

High Performance Schools Guidelines for New York State: Lessons Learned Developing NY-CHPS

Dale R. Stanton-Hoyle, TRC Energy Services

Matthew Brown, New York State Energy Research and Development Authority

ABSTRACT

In late 2004, the New York State Energy Research and Development Authority (NYSERDA) was invited by the New York State Education Department (NYSED) to collaborate on the development of new guidelines for high performance schools. The guidelines meet NYSED's specific regulations and New York State's codes while helping planners and designers of new construction and renovation projects to make schools more energy-efficient, healthy, durable and conducive to learning.

Much as the U.S. Green Building Council's Leadership in Energy and Environmental Design® (LEED) system promotes high performance design for a variety of building types, school designers have developed guidelines specific to the needs of schools and local climate conditions. NYSEDA and NYSED started the development of their new guidelines by reviewing the best ideas developed by school designers around the country: the CHPS materials from the Collaborative for High Performance Schools, Inc. and MA-CHPS from the Massachusetts Technology Collaborative. NYSEDA and NYSED wanted to expand several sections within these documents to more comprehensively address indoor environmental quality, operations and maintenance, and durability. To accomplish this, NYSEDA and NYSED developed NY-CHPS.

This paper reports on the development process of this important product, the lessons learned from adapting innovative material from other states, the critical input from the NY-CHPS advisory council, and the opportunities that may exist for transferring at least part of these guidelines to other states.

Introduction

Why Focus on High Performance Schools?

New York has prided itself on having a strong commitment towards its public K-12 schools for many years. This is evidenced from the creation of the New York State Education Department's (NYSED) Manual of Planning Standards around 1910, to the New York State Energy Research and Development Authority's (NYSERDA) Energy Smart Schools Program, to the collaboration of these two organizations in developing NY-CHPS. In New York State, there are over 4,500 public K-12 school buildings with more than 2.8 million students and another 250,000 teachers and administrators (Thurnau 2006). Schools in New York spend close to \$5 billion annually on construction and renovations and approximately \$500 million annually on utilities (Thurnau 2006). The opportunity to make a lasting impact on one of the largest market segments in the State is enormous.

As NYSEDA started this endeavor with NYSED, they noted there are many good design guides for other buildings but not many specific to schools. They also noted that several

of the more widely used guidelines do not do enough with regard to durability, indoor environmental quality, and operations and maintenance (O&M). There are green guides, high-performance rating systems, energy-efficiency codes, standards, and guidelines, but most of these have been used primarily for office and municipal buildings. With an average building age of more than 50 years, public K-12 school districts in New York have a tremendous opportunity to build and renovate schools that are much better than the ones currently in service (NYSERDA 2006). With these thoughts in mind, NYSERDA and NYSED began efforts to enhance existing green building guidelines for New York State schools.

What is a High Performance School?

There are many definitions of a high performance school. Each definition reflects the priorities of the organization, state, or locality that is using the definition. It was important at the beginning of this process that NYSED defined a high performance school as it relates to New York State K-12 schools as having three distinct attributes:

- It is designed to enhance the learning and working environment.
- It is less costly to operate than a conventional school over the life of the building.
- It conserves important resources such as energy and water.

A high performance school is designed to optimize the durability of the facility and to utilize high-efficiency, correctly-sized heating, ventilating, and air conditioning equipment and lighting systems. Wherever possible, appropriate amounts of glare-free daylight should be brought into the school to enhance the learning environment. The building shell should integrate the most effective combination of insulation, glazing, and thermal mass to ensure energy efficiency. Plumbing fixtures are specified to reduce water consumption. When used together, these design measures can significantly reduce the operational costs of a school building. Based on research performed to date, it is reasonable to estimate that 20%-40% cost savings in utility bills versus a non-green building of the same size and shape are possible (Katz 2005).

A high performance school should also be thermally, visually, and acoustically comfortable. Thermal comfort means that teachers, students and administrators should be neither hot nor cold as they teach and learn. Visual comfort means that the quality of lighting makes visual tasks, such as reading and following classroom presentations, easier. Acoustic comfort is achieved when students and teachers can easily hear and comprehend each other, and are not impeded by loud ventilation systems or noise from adjoining spaces or the outdoors.

High quality indoor air is another important feature of a high performance school. Air intakes should be located away from potential sources of contamination and ventilation systems should be designed to introduce optimal quantities of fresh air. Architects and engineers should incorporate best design practices to prevent water intrusion into wall and roof assemblies. This, in turn, reduces the potential for the accumulation of moisture in materials that could support mold growth or lead to premature replacement of indoor finishes and even structural elements.

Benefits of High Performance Schools

For many years, educators and school districts have sought to quantify the benefits of high performance schools. Several recent studies show tremendous benefits from high

performance schools (HPS) design (HMFH 2005) (Kats 2005) (Paladino et al. 2005). The following examples of benefits were provided in these three reports:

- 30% average energy savings above code requirements.
- 5% increase in test scores.
- 5% reduction in teacher turnover.
- 15% reduction in absenteeism.
- 20% reduction in potable water use.
- 150% ROI.
- 22% reduction in construction waste.
- 1.5% to 2.5% higher construction costs but with financial benefits 10 to 20 times as large.
- 1.8% to 5.1% higher total project costs, with an average of 3.2%.
- 9% savings in construction costs in one case.

In addition to these recent studies, there is a large body of resources that emphasizes different benefits from designing high performance or green schools. Each standard or guideline will have slightly different results, which will reflect the priorities and goals of each document. As an example, some resources place greater emphasis on energy efficiency; others on green characteristics; and others on better environments for student learning. NYSERDA/NYSED evaluated these approaches and ultimately, NYSED developed a list of priorities that helped drive the emphasis of NY-CHPS. The following benefits of HPS design were added directly into NY-CHPS to help the users understand and focus on what NYSED wanted to emphasize in school construction and renovation.

Provide an outstanding learning environment. First and foremost, schools designed to meet NY-CHPS must improve the learning environment. Mostly this is accomplished by ensuring that classrooms are comfortable and do not have visual (e.g., glare), audio (e.g., background noise), thermal or other indoor environmental quality (IEQ) conditions (e.g., poor air quality) that could inhibit learning.

Durability. NY-CHPS helps designers and districts understand the true life-cycle cost of a school. NY-CHPS rewards designs that focus not just on initial construction costs, but those that also address energy, maintenance and replacement costs. NY-CHPS helps designers and school officials select flooring, roofing, wall, and other building systems based on total, life-cycle cost of ownership.

Easy to operate and maintain. Schools must be properly maintained to be energy efficient, healthy, and lasting. Maintenance expenses must be considered during design as they represent a significant expense to district tax payers. NY-CHPS rewards district commitments to use an Energy Plan, Energy Benchmarking, Building Operator Certification training, and a Maintenance Plan. Healthy and safe buildings contribute to lower absenteeism rates and more productive occupants.

Utilize natural resources. Schools buildings should be designed with special attention to building orientation on the site to capture natural lighting, passive solar heating, and natural cooling effects. Designers must pay special attention to room location (to benefit from daylight),

window placements, and glazing selection. Sites should be selected to preserve natural resources and to minimize adverse impacts on the environment.

Take advantage of renovation projects. The average school building in New York is over 50 years old and the vast majority of K-12 projects are renovations. The renovation of school buildings provides districts with an opportunity to increase energy efficiency and indoor environmental quality while maintaining and promoting building durability.

Long-term benefits to students, teachers, and taxpayers. High performance schools provide direct benefits to teachers and students by improving the educational environment. Furthermore, districts that build high performance schools will derive savings through reduced energy, maintenance, and replacement costs.

How Much More Will It Cost?

It is usually assumed that building a high performance school is more costly than a standard school, but that is not always the case. By using an integrated design process from the start, better buildings can usually be built at little—and sometimes no—additional construction cost. Higher design costs will usually be incurred, but this is usually only a fraction of overall project costs, and many times incremental design costs can be offset by savings in other areas. For example, if an architect proposes saving energy by changing the windows from double glazing to triple glazing, this will save energy but will cost more for the windows. However, engineers may be able to eliminate the perimeter hot water radiation system because the perimeter heat loss is reduced, and heating can be done with just heat from the air system. They might also determine that air duct sizes for heating and cooling can be reduced, or the boiler may be downsized. The reductions in HVAC equipment could more than pay for the added cost for the triple glazing. In the traditional non-integrated process—in which designers primarily sit in their separate offices and use a standard, “worst case design” method—such integrated savings are often not possible, and systems can be needlessly over designed and inefficient. NY-CHPS is structured to help this situation by encouraging an integrated design process.

The Evolution of NY-CHPS

The New York Manual of Planning Standards

Schools in all states have guidelines and standards that the schools must follow to get a building permit. This includes regional, state and local codes, as well as regulations that may be imposed by state or local school bodies. In addition, there are state and federal environmental regulations that control issues like runoff into bodies of water and the protection of wildlife and wetlands. Finally, there are utility requirements to comply with as well. This complicated array of requirements makes it important for designers to remain knowledgeable of all the requirements in effect for the construction or renovation of any new school project.

In New York, the State Education Department (NYSED) developed an important Manual of Planning Standards (MPS) around 1910. The MPS has served as the required path for getting a building permit for K-12 schools throughout the state ever since. The MPS predated most

building codes by as much as 50 years and served well to ensure that New York schools were safe and well built.

Since its original issuance, NYSED has incorporated innovative material into the MPS, addressing the emerging trends in education to include daylighting, low background noise levels, student access to views, and durability of materials. As a credit to the MPS and the staff in NYSED's Facilities Department, many prerequisites and credits that are in most of today's high performance guidelines had been incorporated into the MPS for years, and in many case, decades. When NYSED first approached NYSERDA about the opportunity to develop an HPS guideline, NYSED stressed the importance of their culture and mandate: to help school districts design excellent schools that enhance the learning environment.

NYSERDA's Energy Smart Schools Program

For 30 years NYSERDA, as a State Authority created by the New York State legislature to address the State's energy and environmental challenges, has been helping commercial, industrial, residential and institutional customers improve the energy efficiency of their buildings. As part of its mandate, NYSERDA started the Energy Smart Schools Program to focus resources to help this key market sector. In addition to its core incentive programs, NYSERDA provides school districts and other key market actors, with Building Operator Certification Training classes, high performance on-line training for designers, energy benchmarking services, a comprehensive O&M Toolbox, energy savings calculation tools, and support for school associations throughout the State. With the majority of New York schools being more than 50 years old and with the ever expanding infrastructure needs of education, many schools are now being built and renovated. NYSERDA realized that this invitation from NYSED to participate in this effort was a significant opportunity to reduce the energy consumption of those new and renovated schools by working with NYSED on HPS guidelines.

The National Search for Schools Design Materials

The planning process was started with a national search of design materials used both for schools and other buildings. Hundreds of guidance documents were found. Prominent organizations have produced excellent materials such as ASHRAE's **GreenGuide** and U.S. DOE's **National Best Practices Manual for Building High Performance Schools** (ASHRAE 2004) (DOE 2002). Individual states, counties and university systems have guidelines. Some are arranged with an emphasis on pre-design policies; others on detailed design criteria that only an engineer or architect would use; some very prescriptive; and finally those based on scoring systems. NYSERDA and NYSED chose this last approach—a relatively short scoring system with a mix of prerequisites and requirements—for NY-CHPS. This type of system has a variety of advantages:

- Designers have the flexibility to use different approaches for different projects while still working within the goals of the system.
- It allows the specific needs of the district to be integrated into a building. NY-CHPS is about a using thoughtful design process, not about any specific measure or strategy.
- Designers had begun to develop a familiarity across state and institutional boundaries with the LEED rating system.

- People generally love competition. They do not just ask if an Olympic skater completed a good routine; they ask if the skater earned a medal. Similarly, people ask if a new building has won any awards.

From LEED to CHPS to MA-CHPS to NY-CHPS

The US Green Building Council's LEED rating system has long been considered to be the leading system helping building owners, architects and engineers to design, build and operate buildings in a more sustainable manner. In the late 1990s and early years of the new millennium, many people involved in the design and operation of K-12 schools felt that, despite the advances and great strides made by the LEED system, certain aspects were not yet sufficiently addressed, especially as it relates to the specific needs of schools. The Collaborative for High Performance Schools (CHPS) was one of the first groups to try to address this. CHPS worked from the LEED documents and developed a design guideline and scoring system that was specialized for the K-12 environment. Massachusetts built on this effort and customized the CHPS materials for the Northeast climate and for the specific needs of the Massachusetts Department of Education. NYSERDA and NYSED chose to use MA-CHPS as a starting point because it was built on these other collaborative efforts. In addition to this significant resource, NY-CHPS drew from additional peer-reviewed material during its development. To help both NYSERDA and NYSED focus priorities and evaluate potential enhancements, an Advisory Council (AC) was created to support and guide the development of NY-CHPS.

The Importance of the Advisory Council

Convening the AC was important because without the AC, NY-CHPS would not be as well rounded or as complete. The AC was created to inform and guide the process. To ensure that the guidance received would be balanced, great effort was made to ensure that it was a balanced group of individuals. The AC consisted of members from the following groups:

- Superintendents of Buildings and Grounds Association.
- Association of Educational Safety and Health Professionals.
- Association of School Business Officials.
- Council of School Superintendents.
- New York State Department of Health.
- A Teacher/Energy Manager.
- The Healthy Schools Network.
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- Association of Energy Engineers (AEE).
- The American Institute of Architects.

While the AC is comprised of members from many professional groups, formal endorsement of the Guidelines from these respective organizations was not sought, and participation of the AC members was not as a formal representative of these organizations.

Industry Buy-In

One of the key goals of incorporating the AC into this process was to develop industry buy-in for the end product. A fear of both NYSERDA and NYSED was that, with several existing guidelines already available, architects, engineers and the construction industry as a whole would find another new guideline confusing or repetitive. Furthermore, many of the organizations represented on the AC were associations representing the men and women who manage schools on a day-to-day basis. Their support and buy-in is critical to the success of any project in a school, but with the potential benefits being so expansive, their early understanding and support of the Guidelines was as vital as the technical content. The AC members have volunteered to participate in the initial marketing and deployment of NY-CHPS.

Technical Resources

Advisory Council members were more valuable than any written resource for providing excellent technical material. Especially critical were the real world experiences that several members brought to the table. Many AC members had already worked on both successful and unsuccessful projects that had attempted to incorporate high performance design features.

The Collaborative Process

Nearly all processes are enhanced when professionals are able to discuss topics with their peers, but the collaborative effort was particularly impressive during AC meetings that were used to develop NY-CHPS. Both NYSERDA and NYSED have had the privilege of facilitating many advisory groups, however, this group took great pride in their work. Unlike many advisory groups that serve a political purpose or who rubber stamp the decisions of staff, AC members regularly volunteered to engage in research and additional work to support the AC's desire to better understand or expand on specific topics. Also, the group took care to ensure that all parties' views were heard and understood before decisions were made. All-in-all, it was an extremely talented group of individuals who partnered together and worked smoothly together.

A New Entity Takes Shape

NYSED Puts its Stamp on NY-CHPS

From the beginning, NYSED was active in guiding this project. While a high performance school guideline was not part of the MPS, the principles of high performance design have been primary drivers within NYSED's Facilities Department since its inception in the early 1900s. One of the first steps that NYSED took was to develop a working document that outlined its principles for this effort. As detailed in the benefits section above, the working document stated that school buildings must directly enhance the learning environment, be healthy, durable, safe and the least possible cost to operate over the life of the building. This emphasis included acoustics, air quality, integrated pest control management, thermal comfort, visual comfort, and more. This also shifted the emphasis somewhat away from other guidelines' scoring systems by reducing the relative importance of recycled materials and other credits that benefit society without directly affecting the learning environment of teachers and students.

The importance of materials durability, IEQ, and O&M. NY-CHPS includes an important new section on materials durability because, similar to energy costs, the durability of school walls, floors, and other major systems have a large impact on the overall operating costs. Selecting more durable materials can also improve IEQ by avoiding water damage and mold growth. Figure 1 shows an example of a new durability section in NY-CHPS. Note that life-cycle costing is a cornerstone of the approach to durability.

Similarly, IEQ has been strengthened and expanded compared to previous HPS guidelines. There are 19 IEQ prerequisites in NY-CHPS. Credits were increased from 24 to 32 points. Stricter acoustical requirements were added and there are new credits for “Air Flow Stations,” “Continuous Air Monitoring,” and “Interior Air-Handling Units.”

Finally, NYSED has a strong appreciation for the importance of O&M in controlling energy costs, maintaining healthy buildings, reducing other operating costs, and extending building system life. For this reason, NY-CHPS has a new section on O&M. An example of an O&M prerequisite is shown in Figure 2. This type of credit, instead of involving design criteria for the building, requires a district policy that school leaders commit to good O&M practices beyond the construction of the school.

Figure 1. Example of New Durability Credit

4.1.5 CREDIT: ROOF SYSTEMS BASED ON LCC	
2 points	Select roof systems based upon an LCC analysis.
<p>The selection of roofing systems shall be based upon an LCC analysis. Initial cost is not the best determining factor in the selection of a roofing system. A high quality roofing system should last 25 years or more while a low quality roofing system may require replacement in only 10 years. The 30 year lifecycle cost of the lower quality roof, for example, would be more than three times the initial cost.</p>	
LCC Factors	
<ul style="list-style-type: none"> • Specify roofs with at least 15 to 20 year warranties. • Enhanced EPDM products are designed to perform in more rigorous environments, with improved puncture- and tear-resistance. • The LCC analysis should include first cost, time before maintenance is required, frequency of maintenance, cost of monitoring, cost of failure, cost of tear-off, cost of re-roofing, and value of warranty versus warranty time. 	
Documentation	
<ol style="list-style-type: none"> 1. Use the NIST analysis program BLCC5 or another LCC model to perform an LCC analysis of the roofing system. Print and attach a copy of the completed reports. 2. Include a short description of the roofing materials selected. 	

Emphasis on marketing. At the very first planning meeting between NYSED and NYSERDA, NYSED raised the issue of “marketing.” From the earliest stages, one of NYSED’s and NYSERDA’s goals was to ensure that key stakeholders would be provided a guideline that they

would find easy to understand, logical and beneficial to follow. NYSED emphasized that NY-CHPS should not be a guideline that “just sits on the shelf.” Planning is currently in place to begin marketing the guidelines to architects, engineers and school officials in the spring of 2006.

Figure 2. Example of O&M Prerequisite

6.1.1 PREREQUISITE: ENERGY PLAN	
Prereq.	The school shall prepare a comprehensive energy plan that addresses best operating practices to reduce energy costs while maintaining comfort.
<p>The school shall develop an Energy Plan including procedures for building occupants and their roles in minimizing energy use. The Energy Plan should relate to the behavior of school occupants including principals, custodians, teachers, and students with regard to energy.</p> <p>The single most important energy cost management tool is a well conceived district energy policy that defines clear expectations for building performance. 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.</p> <p>Documentation</p> <ol style="list-style-type: none"> 1. Develop a comprehensive energy plan. 2. Develop a formal school board policy stating that the district will maintain and enforce the energy plan. 	

99 Percent Perspiration

A wise editor once said that good writing takes one percent inspiration and 99 percent perspiration. A lot of attention to detail was required to work out the differences and overlaps with national and state codes, New York’s MPS, environmental regulations, and other guidelines. As more effort was expended to develop new sections on materials durability, operations and maintenance, system sizing, and upgrading the indoor environmental quality section, a profound respect evolved for those who have developed the original LEED/CHPS/MA-CHPS material. This process required NYSERDA, their consultant TRC Energy Services, NYSED, and in many cases the AC members themselves, to do extensive research. Various scenarios were played out to try to ensure that designers would be able to understand and apply each requirement. As codes and other standards (e.g., ASHRAE Standard 90.1) were changing, material in NY-CHPS was updated to make sure that a NY-CHPS school would be ahead of current requirements. The payoff for this is a strong document that has now gone through four rounds of collaborative review (LEED, CHPS, MA-CHPS and now NY-CHPS).

What Does Voluntary Mean?

From the very beginning of this effort, both NYSED and NYSERDA agreed that with no separate funding currently available from the New York State General Fund to support NY-CHPS, that it would not be possible to provide an independent third-party rating system. With that in mind, NYSED asked NYSERDA and the AC to develop NY-CHPS as a “voluntary” self-scoring system. On the other hand, as noted above, people love competition. The hope is that school officials and local leaders—desiring better schools and lower operating costs—will require their design teams to use NY-CHPS and to follow the documentation requirements. NY-CHPS requires that documentation for each prerequisite or credit be kept on file where it can be accessed by anyone for a period of five years. In addition, post-installation documentation has been added so that school districts must also prove that design objectives have been met. To be recognized as a NY-CHPS school, the design team must meet all prerequisites and 65 out of 133 credit points.

The support structure for recognition has not been developed yet, but for those schools that do a good job of self scoring, various forms of recognition may be available. The hope is that before long, New York’s governor will be standing in front of a NY-CHPS school (and the TV cameras) telling the community that this new way of building schools will benefit the students and the community.

Lessons Learned

An exciting opportunity. The amount of construction and renovation of schools in New York provides a tremendous opportunity. During the development of NY-CHPS, NYSED and NYSERDA learned more about how better and more integrated methods of design deliver huge savings in better learning environments, operating costs, and quantifiable benefits in student performance. NY-CHPS is just starting to be used by NYSED and is also available from NYSERDA at <http://www.nyserda.org/programs/schools/NYCHPS.asp>.

Stand on others’ shoulders. So much great work has gone into the development of HPS guidelines nationwide that no one needs to “re-create the wheel.” LEED, CHPS, and MA-CHPS have made improvements in each prior system. By “standing on the shoulders” of those who have gone before, NY-CHPS was able to borrow from the best materials and spend time on areas that had not been addressed as fully. The new sections on durability, indoor environmental quality, and O&M accomplished NYSED’s goals of enhancing the learning environment while reducing operating costs to district tax payers.

Many hands make light work. No one group could have done what was accomplished with good cooperation between all the groups involved. NYSED, NYSERDA TRC Energy Services, and the AC kept contributing and interacting through the final edits of the Guidelines. The AC helped to make the Guidelines well rounded and complete; AC members were more valuable than any written resource for providing excellent technical material. Even representatives of the MTC and the Massachusetts School Building Authority provided support through the end of the project.

Why stop with one state? Staff from NYSED are very pleased with the way NY-CHPS has developed and the benefits they expect to see. The members of the AC have also reported that they are pleased with the balance, direction and especially the new material that has been added. Discussions have already been started to try to build on the work of NY-CHPS toward regional or national HPS guidelines. The NY-CHPS development effort has been made with close communication and support from staff who manage the MA-CHPS effort. Specifically, Kim Cullinane and Andrea Ranger have indicated that they were interested in the changes made in NY-CHPS, and they may consider several of the modifications for future versions of MA-CHPS. The Northeast Energy Efficiency Partnerships and the US Green Building Council are currently working on K-12 guidelines. It may be possible for NY-CHPS to combine efforts with these or other groups to help produce better schools nationwide.

References

- ASHRAE 2004. *ASHRAE GreenGuide*. Atlanta, Ga.: American Society of Heating, Refrigerating, & Air-Conditioning Engineers.
- [DOE] Department of Energy 2002. *National Best Practices Manual: For Building High Performance Schools*. Washington, D.C.: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.
- [HMFH] HMFH Architects, Inc. and Vermont Energy Investment Corp. 2005. *The Incremental Costs and Benefits of Green Schools in Massachusetts*. Prepared for the Massachusetts Technology Collaborative. HMFH Architects, Inc./Vermont Energy Investment Corp.
- Kats, Greg. 2005. *National Review of Green Schools: Costs, Benefits, and Implications for Massachusetts: A Report for the Massachusetts Technology Collaborative*. Capital E.
- [NYSERDA] 2006. *NYSERDA Schools Benchmarking Database*. Albany, N.Y.: New York State Energy Research and Development Authority.
- Paladino, Tom, Barbara Erwine, Vidhi Agarwal, and Simon Wan. 2005. *Washington High Performance School Buildings: Report to the Legislature*. For the Washington State Board of Education and Office of the Superintendent of Public Instruction. Paladino and Company, Inc.
- Thurnau, Carl (Director of Facilities. New York State Education Department). 2006. Personal communication. January.