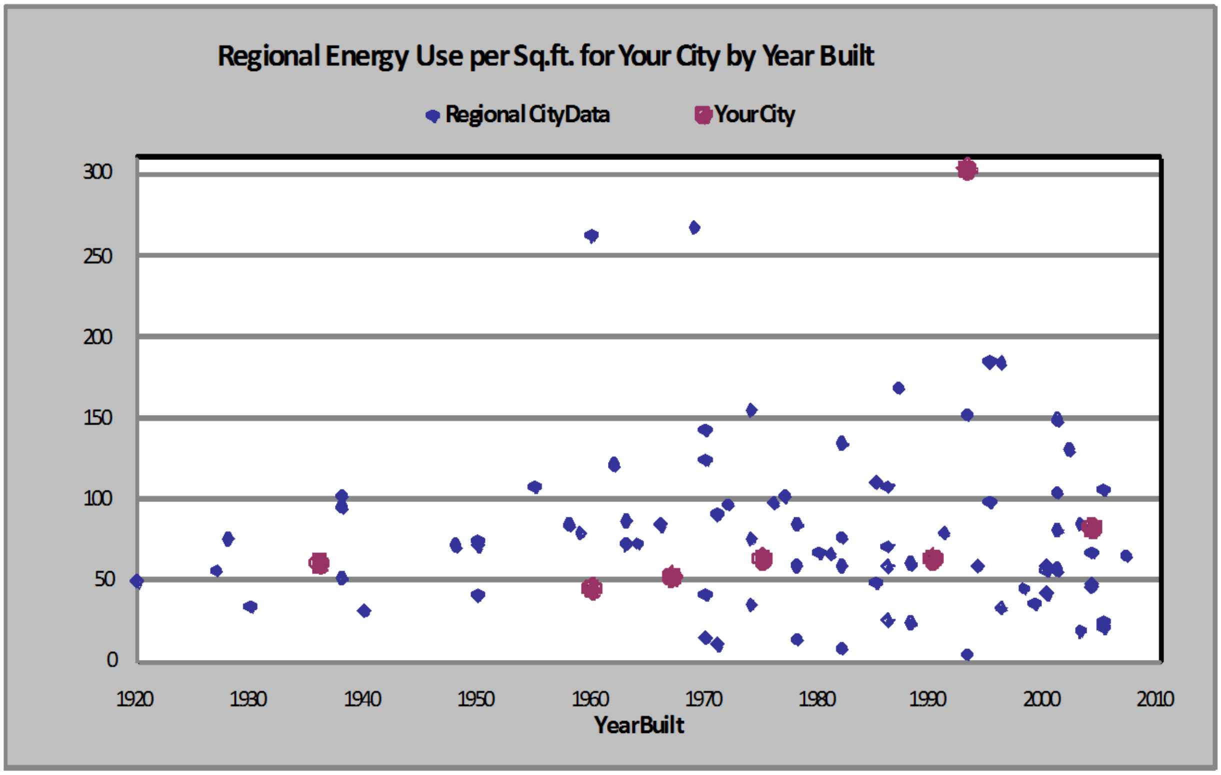
In the dozens of best-practices Energy Master Planning workshops we have conducted with SCORE and CitySmart partners, we have discovered that only in very rare cases do facilities managers and financial decision-makers have any methodology to evaluate the life-cycle benefits of energy efficiency investments. In addition, procurement rules in public sector organizations typically require bids to be awarded on lowest cost. If solicitations do not allow for (or in fact discourage) alternate bids for higher-efficiency equipment, the city or school district has no way to entertain alternatives that could yield much higher savings over the life of the equipment.

<u>Energy Performance Benchmarking</u>

Energy performance benchmarking gives facilities managers and departmental managers the data they need to compare the performance of their buildings. Drawing from our own Program Regional Database, the Department of Energy's (DOE) Commercial Building Energy Consumption Survey (CBECS), and the Environmental Protection Agency's (EPA) Portfolio Manager Tool, the SCORE and CitySmart programs have benchmarked more than 2,500 sites operated by more than 185 organizations against regional and/or national peer facilities. Types of buildings benchmarked include K-12 schools, colleges/universities, offices, city halls, convention centers, courthouses, fire/police stations, hospitals, libraries, recreation centers, retail stores, water treatment plants, and warehouses.

This information helps determine where there are opportunities for performance improvements, and in some cases argues against misperceptions about which buildings are the best performers. For example, some department managers believe that newer buildings built with new technology and under stricter energy codes perform better than older buildings. However, our experience with benchmarking buildings has shown, perhaps counterintuitively, that on a per-square-foot basis, there is no correlation between building age and energy performance. This is shown in Figure 1 below, where a city's per-square-foot energy use by building is compared to similar buildings in the same climate region in Texas.

**Figure 1. Comparison of energy use by year built**
*(Source: CLEAResult Texas CitySmart Database)*




There are a number of factors that cause the lack of correlation between building age and energy use. For example, the energy savings from better windows and roofs in a newer building could be offset by a greater concentration of plug loads and higher outside air requirements. Management should never assume that newer buildings are their best performers, and in fact, they should actively seek energy efficiency opportunities throughout their entire building portfolio.

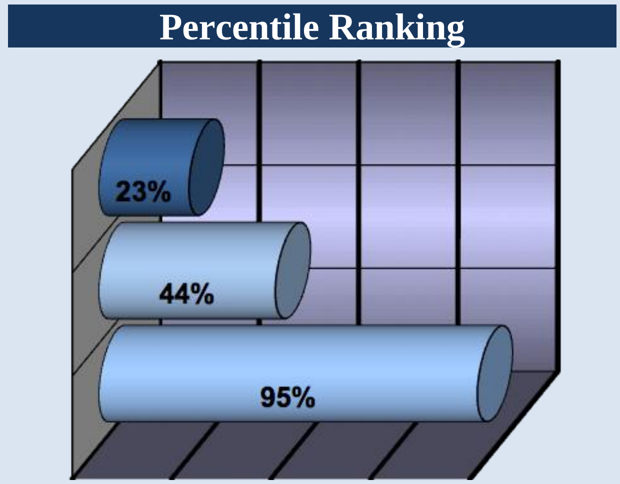
At the building level, public sector managers can also make side-by-side comparisons of buildings in their organizations using the type of building-level Energy Performance Benchmarking Analysis shown in Figure 2.

Figure 2: Sample ISD/District-wide Benchmarking Summary

## Sample ISD/ District Wide Summary

| Local Benchmarks | Local Average* | Our District |
|---|---|---|
| Annual Energy Use (kBtu/sq.ft) | 46.9 | 61.0 |
| Annual Energy Cost ($/sq.ft.) | $1.20 | $1.27 |
| Annual Energy Cost ($/student) | $159 | $72 |

**Average for schools in similar climate regions of Arkansas & Texas.*




*(Higher percentiles indicate lower energy use/lower costs)*

Upon completing the Benchmarking process, we encourage participating organizations to share their benchmarking results with various stakeholders, including maintenance staff, teachers/employees, the board of directors, and city councils. The results are useful in justifying upgrades at poor performing buildings or highlighting well-performing buildings. Organizations often discover surprising pieces of information hidden in their results, which helps deepen their understanding of those facilities.

Benchmarking Case Study: Independent School District #1

After ISD1's senior management from various departments reviewed the district's SCORE benchmarking reports, the low scores relative to their peers motivated them to make energy efficiency a priority across the district. One step ISD1 took was to create an energy management task force in the summer of 2007, comprised of key decision makers from facilities, maintenance, finance, information technology, and transportation, as well as school principals and outside consulting firms. In addition, ISD1 used the data to justify creating an energy manager position in the district and hired an experienced energy manager who is tasked with identifying energy saving opportunities and reducing energy consumption.

Since creating the energy manager position and the energy management task force, ISD1 has been proactively working to identify and implement energy saving opportunities. Energy efficiency projects planned in the district for 2008 include high efficiency HVAC upgrades, lighting retrofits, window film, and high performance design on new construction projects. These projects are estimated to save 815 kW, equivalent to the typical peak electric demand of two 70,000 square foot elementary schools.

Energy Master Planning

Leaders from individual school and city departments (including facilities, administration and finance) often have never met to discuss how the efficiency and performance of their energy-using equipment affect each other. For example, while a maintenance staff member might recognize poor light quality in a classroom, he or she does not have the tools necessary to quantify the potential energy savings available, nor the avenue to express that opportunity to financial decision-makers. Likewise, a financial officer is certainly aware of energy expenditures, he or she is often unaware of the measures available to reduce them.

The Energy Master Planning process is designed to bring these departments together to focus on how they can collectively optimize energy efficiency opportunities in the short and long term, regardless of where those opportunities exist in the organization. The results of the process are collected in a customized Energy Master Plan (EMP).

An EMP illustrates an organization's mobilized efforts toward reducing energy costs – one of its largest operating expenses. The EMP is an adaptable and evolving organizational resource that documents successes-to-date, along with short and long-term strategies for managing energy consumption. The most effective EMPs are clear and concise, set a realistic scale and timeline, and assign clear responsibility and accountability within an organization.

The principal objectives of energy master planning are for partners to examine how they operate with respect to energy efficiency and to identify gaps in their processes. Energy Master Planning guides partners through the process of creating an energy master plan with common goals, objectives, projects and timelines. The goal of this process is to help generate cross-departmental consensus on immediate project funding priorities, while instituting a planning philosophy that integrates energy efficiency into future construction and renovation projects.

In addition to identifying strategies for improvement, the EMP also reflects an organization's achievements in energy management. We encourage well-performing organizations to document their best practices and recent successes in the EMP, as doing so will ensure that their efforts and commitment to reducing energy costs are recognized by the surrounding community.

Once finalized, the partner is encouraged to present the master plan to its school board, city council, or governing body for formal approval. This has proven to be an effective contributor to plan implementation, as partners have told us that anything endorsed by their board or council is seen as a priority by staff. An endorsed EMP promotes a sustainable commitment to increasing efficiency by: 1) providing an actionable framework for reducing energy costs; 2) promoting positive public relations in the community; 3) instilling a greater awareness of where an organization stands with respect to others; and 4) spreading budget dollars further.

More than 125 school districts, higher education institutions, cities, and counties have developed their own Energy Master Plans. Several school boards / government councils have endorsed the EMPs within their communities, while many others have implemented various aspects of the plan within their respective organizations.

## PROJECT SUPPORT

While Benchmarking and Master Planning identify both where and how to begin, schools and local government need to then undertake projects. Public entities can take advantage of relationships with architects, engineers, and contractors to identify and develop projects, but public procurement processes frequently keep those firms from providing too much assistance (from fear of losing a developed project to a lower-priced competitor). And even in a competitive bid process, contractors, architects, and engineers will default to "tried-and-true" designs that have low performance risk and a low first cost. The entire procurement process rewards low first cost and penalizes low life-cycle cost. To keep energy efficiency "on the table," schools and cities need assistance during project identification and development.

To address school and local government concerns that include lack of information, time to analyze options, vendor neutrality (or lack thereof), and concerns about performance, SCORE and CitySmart offer a range of additional services. These include:

<u>Project identification and scope development</u>: Program staff will visit facilities to assess the current technologies used for building or facility operations. Staff can also analyze the energy savings potential for more efficient technologies or services (e.g., building tune-ups or "retro-commissioning").

<u>Project drawing and specification review</u>: The best time to integrate energy efficiency is at the earliest possible design stage – schematic design. However, if conversations about energy efficiency begin later in the design process, staff can review design development or even construction drawings to determine what alternatives could be priced out and still implemented at that design stage.

<u>Bid solicitation</u>: While the programs cannot recommend specific vendors, staff can supply information to be included in bid requests, and can also review bids to ensure that proposals are consistent with bid intent (i.e., proposed substitutions or alternatives will meet target energy performance).

<u>Alternative financing options</u>: In those instances where bond financing is not available or is too costly, the programs support investigations into tax-exempt

leasing or other alternatives (e.g., Energy Efficiency Conservation Block Grants, QSCB). These sources can allow schools and local governments to implement projects sooner rather than later.

Measurement and verification of results: The programs must provide measurement and verification of results. While not conducted at the level of a performance guarantee, these activities do provide assurance that estimated demand and energy savings are realized.

Public relations support: Especially in the current economy, one of the great challenges for public institutions is to garner public support for any significant capital expenditures. The programs obtain print, television, and/or Internet coverage to demonstrate the value of these projects.

Case Study: Mesquite Independent School District

Mesquite ISD offers an example of a program partner taking advantage of the full range of services provided by the SCORE Program. Upon joining the program in 2006, many of the district's classrooms and gymnasiums were still lit with technology from original construction in the 1960s. Realizing the need to both upgrade lighting quality and reduce energy expenditures, the district commissioned a lighting audit of all its facilities.

In addition to helping the district review the audit results, SCORE staff benchmarked the total energy performance of the district's buildings and compared them to buildings of similar size in the area. The analysis illustrated that the lighting systems were in critical need of upgrades in almost 60 district buildings.

The findings were presented to district management at an Energy Master Planning Workshop. Although management understood that improving lighting systems would result in reduced energy expenditures, the projects $2.1 million price tag at first seemed cost-prohibitive. Through the EMP process, the SCORE Program demonstrated the immediate financial viability of a comprehensive lighting upgrade. The district was eligible to receive over $370,000 in utility incentives. Coupled with a projected annual energy savings of $618,000, the project would easily pay for itself in fewer than three years.

Using this information, Mesquite ISD decision makers worked to rearrange priorities and identify sufficient capital funds. The district quickly issued requests for proposals for the entire project. SCORE staff helped the district evaluate the proposals, and after selecting a vendor, the district completed the upgrades seven months later.

Upon completion, the district found that their actual utility savings were more than $750,000 per year - $132,000 more than originally estimated. The district upgraded lighting at 58 buildings, resulting in 2.5 megawatts of peak demand reduction and more than 6,000,000 kilowatt-hours of reduced energy use. The district's accomplishments were featured in several news outlets, including the Dallas Morning News and Gallery Watch.

Results to Date

To date, SCORE and CitySmart program services have resulted in more than 45 megawatts (MW) of reduced peak demand and more than 102,000 megawatt-hours (MWh) of reduced energy use. The programs have paid over $8 million in incentives to help participating organizations offset project costs. Table 1 provides summary information on the programs' savings and incentive payments over their history.

Table 1. SCORE and CitySmart Program Savings since 2006

| Year | # of Projects | Total kW | Total kWh |
|---|---|---|---|
| 2009 | 1,326 | 21,028.00 | 48,337,135 |
| 2008 | 551 | 9,980.39 | 23,620,616 |
| 2007 | 391 | 11,743.86 | 23,853,539 |
| 2006 | 351 | 2,849.15 | 7,117,913 |
| **Total** | 2,619 | 45,601.403 | 102,929,203 |

Of particular interest for this paper is whether program participants are sustaining investment in energy efficiency projects over time. One goal of the program is to promote institutional sustainability –

either with or without partnership with the program – the capacity within the organization to continue to identify and pursue reductions in the use of energy (and hopefully other resources).

Table 2 provides information on those schools and cities who have participated in the programs for more than one year. Because the areas in which the programs are offered have been increasing significantly over time, it is early to determine the level of repeat participation across all areas.

Nonetheless, these data demonstrate that repeat participation has been high. In addition, since 2007, the number of projects per partner has remained relatively static, even as the number of projects and partners have greatly increased.

Table 2. Program Participation in Multiple Years

| Year | # of Partners Completing Projects | # of Repeat Partners from Previous Year | # of Repeat Partners from the Past 2 years |
|---|---|---|---|
| 2009 | 236 | 85 | 85 |
| 2008 | 110 | 43 | 43 |
| 2007 | 69 | 15 | N/A |
| 2006 | 17 | N/A | N/A |
| **Total** | 432 | 143 | 89 |

INCREASING OCCUPANT COMFORT

For a real project – a lighting retrofit, for example - the creation of a constituency for energy efficiency means that the perceived lighting "quality" is tangible to the occupant and influences future projects more strongly than energy reductions. The term generally used to account for these other factors is Non-Energy Benefits (NEBs). The benefits may be societal, environmental or economic, might be directly for ratepayers, investors, or households, and could improve safety, reliability, and reduce maintenance.

There is no agreed-upon method to quantify a dollar value of NEBs. But once informed about non-energy benefits, stakeholders usually understand them and incorporate that knowledge into their decision making. Informing partners about these benefits is a key way the SCORE and CitySmart programs help schools and local governments evaluate options when replacing or purchasing equipment that will reduce peak demand. Program partners may not know the net-present-value of NEBs they favor, but not knowing the dollar value of a benefit does not prevent them from choosing the more sustainable option. Certainly there are some people who do a quick mental calculation and probably assign their favorite non-energy benefit a value.

There are published methodologies to calculate a dollar value for NEBs[ii]. The methodologies are well thought out and researched, but schools and cities require more than a theoretical dollar value for a non-economic benefit. An energy efficient retrofit provides both. Also, to be fair, there are other possible outcomes to any project – the law of unintended consequences (for example, a school district might include specifications for 28 Watt lamps without realizing it had previously made a five-year purchase agreement for 32 Watt lamps). Here too, the SCORE and CitySmart programs strive to anticipate the barriers to sustainable energy efficient choices by sharing lessons learned among participants, as well as industry best practices and guidelines.

Non-energy benefits enjoyed by program participants fall chiefly into three main categories: lighting quality, HVAC improvement, and increases in outside air.

Lighting Quality

The types of projects completed under the SCORE and CitySmart programs usually involve interior fixtures. The quality of interior lighting is very important for occupant comfort, and a major design challenge is to specify the highest quality lighting system with the lowest cost and smallest energy usage.

In Texas public schools, most classroom lighting is provided by 2x4 recessed fixtures with fluorescent lamps. Older schools continue using original T12 lamps with magnetic ballasts, while almost all new schools use T8 lamps and electronic ballasts. Cities and city buildings utilize all lighting technologies available – incandescent and halogen, fluorescent (linear and CFL), high-intensity discharge (MH, HPS, LPS, MV), LED, cold cathode, and neon.

No matter the application, there are almost always better choices for interior lighting systems. There are also easily obtainable, specific metrics to objectively compare designs. During implementation of the SCORE and CitySmart programs, we have learned that many new schools are over-lit, according to IESNA design guidelines[iii].

While many older lighting systems provide more light than needed, other old lighting systems do not provide adequate light. Surprisingly few of the people responsible for specifying and/or purchasing lighting systems at schools or cities are familiar with terms used to judge different systems, such as Color Rendering Index (CRI), maintained lumens or lamp lumen depreciation, color temperature, and ballast factor.

While confusion abounds inside school districts and cities regarding appropriate lighting levels, industry-specific methods to compare lighting systems allow relatively simple analysis for comparing both occupant comfort and energy efficiency. Most architects and engineers providing professional services to schools and cities can perform additional analysis during design to present alternates to an owner, but most schools and cities are reluctant to pay for it. The end result is that by default, spaces are provided with more light than needed.

A superior alternative lamp and ballast combination installed in one of the most common (2x4 recessed fluorescent lamp) fixtures has been successfully adopted in a few school districts in Texas. The fixture type can be installed either as part of new construction or as a retrofit. Also important to the designer is that there is almost no change in the number of fixtures a particular space requires, so ceiling grids and plenum clearances do not need redesigning. The lamp and ballast system uses 48 Watts per fixture, and consists of two high lumen T8 lamps (3100 lumens) and one premium efficiency, instant start, electronic ballast, with a ballast factor equal to 0.77 (reduced-light-output). The lamps are 32 Watt with a CRI of no less than 80 and a color temperature of 4100 or greater. This combination of lamps and ballasts provides the recommended average maintained footcandles at the student desk surface, and most people perceive the light to be of higher quality than traditional T12 fluorescent lighting (or even first-generation T8 lighting). The occupant is more comfortable, while the energy usage is much lower, addressing two key aspects of a sustainable design.

Lighting Case Study: Plano Independent School District

Unlike many districts that still employed T12 lighting, Plano ISD had long since made the switch to T8 technology. However, through participation in the SCORE Program, district staff realized there was still an opportunity to significantly increase lighting efficiency. SCORE staff selected and toured a representative sample of 30 Plano ISD buildings in order to gather data on the existing lights. They used this data to identify opportunities and calculate estimate savings, program incentives, and payback periods for each school.

The majority of Plano ISD schools had three-lamp T8 fixtures in both classrooms and offices. After reviewing their options, district officials decided to retrofit these rooms with two-lamp, high-performance T8 lamps and premium-efficiency ballasts. The new, high-performance T8s produce higher light output than their predecessors, which enable appropriate light levels to be maintained even with a reduction in lamp count.

Plano ISD first tested one wing in a single school to demonstrate that the light provided by the two-lamp solution met recommended levels, with good colors and visual appeal. The superintendent and several other key decision-makers were so impressed with lighting quality and estimated energy savings that they decided to expand the scope of the project's first phase from eight schools to 24. The school aims to eventually perform similar upgrades on all 85 of its campuses.

We have found a particular lighting retrofit to generate near unanimous agreement that the new lighting system is better than the old lighting system:

replacing school gymnasium HID lighting with linear fluorescent lighting. High-bay fixtures (usually metal halide, but mercury vapor and incandescent are not uncommon) are replaced with fixtures using four foot T8 or T5 lamps with electronic ballasts.

While the resulting demand and energy savings are certainly appreciated, students, teachers, and administrators focus on the better lighting quality. The fluorescent lamps have a high color rendering index, higher color temperature, and lower lamp lumen depreciation. They turn on instantly, and the ballasts do not "hum." Because they do not require a re-strike time, controlling the operation via occupancy sensors can increase energy savings. But choosing the more efficient type of lighting is sustainable only when it become standard practice to specify high performance fluorescent lighting over HID whenever possible.

HVAC Improvement

School and city building air-conditioning systems can directly affect occupant comfort even more dramatically than lighting. Factors affecting how comfortable an occupant feels include the air temperature and moisture content, air flow, fan and duct noise, odors, and the ventilation rate with outside air; some or all of which can be controlled with a space-conditioning system. A reliable HVAC system is mandatory for controlling interior conditions for schools and offices in Texas and Arkansas.

While it seems obvious that students perform better in classes with air-conditioning, studies have been conducted on real students in classrooms to measure the improvement or drop in error rate of simple math operations[iv].

Many school districts have difficulty financing a cooling system replacement in a normal budget process. When a unit fails – for example, an air-cooled chiller – they may purchase the least expensive and least efficient replacement because it is available. Since an emergency purchase can have a lasting impact, SCORE and CitySmart partners are provided custom-tailored information to assist their evaluation.

For example, two 200-ton air cooled chillers recently began to fail at the City of Waxahachie's Civic Center. The natural inclination for many organizations would have been to simply make a like-for-like replacement, regardless of the potential for increased efficiency. However, under guidance of the CitySmart Program, the city instead chose to replace the chillers with water-cooled units with magnetic bearing technology. The choice resulted in a reduction of approximately 570,000 kilowatt-hours of energy use.

Outside Air

Adequate outside air is important to building occupants' comfort and productivity. The link between ventilation rates and student or office workers has been confirmed by many researchers following rigorous testing methods and statistical validation[v].

These and other studies have shown a direct link between proper outside air and occupant comfort and productivity. Delivering outside air to conditioned spaces is not hard. Delivering the right amount of outside air and controlling that delivery is straightforward for a system designer. Two ASHRAE Standards (62.1 Ventilation, 90.1 Energy Code) guide the designer in providing outside air as efficiently as possible.

Many new schools are being built with Energy Recovery Ventilators or Heat Recovery Ventilators. This allows the system to supply at least the minimum amount of outside air required and reclaim some of the energy used to condition that outside air. Adopting this system as an organization-wide standard for new construction is an example of a sustainable practice: providing healthier air with lower total electric usage than is typical.

CONCLUSION

To varying degrees and in a wide variety of measures, schools and cities participating in the

SCORE and CitySmart programs have committed to a sustained effort to understand the non-energy benefits of energy efficiency and adopt a long-term strategy to manage energy use. In addition, by formalizing that commitment and publicizing non-energy benefits such as increased occupant comfort, they have increased the likelihood that their organizations will continue investing in energy efficiency, use best practices in the design of new buildings and retrofit projects, and promote the value of the projects to their communities.

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