

Program Design & Implementation: Targeting New York State K-12 Schools

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ABSTRACT

There is a great deal of interest to understand and reduce school energy waste, because the public pays for the energy use in schools. Moreover, energy costs in many schools are second only to salaries and account for approximately 20 percent of facilities' operation and maintenance costs. It is also the case that energy and utility costs are typically the single largest controllable budget category. The U.S. Department of Energy predicts that from 2005 to 2006 schools will pay 52% more for natural gas, 34% more for fuel oil, and 11% more for electricity.

The New York State Energy Research and Development Authority (NYSERDA) has developed and implemented its Energy Smart Schools (ESS) Program to help public and private K-12 schools understand and reduce these budget impacts. This paper first outlines the very broad range of services offered and on how those services were initially selected and later improved upon. The paper also highlights the role and specific contributions of multiple representative professional associations in the program design, program delivery, and continuous program improvement process. It goes on to report on what customer response has been to different services and incentives. Finally, the paper shows how these responses were received both directly and through the associations, and includes data on numbers of schools, square footage, and students affected by which service.

The paper is unique because it also presents multiyear energy consumption trends and statistics from more than 500 New York State K-12 schools, which represents over 20% of all NYSEDA-eligible public K-12 schools in New York State. Furthermore, slightly more than a quarter of the schools in the database have submitted energy consumption data for more than one year. The statistics presented in this paper are derived from a significant database of actual monthly energy consumption, which includes information on total energy use and cost, plus a breakdown of electric use versus heating fuel use.

Why Focus on the K-12 Schools Market Sector?

In New York State, there are approximately 4,500 public K-12 school buildings with 2.8 million students and another 250,000 teachers and administrators. Schools in New York State spend close to \$5 billion annually on construction and renovations. It is estimated that these schools also spend over \$500 million annually on utilities. The opportunity to make a lasting impact on one of the largest market sectors in the State is enormous. Furthermore, in the Fall of 2005, the New York State Association of School Business Officials (NYSASBO) and the New York State Association for Superintendents of Buildings and Grounds (SBGA) partnered together to survey their memberships. In this survey, members estimated that their actual utility bills might exceed their approved budgets by up to \$100 million Statewide.

Just because a market sector is large, is not necessarily reason enough to spend resources to design and implement a targeted, sector-based program. NYSEDA also considered the

following characteristics unique to the K-12 market when deciding how to develop a schools program.

New York State K-12 school buildings are relatively homogenous — they have several elements of commonality which make them ideal candidates for a targeted program. First, they are all designed and constructed to meet the same mission and as such share very similar design criteria. Second, they are all designed and constructed to meet not only the same statewide commercial building codes, but also to meet the same set of New York State Department of Education regulations and review. Third, they each share a relatively tight range of daily, weekly, monthly, and annual state-mandated operating schedules and they must meet similar heating, cooling, and ventilation operational requirements. For example, NYSED design and operations requirements call for minimum ventilation rates of 15 cfm per occupant, minimum desktop lighting of 30 footcandles, and a classroom temperature range of 66°-70° F. dry bulb (NYSED, 1998). Additionally, according to the U.S. Department of Energy, there are only two, very similar climate zones in New York State. Therefore, the temperature and humidity conditions affecting schools' energy use are more similar than dissimilar across the State. Finally, each school has a comparable mix of occupants, who all behave similarly from building to building. These are all characteristics that energy efficiency program designers look for in any particular market sector.

What Services Can and Should be Provided?

The New York State Energy Research and Development Authority (NYSERDA) is a public-benefit corporation created in 1975 by the New York State Legislature to address the State's most difficult energy and environmental challenges in ways that drive positive economic results. NYSEDA administers the **New York Energy SmartSM** program, which supports public-benefit programs during the transition to a more competitive electricity market. NYSEDA uses the System Benefits Charge (SBC) funds, which is a surcharge on the electricity transmitted and distributed by the State's investor-owned utilities, to create several public-benefits programs. To ensure NYSEDA provides the best service to its customers, it continuously reviews programs and initiatives to identify new opportunities and potential areas to improve. As part of this ongoing improvement process, NYSEDA determined that the K-12 schools sector could benefit from additional services and was an excellent candidate for a sector-based program. In 2002, NYSEDA issued a competitive solicitation to contract with a qualified firm to help NYSEDA provide a number of services for the schools market. The result of this competitive selection process was a contract with TRC to support NYSEDA's **Energy Smart Schools Program**.

Many years ago, the management guru Peter Drucker coined the phrase, "You can't manage what you can't measure." NYSEDA discovered very early in its program design process that schools' buildings and grounds professionals and their partners the schools' business officials had almost no information available to them regarding energy use and cost patterns in schools. That is, they knew that "energy" was a significant part of their budget and that it was increasing every budget cycle. However, they had no way of knowing whether the electric and heating fuel bills they were paying for the district or any building in it were high, low, or average compared to their peers and for their use patterns. In response to this lack of awareness, NYSEDA determined that energy benchmarking would be a cornerstone service provided by its Energy Smart Schools Program (Coleman, 2004).

NYSERDA's approach to energy benchmarking is designed to provide two major, interrelated results. First, it gives both NYSERDA and its schools customers a multi-parameter current baseline of energy use and cost against which to forecast and measure future improvement. Second, benchmarking combined with recommendations of how to find the most likely energy savings provides customers with a path to action, with a tool to overcome inertia, and with the information needed to take the next step. More details on these energy benchmarking reports to schools and statewide results to date are discussed below.

Next, NYSERDA and TRC contacted the New York State Education Department (NYSED), to gain insight on the design, construction, operations, maintenance, and budgeting barriers to improving energy efficiency in schools. Parallel with that, TRC and NYSERDA also contacted the New York professional societies representing school staffs involved with energy: the New York State Association for Superintendents of Buildings and Grounds (SBGA) and the New York State Association of School Business Officials (NYSASBO). These three organizations represented the professionals handling the majority of the regulatory, operational, and budgeting issues facing New York's K-12 schools.

As a combined result of *getting the facts* from both energy benchmarking and from their partners noted above, NYSERDA developed the following full list of services being delivered under the ESS Program:

- Energy Benchmarking — including use of the U.S. Environmental Protection Agency's (EPA) Building Performance Rating System or Portfolio Manager
- National and State-level Recognition — with EPA
- Offsite Limited Scope Technical Assistance Support
- Computer-based Tools:
 - School Plug Load Model
 - Fuel-switching Model
 - Thermostat Setback Model
- Building Operator Certification (BOC) Training — delivered in partnership with the Northeast Energy Efficiency Partnership (NEEP), the Northwest Energy Efficiency Collaborative (NEEC), NYSED, and SBGA
- Biannual *Energy in Schools* Conference — with EPA and SBGA
- Comprehensive Maintenance Planning Template (NYSERDA & NYSED, 2005) — with NYSED
- New York State High Performance Schools Guidelines (NYSERDA & NYSED, 2006) — with NYSED
- One-day Seminar Series on Advanced Lighting, Building Control systems, Boiler Optimization, and Energy Alternatives — with SBGA

Each of these services is discussed in more detail below.

Energy Benchmarking

NYSERDA started integrating benchmarking into its school's efforts in 1998, with a focus on use of the EPA's Benchmarking Tool — Portfolio Manager (EPA, 2003). The EPA made a commitment to energy benchmarking several years ago, which ultimately led to the availability of today's web-enabled tool — the Building Performance Rating System, or

Portfolio Manager. Versions of Portfolio Manager are available for several building types, including K-12 schools. The most recent update of the version for schools was released in late January, 2004. The purpose of this paper is not to present a detailed description of Portfolio Manager. However, a brief description of the model is presented below in order to place this work in New York State in context for the reader.

The output of Portfolio Manager is a single energy ‘Score’ on a 1 to 100 scale. The EPA Score represents the percentile ranking of the normalized energy intensity of a particular building when compared to a national database of schools. For example, a score of 30 means that 29% of schools nationwide are more energy intensive per square foot and that 69% are less energy intensive per square foot. Portfolio Manager requires the following inputs to develop the score (EPA, 2003):

- Gross square footage
- At least 12 months of concurrent energy consumption for all fuel types
- Weekly hours of occupancy
- Number of students
- Number of months in operation
- Percent of building that is cooled
- Whether there are cooking facilities in the building
- Number of computers in the building

Portfolio Manager uses these values as inputs to a sophisticated model that normalizes for each of these variables. It also includes both a climate (heating and cooling degree day) and a weather normalization routine. The model generates the percentile score through comparison of a building’s energy use to the data in the 1999 Commercial Buildings Energy Consumption Survey, compiled by the Energy Information Administration of the U.S. Department of Energy. This survey data is the model’s baseline.

NYSERDA and TRC used this opportunity to develop a list of seven indicators to use as New York State benchmarks without being constrained by the need for a perfect regression algorithm (Sharp 1998). The list was developed based on discussions with NYSERDA staff, school business officials, school superintendents of buildings and grounds, and energy managers with various Boards of Cooperative Educational Services (BOCES) around the State. The indicators being analyzed and reported to schools include the following:

- EPA Portfolio Manager Score
- Site energy — kBtu/sq. ft.
- Electric use — kWh/sq. ft.
- Heating fuel use — kBtu/sq. ft.
- Normalized heating fuel use — Btu/sq.ft./HDD
- Energy cost — Dollars/sq. ft. and Dollars/student

Of all the public K-12 schools in New York State, slightly more than 2,400 of them are eligible for NYSERDA services. The others, primarily in New York City and on Long Island, receive their power from the New York Power Authority and the Long Island Power Authority respectively and do not pay into the System Benefits Charge program, which is a critical eligibility requirement to receive services from the Energy Smart Schools Program. Among

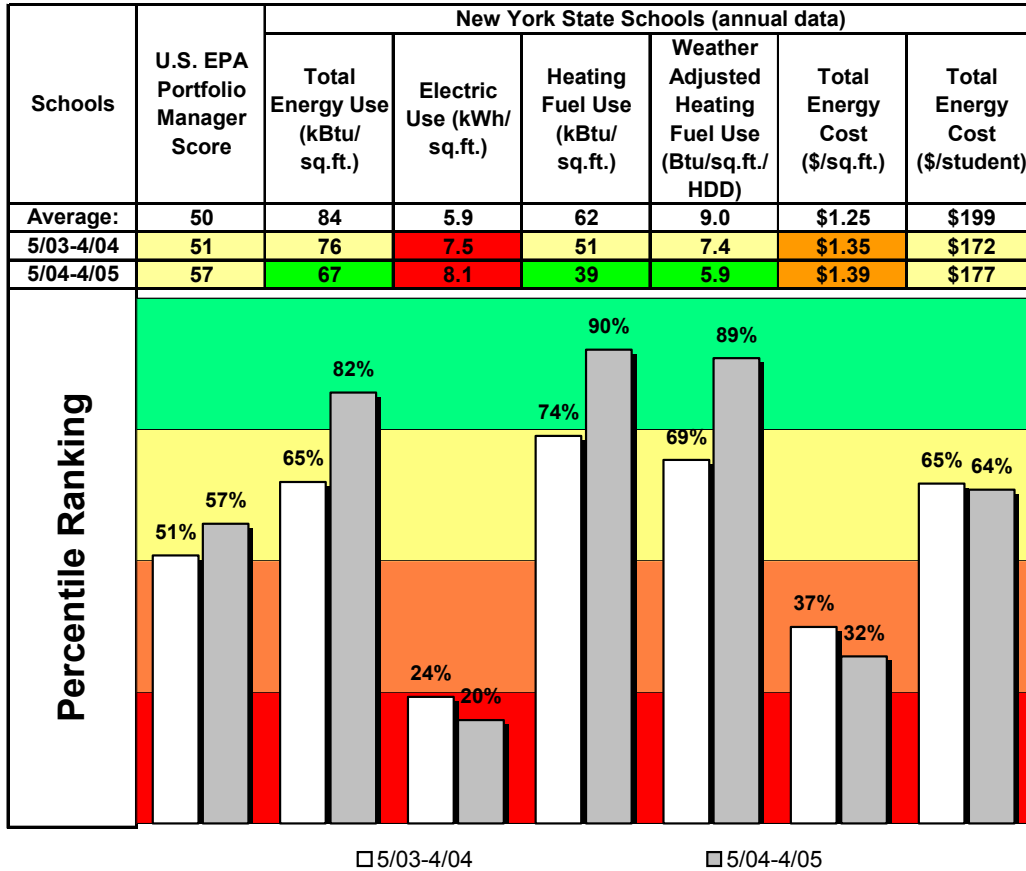
those 2,400 schools, NYSERDA has now benchmarked more than 500 — or 20% of the population. These benchmarked schools encompass over 50 million square feet and teach more than 275,000 students. A summary of some of the results is shown in Figure 1, below. Multiyear trends in these consumption and cost data are presented at the end of this paper.

Figure 1. Energy Benchmarking Results

Parameter	Average	Median
Building Size (sq. ft.)	113,000	78,000
U.S. EPA Portfolio Manager Score	35	30
Total Energy (kBtu/sq. ft.)	82.1	80.4
Electric Use (kWh/sq. ft.)	6.76	5.82
Heating Fuel Use (kBtu/sq. ft.)	59.0	58.8
Heating Fuel Use (Btu/sq.ft./HDD)	8.9	8.4
Energy Cost (\$/sq. ft.)	\$1.34	\$1.32
Energy Cost (\$/student)	\$228	\$214
Student Density (students/100,000 sq. ft.)	621	613
Electric Cost (\$/kWh)	\$0.115	\$0.116
Fuel Oil Cost (\$/gal)	\$1.48	\$1.50
Natural Gas Cost (\$/therm)	\$1.00	\$0.99
Weekly Operating Hours	62	60
Operating Months per Year	11	11

More important than the results listed above is how this information is delivered to the decision makers in the school districts. Communications experts have long known that people tend to understand and absorb information presented graphically more readily than that shown as straight text or numbers. Therefore, NYSERDA and TRC developed the graph shown in Figure 2 below as the way to summarize the benchmarking results for an individual school.

Figure 2. Energy Benchmarking Summary Graphic



For the above sample school, this graph is designed to convey the following messages to the decision makers:

- EPA Score: *“Somewhat better than average...how to improve?”*
- Total Energy Use: *“Much improved over last year...what’s the breakdown?”*
- Electric Use: *“Quite poor...and it’s worse than last year!”*
- Heating Fuel Use: *“Excellent and getting better!”*
- Recommendations:
 - Perform a NYSERDA-supported onsite energy audit
 - Focus on major electric systems and building plug load where there are significant low-cost/no-cost improvement opportunities
- Potential savings if costs upgraded to just “Average” — \$0.14/sq.ft. X 100,000 sq.ft. = \$14,000/year

The graph is part of a six-page report that describes each indicator, shows the reader where the building ranks for each indicator with respect to the rest of New York State K-12 schools, provides them with recommended next steps, and directs them to specific NYSERDA support programs based on their findings. Where appropriate, the report also tells the reader if they have qualified for any awards as well as how to contact TRC for follow on help with next

steps (see below). Additional information on statewide results to date and trends over time are shown at the end of this paper.

National and State-level Recognition

Recognition for excellence is always an important part of a successful program. From the beginning of the benchmarking effort, New York wanted to recognize excellence and reward those who have achieved an outstanding level of improvement, as well as those who are able to operate their buildings at a very high level of efficiency. Awards provided by the EPA are ideal for this purpose.

First, the EPA provides the ENERGY STAR[®] Leader Award for those organizations who can achieve a 10 point improvement in the average Score of all of their building stock combined. To date, two K-12 school districts in New York have received the Leader Award. TRC facilitates the completion of all required documentation for the school district. Only 20 organizations in the nation have received this award, making New York Schools a major recipient of this prestigious award.

The EPA also provides the ENERGY STAR Building Label for those buildings which score a 75 or higher in the EPA's tool. More than a dozen New York schools have received scores high enough to receive the Building Label. As a component of the services delivered under the Energy Smart Schools Program, TRC provides the EPA-required PE certification free of charge. NYSERDA is considering adding a State level recognition to its Energy Smart Schools Program.

Off Site Limited Scope Technical Assistance Support

One of the many issues faced by all organizations is finding the time and resources to get a project started. NYSERDA's experience has been that its energy benchmarking reports generate not only interest and a desire to act, but also a need for follow up analysis. While NYSERDA has several programs that provide in-depth energy engineering analysis; many times organizations need only a few hours of assistance to answer a specific question or to help it decide the best path to move forward on a specific project. These limited needs do not require a full energy engineering analysis and they are typically urgent needs that cannot wait for a full project to be put in place. Under NYSERDA's supervision, TRC provides off-site, limited-scope technical support to K-12 schools to facilitate these kinds of efforts.

Computer-based Tools

Several times, schools' requests for additional help as discussed above have highlighted broader, sector wide needs. As these arose, TRC would assess whether or not a tool/solution could be cost-effectively developed, and then make a recommendation to NYSERDA. To date, NYSERDA has authorized the development and distribution of the following, first order, easy-to-use, spreadsheet-based tools for schools facility managers:

- School Plug Load Model
- Fuel-switching Model
- Thermostat Setback Model

In each case, the tools were designed to provide basic, decision making support for the users. That is, their precision was calibrated to meet the user needs — not to provide detailed, professional engineering calculations. Following initial development, each tool was used and evaluated ‘in the field’ by self-selected SBGA members. Upon NYSERDA approval, initial versions were then made available to the entire sector. Improvements are continuously made to the tools as user feedback is received. That user feedback regarding the usefulness and quality of the tools has been universally positive.

Building Operator Certification (BOC) Training

The Building Operator Certification Training Program is a nationally recognized multi-day training program that was designed specifically for facility operators. The BOC includes two levels of training, and completion of each level of training includes a certification of the individual completing the course work. The 100 Level is comprised of 8 one-day training classes covering topics such as: building system overview, energy conservation techniques, HVAC systems and controls, efficient lighting fundamentals, environmental health and safety regulation, indoor air quality, and facility electrical systems. The 200 Level course is designed for more advanced facility operators. To achieve the 200 Level certification, attendees must attend four core classes as well as two elective classes. Attendees for both levels must satisfactorily complete all course work, exams and homework to be certified. NYSERDA has successfully delivered nine BOC courses, elevating the skills of 240 facility professionals. Individual class and overall course evaluations returned by the attendees indicates a consistently high level of satisfaction with the courses.

Biannual *Energy in Schools* Conference

Once every two years, NYSERDA holds a two-day conference designed to bring facility operators, business officials, energy managers, teachers, and the entire energy industry to one place. The conference is comprised of four concurrent sessions, a student project display area, a trade show, alternate-fuel vehicle displays, and key-note speakers. In 2004, over 450 attendees participated in the conference making it the largest yet. The next conference is being planned for November of 2006 in Rochester, NY. Detailed topic information will be forthcoming shortly.

Comprehensive Maintenance Planning Template

All public K-12 schools in New York State are required to comply with regulations and requirements as set forth by the State Education Department. As the cognizant agency with responsible for oversight of all K-12 schools, NYSED requires that all districts complete a number of reports. Three of these reports are the Five Year Capital and Facilities Plan, the Facility Report Card, and the Comprehensive Maintenance Plan. NYSERDA and TRC developed a customizable spreadsheet (NYSERDA & NYSED, 2005) that school districts can use free of charge to track and maintain the status of their facilities and to ensure that all school buildings are in a state of good repair. NYSERDA and TRC developed this spreadsheet relying on heavy input from SBGA members and the staff in the Facilities Department of the State Education Department. In addition to facilitating compliance with reporting requirements as set forth by NYSED, overall goals of this document are to:

- help facility managers better understand and control their energy costs;
- improve occupant health, safety and comfort;
- help justify capital expenses that reduce energy or maintenance costs;
- focus preventative maintenance approaches to improve overall maintenance; and
- document capital expenses above and beyond annual costs (for service contracts, supplies and recurring costs).

Once a district has inputted the basic facility information and maintenance information, annual reporting becomes a matter of updating project information and specific building status. To further encourage best practices, many advanced guidelines and principles were introduced into the Comprehensive Maintenance Planning Template that were not specifically required by any Commissioner's Regulations or the Manual of Planning Standards.

New York State High Performance Schools Guidelines (NY-CHPS)

In late 2004, the New York State Education Department approached NYSERDA with an invitation to partner together on the development of a high performance design guideline tailored specifically for New York K-12 schools. NYSED's intent with this document was to add it to the Manual of Planning Standards as a voluntary appendix. At the time this paper is being written, final work is being completed with the anticipation that it will be public by the time of its presentation. "Ownership" of the Guidelines has already been transferred to NYSED. NYSED's High Performance Schools Guidelines (NYSERDA & NYSED, 2006) are based on the Massachusetts Collaborative for High Performance Schools Guidelines (MA-CHPS), which were in turn based on CHPS, Inc. Guidelines. New York has tailored the Guidelines for New York code requirements and the priorities of the State Education Department. In addition, New York has organized and added new material to emphasize criteria that directly contribute to student learning, reduced maintenance, and long building life. Specifically, new material and upgrades to existing material focused on: materials durability, operations and maintenance and indoor environmental quality.

One-Day Seminar Series on Advanced Lighting, Building Control Systems, Boiler Optimization, and Energy Alternatives

As part of their ongoing partnership, TRC and NYSERDA worked with SBGA on a survey of its members' information and training needs. In the energy arena, the top three needs reported were for advanced lighting, building controls, and boiler optimization. NYSERDA had TRC work with SBGA's training arm, the School Facility Management Institute (SFMI) to develop, schedule, market, and deliver a series of 11, one-day seminars to meet these needs. As this paper is being written, those seminars are being delivered. Evaluations from over 100 attendees to date have been very positive.

Findings and Conclusions

Starting from scratch, with a previously untried approach, NYSERDA has designed and implemented a K-12 Energy Smart Schools Program that has accomplished the following:

- Established successful and enduring partnerships with the organizations representing K-12 schools regulators, facilities managers, business officials, and designers.
- Designed a multi-parameter Energy Benchmarking tracking and reporting system.
- Energy benchmarked over 20% of the 2,400 NYSERDA-eligible New York State K-12 schools.
- Through its benchmarking, facilitated U.S. EPA ENERGY STAR Leader Awards for two school districts, comprising 20% of these EPA awards delivered nationwide.
- Through its benchmarking, facilitated over a dozen eligible schools for the U.S. EPA ENERGY STAR Building Label.
- Provided Building Operator Certification courses to 240 K-12 buildings and grounds professionals responsible for more than 20 million square feet of educational space.
- Provided advanced lighting, building controls, and boiler optimization seminars to over 300 K-12 buildings and grounds professionals.
- Held two, highly-rated *Energy in Schools* conferences for a thousand attendees.
- Developed and delivered a *Comprehensive Maintenance Planning* template for use by all 700+ New York State K-12 school districts.
- Developed and delivered state-of-the-art *High Performance Schools Guidelines (NY-CHPS)* for use in school building new construction, additions, and major renovations.

“...a targeted, cross-program approach was piloted for k-12 schools by NYSERDA. The effort has been successful by providing services specifically designed and packaged to encourage energy efficiency throughout the sector...”
New York State Public Service Commission, March, 2006.

In addition to the above direct services, a desired program result was to increase K-12 schools participation in other, related NYSERDA programs. NYSERDA’s Commercial-Industrial Performance Program (CIPP) and its Smart Equipment Choices Program (SEC) in particular have beneficial elements for schools. In the two years immediately preceding the start of the ESS Program, a total of only 5 schools took advantage of CIPP. In the slightly over three years of the ESS Program, an average of 20 schools *per year* have participated in CIPP. Similarly, only 13 schools took part in SEC prior to the start of ESS, while over 15 *per year* have participated since. These numbers indicate a strong increase in both the knowledge and the use of NYSERDA programs by New York State K-12 schools.

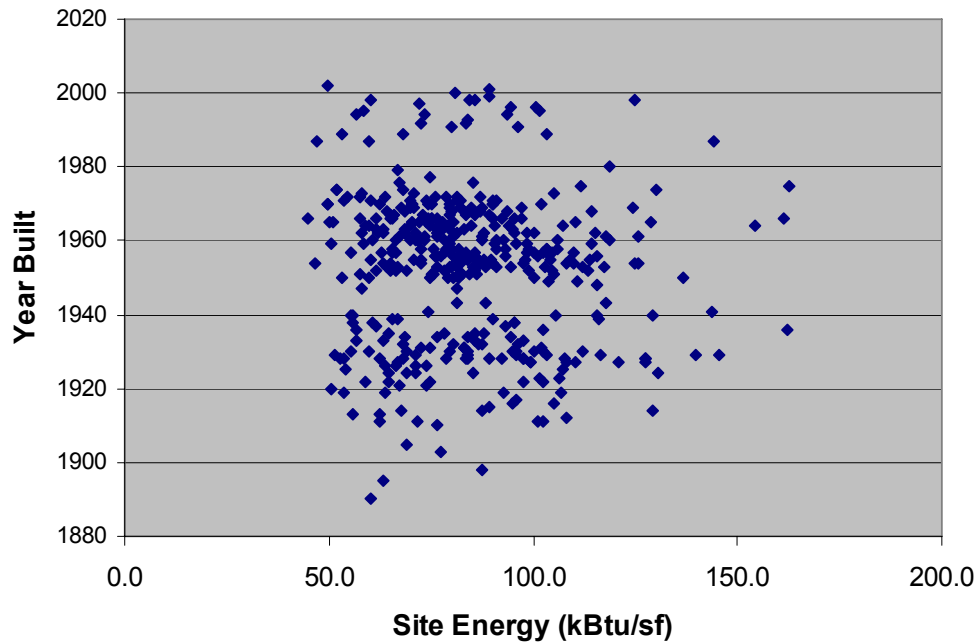
NYSERDA & TRC have also been tracking trends in several of the energy benchmarks since the Energy Smart Schools Program began in the 2002-2003 school year. Over that period, the unit cost to schools of both fuel oil and natural gas have each risen over 50%! Cost of electricity has risen about 18% over the same period.

However, preliminary analysis shows over a 12% reduction in total energy use per square foot in benchmarked schools over the past three years of the Energy Smart Schools Program. This data is based on actual utility bills. Detailed impact assessments are ongoing, but this indicates a significant potential impact of the Program on energy use in the K-12 schools market.

As a final point, the energy benchmarking data have also been examined to determine whether there are school building factors such as age, size, location in the State, percent air-conditioned, student density, etc. that might have a direct correlation with school energy use. Surprisingly, review of each of the above factors relative to site energy use found no correlation at all. A graph of energy use versus year built is shown in Figure 3 below as an example of this lack of correlation.

Figure 3. New York State Schools' Energy Use Versus Age

Site Energy (kBtu/sf) vs. Year Built



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