NY-CHPS Version 1.1
High Performance Schools Guidelines

An Appendix of the
New York State Education Department
Manual of Planning Standards

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Preface

NY-CHPS IN BRIEF

The New York State Education Department's (NYSED) High Performance Schools Guidelines (NY-CHPS) are based on the Massachusetts Collaborative for High Performance Schools Guidelines (MA-CHPS), which were in turn based on CHPS, Inc. Guidelines. NYSED has tailored NY-CHPS for New York code requirements and to follow NYSED priorities. In addition, NYSED has organized and added new material to emphasize criteria that directly contribute to student learning, reduced maintenance, and long building life.

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CHPS

NEW BUILDINGS INSTITUTE

United States Green Building Council (USGBC)

The United States Green Building Council (USGBC), through its Leadership in Energy and Environmental Design (LEED) Green Building Rating System® for new construction, has provided the core material and invaluable research that have helped make NY-CHPS possible. In many instances, references to LEED guidelines have been included because they are state-of-the-art, because they are the most widely known and applied in the U.S., and because the USGBC provides many resources, including reference guides, to support the design and construction of green buildings. New York would like to acknowledge its appreciation to the U.S. Green Building Council for their national and international efforts and leadership in the promotion of green building design, operation and practices. Additional information about the U.S. Green Building Council and the LEED rating systems can be found at: http://www.usgbc.org/

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Introduction

PURPOSE OF NY-CHPS

The purpose of NY-CHPS is to provide a framework that helps school districts and their design teams design and build sustainable school buildings that enhance the educational environment and facilitate learning. High performance schools optimize resources over the life of the facility, are less expensive to operate than standard buildings, and help to ensure healthy, safe, and high quality learning environments for all occupants.

NY-CHPS was developed as part of a collaborative effort between the New York State Education Department and the New York State Energy Research and Development Authority. An Advisory Council was created to inform and guide the process consisting of members of 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, the Healthy Schools Network, ASHRAE, Association of Energy Engineers, and the American Institute of Architects. NY-CHPS is built from a Massachusetts version of the guidelines of the Collaborative for High Performance Schools, Inc. (CHPS). CHPS was originally developed as part of a collaborative effort in California. New York is grateful for all those involved in the California and Massachusetts development processes. In recognition of the development process, New York has named these guidelines, NY-CHPS.

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.

SCHOOL FACILITIES MUST BE DURABLE

NY-CHPS helps designers and school districts understand the true life-cycle cost of a school, focusing not just on construction costs, but also on energy, maintenance, and replacement costs. School construction bonds are typically paid over periods up to 30 years. New school buildings must include technologies and building materials that outlast the bonds that pay for them. NY-

CHPS helps designers and school officials select flooring, roofing, wall, and other building systems based on total, life-cycle cost of ownership.

School Facilities Must Be Easy to Maintain

Schools must be properly maintained to be energy efficient and healthy. Maintenance expenses must be considered during design because they represent a significant expense to school districts and taxpayers. High performance schools recognize the vital role of durable products and ease of maintenance in keeping buildings healthy and safe. Healthy and safe buildings can contribute to lower absenteeism rates and more productive occupants.

Buildings Should Be Designed to Utilize and Preserve Natural Resources

Schools buildings should be designed with special attention to building orientation on the site to capture natural lighting, passive solar heating during the winter months, and natural cooling effects during the warm months. Designers must pay special attention to room location (to benefit from daylight), window sizing and placements, and glazing selection. Sites should also be selected to preserve natural resources and to minimize adverse impacts on the environment.

Renovation Projects Are an Opportunity for High Performance Design

The average school building in New York is over 50 years old as of 2005. Many will undergo significant renovation in the coming years. The renovation of school buildings provides school districts with an opportunity to increase energy efficiency and indoor environmental quality while maintaining and promoting building durability. Healthy and environmentally-friendly schools can contribute substantially to achievement of educational goals. High performance renovation can help New York's older school buildings to continue to cost-effectively serve school districts for many years to come.

Provide Long-Term Benefits to Students, Teachers and Taxpayers

High performance schools provide direct and indirect benefits to teachers and students by improving the educational environment through spaces that are well lit, have good acoustics and indoor air quality, and are designed to optimize learning. School districts that build high performance schools derive savings through reduced energy, maintenance, and replacement costs. High performance schools take steps to be the next generation of schools that provide lasting benefits to the community.

General Notes

NY-CHPS is an Appendix to the NYSED Manual of Planning Standards (MPS). All school construction projects that fall under the auspices of NYSED and that require a building permit must meet all local (where applicable), state and federal codes, as well as all requirements in the MPS, including the New York Uniform Fire Prevention and Building Code and the New York

State Energy Conservation Construction Code. To maintain consistency among the various NYSED documents, various sections of NY-CHPS reference specific New York State Codes, regulations of the New York State Department of Environmental Conservation, and federal requirements. In addition, some sections that address building operations include a requirement that "the school district must develop a formal policy to …" These kinds of requirements are intended to involve the school district superintendent and the school board to formalize policies that will benefit the school for years to come.

WHAT IS A HIGH PERFORMANCE SCHOOL?

A high performance school has three distinct attributes: it is designed to create a healthy and comfortable learning and working environment; it is less costly to operate than a conventional school over the life of the building; and it is constructed to conserve important resources such as energy and water.

A high performance school is designed with durable materials and uses high-efficiency, "correctly-sized" heating, ventilating, and air conditioning (HVAC) equipment and lighting systems. Appropriate amounts of glare-free daylight are brought into the school to enhance the learning environment and reduce lighting costs. The building shell integrates the most effective combination of insulation, glazing, and thermal mass to ensure energy efficiency. Plumbing fixtures are specified to reduce water consumption. Together, these measures significantly reduce the operational costs of running the school building. Based on recent research completed around the country, 20% - 40% cost savings in utility bills are common versus a non-high-performance building of the same size and shape.

A high performance school is also thermally, visually, and acoustically comfortable. Thermal comfort means that teachers, students and administrators are neither hot nor cold as they go about their daily activities. 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.

Indoor air quality is another important feature of a high performance school. The significant amount of time students and teachers spend inside schools during their educational career, combined with children's increased susceptibility to indoor pollutants, underscores the importance of good indoor air quality. Indoor pollutants such as chemical toxins and biological agents can create significant health risks and adverse learning conditions. In a high performance school, air intakes are located away from potential sources of contamination and ventilation systems are designed to optimize quantities of fresh air. Architects and engineers also 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.

Where possible, a high performance school is built on an environmentally responsible site. To the extent possible, the school's site should conserve existing natural areas and incorporates them into the curriculum. Stormwater runoff is minimized or captured on site for irrigation or flushing water closets. The site should be accessible to bicycle and pedestrian traffic and be conveniently located for community activities.

While operational savings, environmental stewardship, and community-building are attractive benefits, it is important to emphasize that, above all, a high performance school must provide an environment that enhances the primary mission of the New York State Education Department: to raise the knowledge, skill, and opportunity of all the people of New York.

HOW MUCH MORE WILL IT COST?

It is usually assumed that building high performance schools is more costly, 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 may be incurred, but this is usually only a small 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 the possibility of saving energy by changing the windows from double glazing to triple glazing, this will save energy but will cost more money for the windows. But then the engineers might find that they can 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. A designer might also determine that air duct sizes for heating and cooling can also be reduced, or the boiler may be downsized. In the final analysis, 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” sheet method — such integrated savings and advantages are often not possible, and systems can be needlessly over designed and inefficient.

Most architectural and engineering firms involved in school design have already developed at least some expertise in sustainable design and high performance schools. However, there are a number of new skills and processes involved in the design of a high performance school that deserve additional fees. A commissioning authority and an energy analysis firm may need to be added to the design team at additional cost. These are usually contracted directly by the owner. The architect is usually in charge of the high performance design process and will have a number of additional tasks to perform in executing and documenting the process. The engineers, who in the past were usually paid on a percentage of the cost of the equipment in their work, may have additional tasks related to high performance design and may be asked to reduce the size and cost of their equipment to more closely match the reduced building loads. School districts are encouraged to openly discuss these potential costs with their design professionals at the interview stage.

Despite the efforts of skilled professionals using an integrated design process, a high performance school's first cost may be slightly more than that of a conventional design. But the cost/benefit analysis of the project as a whole (as in past projects) will show substantial savings. A report published in December, 2005, by the Massachusetts Technology Collaborative indicated that for 30 high performance schools nationwide and an analysis of available research, high performance schools cost 1.5% to 2.5% more than conventional schools, but the high performance schools provide financial benefits that are 10 to 20 times as large. Savings can accrue from reduced energy use, reduced water and sewer use, reduced equipment maintenance and replacement costs (by using life-cycle cost analysis to select materials, for example), reduced site maintenance, reduced liability costs and even possibly reduced sick-time losses from student and teacher absences by eliminating out gassing of volatile organic compounds from the building materials.

USING NY-CHPS

NY-CHPS is provided by NYSED as a benchmark for high performance school buildings.

NY-CHPS is divided into seven sections: site; water; energy; materials; indoor environmental quality (IEQ); operations and maintenance; and extra credit. Each section has prerequisites that must be achieved, with the remainder of NY-CHPS consisting of optional credits. These prerequisites and credits allow the school district to show that their completed school meets the criteria for being a New York High Performance School. To obtain this standing, a minimum of all prerequisites and 65 credits must be achieved. The school district must maintain documentation proving that the prerequisites and claimed credits have been met so that the public can review the documentation. Furthermore, for the credits that include Post-Construction documentation, that documentation must be gathered after the school is completed to demonstrate that the building is performing as predicted. All documentation must be maintained where it can be accessed for a period of five years at the school district offices.

NYSED provides NY-CHPS to help designers produce better high performance schools, but the use of NY-CHPS is voluntary. Following NY-CHPS is not required — as following NYSED's Manual of Planning Standards is — in order to receive a construction permit from NYSED.

NY-CHPS SCORESHEET

The following table can serve as a worksheet for totaling your points.

NY-CHPS Scoring			
		Total Points	**133**
Section	**1. SITE**	**Group Points**	**15**
		Group %	**11%**
1.1.1	Code Compliance	---	Prereq
1.1.2	Joint Use of Facilities	---	Prereq
1.1.3	No Development Near Wetlands	---	Prereq
1.1.4	No Development on Parklands	1	Credit
1.1.5	No Buildings on Floodplains	1-2	Credit
1.1.6	Reduced Building Footprint	2	Credit
1.1.7	Sustainable Site and Building Layout	2	Credit
1.2.1	Construction Erosion/Sedimentation Control	---	Prereq
1.2.2	Post-Construction Stormwater Management	1	Credit
1.3.1	Design to Reduce Heat Islands	2	Credit
1.4.1	Exterior Light Pollution	2	Credit
1.5.1	Transportation, Locate Near Public Transit	1	Credit
1.5.2	Transportation, Pedestrian/Bike Access	1	Credit
1.5.3	Transportation, Minimize Parking	1	Credit
	2. WATER	**Group Points**	**3**
		Group %	**2%**
2.1.1	No Irrigation for Landscaping	1	Credit
2.1.2	Reduce Potable Water for Landscaping	1	Credit
2.2.1	Indoor Water Use Reduction	1	Credit
	3. ENERGY	**Group Points**	**26**
		Group %	**20%**
3.1.1	Minimum Energy Performance	---	Prereq
3.1.2	HVAC System Sizing	---	Prereq
3.1.3	Superior Energy Performance	1-10	Credit
3.2.1	On-Site Electricity Generating Renewables	2-5	Credit
3.2.2	On-Site Thermal Energy Renewables	1-4	Credit
3.3.1	Third-party Commissioning	---	Prereq
3.3.2	Third-party Training	---	Prereq
3.3.3	Identify an Energy Manager	---	Prereq
3.3.4	Track Energy Costs	---	Prereq
3.3.5	Energy Management System Controls	---	Prereq
3.3.6	Additional Commissioning	3	Credit
3.3.7	Energy Management System Monitoring	2	Credit
3.3.8	Submetering	2	Credit
	4. MATERIALS	**Group Points**	**26**
		Group %	**20%**
4.1.1	Wallboard and Roof Deck Products	---	Prereq
4.1.2	Floor Systems Based on LCC	1-4	Credit
4.1.3	Interior Wall Systems Based on LCC	1-4	Credit
4.1.4	Exterior Wall Systems Based on LCC	2	Credit
4.1.5	Roof Systems Based on LCC	2	Credit
4.1.6	Other System Based on LCC	2-6	Credit
4.2.1	Storage & Collection of Recyclables	---	Prereq
4.2.2	Site Construction Waste Management	1-2	Credit
4.3.1	Building Reuse 75%	1	Credit
4.3.2	Combined Materials Attributes	1-5	Credit

NY-CHPS Scoring			
	5. IEQ	**Group Points**	**32**
		Group %	**24%**
5.1.1	Access to Views 70%	---	Prereq
5.1.2	Access to Views 90%	2	Credit
5.1.3	Daylighting in Classrooms	5	Credit
5.2.1	Visual Performance	2	Credit
5.3.1	Walk-Off Grills/Mats	---	Prereq
5.3.2	Filter Efficiency	---	Prereq
5.3.3	Drainage	---	Prereq
5.3.4	Irrigation Design	---	Prereq
5.3.5	Electric Ignition Stoves	---	Prereq
5.3.6	Air Intake Location	---	Prereq
5.3.7	Duct Insulation	---	Prereq
5.3.8	Pollutant Source Control, Ducted HVAC Returns	---	Prereq
5.3.9	Air Intake Location: 50 Feet	2	Credit
5.3.10	Low-Emitting Materials	1-5	Credit
5.3.11	Pollutant Source Control, Off-Gassing	2	Credit
5.3.12	Pollutant Source Control, High Efficiency Filters	3	Credit
5.3.13	Air Flow Stations	2	Credit
5.3.14	Continuous Air Monitoring	2	Credit
5.3.15	Interior Air Handling Units	2	Credit
5.4.3	Filters During Construction	---	Prereq
5.4.4	Construction IAQ, Ventilation of VOCs	---	Prereq
5.4.5	Construction IAQ, HEPA Vacuuming	---	Prereq
5.4.6	Construction IAQ, Duct Protection	---	Prereq
5.4.7	Construction IAQ, Building Flushout	---	Prereq
5.5.1	Minimum Acoustical Performance	---	Prereq
5.5.2	Sound Isolation	2	Credit
5.5.3	Improved Acoustical Performance	2	Credit
5.6.1	ASHRAE 55-2004	---	Prereq
5.6.2	Controllability of Systems	---	Prereq
5.6.3	Thermal Control	1	Credit
	6. OPERATIONS AND MAINTENANCE	**Group Points**	**15**
		Group %	**11%**
6.1.1	Energy Plan	---	Prereq
6.1.2	No Fossil-Fuel-Powered Equipment Indoors	---	Prereq
6.1.3	Energy Benchmarking	2	Credit
6.1.4	Indoor Environmental Management Plan	2	Credit
6.1.5	U.S. Green Building Council LEED® EB Updates	2	Credit
6.1.6	BOC Training	2	Credit
6.1.7	Certified Superintendent of Buildings and Grounds	2	Credit
6.1.8	Continuous Commissioning	2	Credit
6.2.1	Maintenance Plan	---	Prereq
6.2.2	Green Cleaning	---	Prereq
6.2.3	Integrated Pest Management Plan	---	Prereq
6.2.4	Purchase Green Label Vacuums	---	Prereq
6.2.5	Computerized O&M Plan, CMMS	3	Credit
	7. EXTRA CREDIT	**Group Points**	**16**
		Group %	**12%**
7.1.1	Performance Monitoring	1	Credit
7.2.1	ENERGY STAR® New Equipment	1	Credit
7.2.2	Prohibition of Personal Electrical Devices	1	Credit
7.2.3	Purchase Low-Mercury Lighting	1	Credit
7.3.1	Clean Energy	1	Credit
7.3.2	Landfill Gas	1-2	Credit
7.4.1	Alternate Fuels Buses	1	Credit
7.4.2	Alternate Fueled Maintenance Vehicles & Equipment	1	Credit
7.4.3	Anti-Idling Measures	1	Credit
7.4.4	Install Diesel Oxidation Catalysts on All Buses	1	Credit
7.5.1	Design to Use Components of the Building as a Laboratory	1	Credit
7.5.2	Design to Use as a Red Cross/Community Shelter	1	Credit
7.6.1	Innovation Credits	1-3	Credit

1 Site (15 points, 11%)

1.1 Site Selection

Purpose: To choose sites that protect students and staff from outdoor pollution and minimally impact the environment, as well as to channel development to centrally located areas, with existing infrastructure, to protect greenfields, minimize transportation requirements, and preserve habitat and natural resources.

1.1.1 Prerequisite: Code Compliance

Prereq.	Comply with all siting and environmental impact study requirements of New York's State Environmental Quality Review Act (SEQR), NYSED's "School Site Standards, Site Selection and Site Development," local utility requirements, PSC requirements and all other, State or federal requirements.

Documentation

Provide a letter signed by the project architect and the school superintendent explaining how the site meets all requirements.

Resources

What is an Environmental Impact Statement?
http://www.dec.state.ny.us/website/dcs/seqr/seqr_3.html

School Site Standards, Site Selection and Site Development, New York State Education Department

Regulations

State Environmental Quality Review Act

1.1.2 PREREQUISITE: JOINT USE OF FACILITIES

Prereq.	Ensure that the building itself (e.g., layout, special design features) facilitates the school's use by the community or other appropriate organizations.

The most successful schools have a high level of parent and community involvement. This involvement can be enhanced if a school is designed so that neighborhood meetings, recreation activities, and other community functions can take place at the school in a safe and secure fashion.

An elevated walking track surrounds this gymnasium. Citizens may be able to use it at times throughout the day as allowed by the school district.

Building or renovating a school provides an opportunity to incorporate community programs and services into the building program. During the planning stages, school districts should give careful thought to the types of programs, services, and facilities they may wish to offer via the future school building (e.g., library services, recreation services, meeting space, space for special events, etc.). As an example, if the community lacks a library, it could plan a library for shared school and community access.

Other strategies that contribute to shared use of the school building include designing separate entrances for spaces likely to be shared, adjusting building orientation and layout to separate classroom and administration areas from shared spaces during events, and designing special features into the school that the community can use, such as an elevated walking track that citizens can use. One high performance school incorporated this type of walking track, as pictured above.

Documentation

A letter signed by project architect and school superintendent indicating features of the school that enhance its shared use with the community.

1.1.3 Prerequisite: No Development Near Wetlands

Prereq.	Comply with both of the following requirements: 1. Do not develop land that is within wetland resource areas or within 100 feet of banks, vegetated wetlands, or vernal pools. 2. Site development includes the school facilities, playing fields and parking lots and construction operations that are not related to wetlands improvement. *Exception:* Drainage outfall structures may be located within the 100 ft. buffer zone.

Comply with Army Corps of Engineers requirements for federal wetlands. Do not develop any portion of the site that lies within the 100 ft buffer for designated New York State wetlands.

Wetlands: specific wetland types subject to protection include, but are not limited to, swamps, marshes, bogs, salt marshes, lakes, ponds, rivers, riverfront areas, and land subject to flooding.

Documentation

State Pollution Discharge Elimination System Construction General Permit (SPDES) Notice of Intent for coverage under the SPDES General Permit and Wetlands Order of Conditions (if applicable). Provide an as-designed site plan showing the delineation of the 100-foot zone.

Regulations

Follow requirements of Army Corp of Engineers, NYSDEC, and SEQR - State Environmental Quality Review Act, and any other applicable state or federal code.

1.1.4 Credit: No Development on Parkland

1 point	Do not temporarily or permanently modify land, which prior to acquisition for the project was public parkland, conservation land, or land acquired for water supply protection.

A school district faces many issues during site selection. Cost, student demographics, and environmental concerns all influence site acquisition. The site is a crucial element in determining the overall sustainability of the school design. Sites are sometimes purchased years in advance, and some of these credits may be out of the control of the school districts and designers at the time the school is being built. However, school districts that are considering multiple sites can substantially lower the environmental impact of the school by choosing centrally located sites, sharing parks or facilities with community organizations, preserving open space, and protecting environmentally sensitive areas.

If at all possible, do not build on land, which prior to acquisition for the project was public parkland, conservation land, land acquired for water supply protection or land restored to agricultural or forestry use. Maintain open spaces.

Documentation

Existing site survey.

1.1.5 Credit: No Buildings on Flood Plains

1 to 2 points	Do not develop buildings on land whose pre-development elevation is lower than the elevation of the 100-year flood (for 1 point) or the 500-year flood (for 2 points) as defined by FEMA and as shown on the FEMA Flood Insurance Rate Map (FIRM) for the site. Refer to the following website for additional information: http://www.fema.gov/plan/prevent/fhm/index.shtm

Both federal and state agencies have worked together over the last several decades to prevent construction of buildings in floodplains to achieve two important results: 1) a significant decrease in building damage and liability; and 2) a restoration of functional floodplains to absorb flood waters and minimize impacts to downstream communities.

The "above the floodplain" requirement applies to the building footprint only, not the site as a whole.

To locate the floodplain elevations, FEMA Flood Insurance Studies (containing Flood and Coastal Profiles) and flood maps are available on the web at: http://www.msc.fema.gov/

Documentation

FIRM Map, highlight plain area OR provide map from FEMA website with flood plain highlighted. Show that the building footprint will not be in the flood plain.

1.1.6 Credit: Reduced Building Footprint

2 points	Increase the Floor Area Ratio (FAR) of the school to be at least 1.67 to reduce the development footprint and preserve open space. The FAR is the building's total square footage divided by the square footage of the building footprint.

Building multi-story schools reduces the amount of land used in construction. Said another way, achieving a FAR of 1.67 requires at least 67% of a school's square footage to be above the first floor.

Documentation

Calculation of the Floor Area Ratio (FAR) by dividing the school facility's total square footage, including all stories, by the facility's footprint.

1.1.7 CREDIT: SUSTAINABLE SITE & BUILDING LAYOUT

2 points	Implement four of the following best practice site strategies: 1. Orient the building(s) to take advantage of maximum natural daylighting; OR plot shadow patterns from surrounding buildings and place buildings to optimize access to daylight (for urban-infill sites). 2. Consider prevailing winds when determining the site and building layout. For example, consider how the shape of the building itself can create wind-sheltered spaces, and consider prevailing winds when designing operable windows and parking lots/driveways to help blow exhaust fumes away from the school. 3. Take advantage of existing built environment conditions, land formations, and vegetation to provide shelter from extreme weather or to deflect unwanted noise. 4. Plant or protect existing deciduous trees to block summer sun and allow winter solar gain. Plant or protect existing coniferous trees to block winter wind. Planting should be done an adequate distance from the building to prevent the accumulation of water along the building envelope. 5. Minimize importation of non-native soils and exportation of native soils. Optimize Cut and Fill (ideally in 1:1 proportions) during clearing and excavation. 6. Create physical connections to existing bike paths, natural features, or adjacent buildings. 7. Design parking lots and driveways to limit student proximity to bus emissions with separate drop-off areas for buses and parents. Design bus loading and unloading areas such that buses need not be lined up head to tail. Do not design bus loading and unloading areas such that bus exhaust is in proximity to any of the school's air intake vents. 8. Site the building to maximize opportunities for on-site renewable energy generation. For example, preserve or ensure availability of space for wood chip storage facilities for biomass heating, wind turbines (if wind resources are adequate), or other renewable energy sources.

Performing a thorough site analysis at the pre-design phase is critical to understanding all the opportunities and complexities of a building site. A good site analysis allows the designer to make informed design decisions to take full advantage of solar orientation, prevailing wind direction, topography, and tree species and locations. Adjacent streets and traffic patterns should be considered, functional synergies with surrounding buildings created, and special environmental elements featured.

Item #1 highlights the importance of building orientation. Energy efficiency and environmental impacts are affected by decisions made early in the planning process. For example, when the building is oriented along the east-west axis, the designer can take advantage of natural daylighting, which reduces the need for electrical lighting and resultant energy consumption. Note: Urban infill projects do not usually have the opportunity to orient the building to the sun, due to tight site constraints. However, project designers are encouraged to think about maximum solar exposure within the limits of the surrounding buildings.

Item #2 encourages designers to consider prevailing winds in their design. Proper orientation can help keep vehicle exhaust away from the school. In addition, winter winds and snow accumulation should be considered to predict and prevent snowdrifts in driveways and in front of air intakes.

For Items #3 and #4 above, during preliminary design, the layout can be oriented to compliment existing topography. Likewise, manmade structures, such as storage structures for biomass fuel, can be carefully sited to provide protection to the site. Plantings of deciduous trees provide shade to the school during warmer months and access to sunlight at the end of autumn when the trees' leaves have fallen.

Importation or exportation of soil can be costly in terms of both dollars and environmental impact. Item #5 encourages the conservation of the environment by minimizing excavation and importation of non-native soils. By optimizing cut and fill (ideally 1:1) during clearing and excavation, use of native soils is maximized, reducing the adverse impacts on the site.

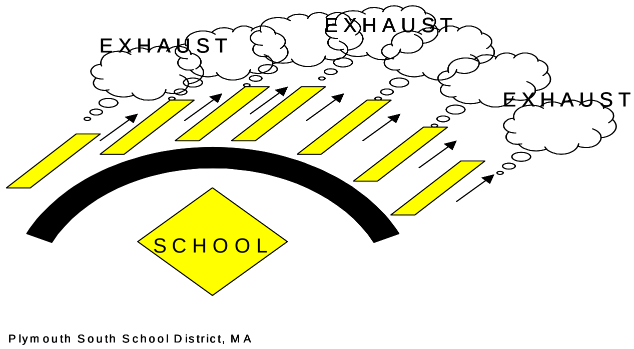
In item #6, creating physical connections means considering features on adjacent properties and designing the site layout such that it promotes their use.

For item #7, Figure 1 below demonstrates a traditional dismissal practice experienced at many schools, and Figure 2 shows an approach that avoids traditional head to tail lining up of buses. In the approach in Figure 2, bus exhaust is not near the intake for other buses or the school ventilation system. When considering site placement of bus parking, also consider prevailing winter winds so that exhaust is not blown into the school air intakes.

Figure 1—Traditional Bus Queuing Strategy

Source: Asthma Regional Council, website: http://www.asthmaregionalcouncil.org/about/BusToolkit.htm

FIGURE 2. EFFECTIVE QUEUING TO REDUCE CHILDREN'S EXPOSURE TO EMISSIONS



Source: Asthma Regional Council, website: http://www.asthmaregionalcouncil.org/about/BusToolkit.htm

Item #8 encourages early consideration of opportunities for on-site renewable energy generation. Biomass heating, for example, can be an effective option for many school projects, but the building and site layout must take the need for wood chip storage into consideration. Wind electricity generation may also make sense for many schools, but wind resources should be investigated early and designers should investigate the best location for turbines on the school site. Likewise, electricity generated by the sun through photovoltaic (PV) panels may be an option, but PV panels must be installed such that they will not be shaded and should be oriented toward the south.

Documentation

For all strategies attempted, develop Site Analysis sketches outlining all of the site's features before the building is placed; AND develop the following for individual strategies for at least four (4) of the items listed in the credit and identified by the numbers below. Site layouts and design narratives may be combined where appropriate.

1. Site layout and design narrative signed by the project architect, showing how the project responds to natural daylighting.
2. Site layout and design narrative signed by the project architect, showing how the project responds to prevailing winds.
3. Site layout and landscape design narrative signed by the project architect, showing how the existing topography and tree coverage respond to weather or deflect unwanted noise.
4. Site layout and landscape design narrative signed by the project architect, showing how the intended or existing plantings increase shade in the summer and allow solar gain in the winter.
5. Develop a Cut and Fill Analysis report that shows a maximum of a 5% deviation from a 1:1 ratio.
6. Site layout and design narrative signed by the project architect, showing how the project responds to natural features and/or adjacent buildings.

7. Site plan showing bus loading and unloading area. Also show on this drawing, or develop a separate drawing, that shows that the building's air intake vents are not located near the loading/unloading zone.
8. Site layout and design narrative signed by the project architect, showing how the project responds to opportunities for on-site renewable energy generation.

Resources

Massachusetts Collaborative for High Performance Schools (MA-CHPS) Best Practices Manual, Volume II -Design. In particular, consult the Daylighting and Site Planning Chapters.

1.2 STORMWATER MANAGEMENT

Purpose: Manage stormwater during and after construction to control erosion and runoff, reducing the negative impacts on water and air quality.

1.2.1 PREREQUISITE: CONSTRUCTION EROSION & SEDIMENTATION CONTROL

Prereq.	Prepare a Stormwater Pollution Prevention Plan (SWPPP) addressing erosion and sediment control that complies with the State Pollution Discharge Elimination System Construction General Permit (SPDES). The plan must meet both of the following objectives: 1. Prevent loss of soil during construction by storm water runoff and wind erosion, including protecting topsoil by stockpiling for reuse. 2. Prevent sedimentation of storm sewer or receiving streams and air pollution with dust and particulate matter *Exception*: If land disturbance is less than an acre for the entire project as a whole, then the project is exempt from this prerequisite.

Obtain NYSDEC State Pollutant Discharge Elimination System (SPDES) and any other applicable state or federal stormwater permit.

Construction projects with a land disturbance of one-acre or more must submit a Notice of Intent and develop a Stormwater Pollution Prevention Plan (SWPPP) to comply with the State Pollution Discharge Elimination System (SPDES) Construction General Permit. Measures to prevent erosion and sedimentation are also required. Stormwater discharges to Outstanding Resource Waters (including public drinking water reservoirs and vernal pools) may require additional review by NYSDEC to protect water quality. Individual municipalities may further delimit the development standards.

A variety of best practices address this prerequisite, including:

Runoff Control

Minimize clearing: phase land grading and clearing if possible, preserve natural vegetation, install temporary and final stabilization as the project progresses.

Stabilize drainage ways: check dams (velocity dissipation), filter berms, grass-lined channel, riprap.

Erosion Control

Stabilize exposed soils: chemical stabilization (soil binders), mulching, permanent seeding, sodding, soil roughening, geo-textiles, erosion control matting, dust control.

Protect steep slopes: geotextiles, gradient terraces, soil retention, and temporary slope drain.

Protect waterways: temporary stream crossings (with clean fill or rock only) vegetated buffer, stream-bank and associated riparian area stabilization.

Phase construction: construction sequencing, limit areas of exposed soils.

Sediment Control

Install perimeter controls: temporary diversion dikes, wind fences, brush barrier, silt fences, stabilized (crushed rock, etc.) construction entrances, fiber waddles.

Install sediment-trapping devices: check dams (energy dissipation to allow particle settling) sediment basins, sediment filters, sediment chambers.

Storm drain inlet protection: drop filters

Documentation

1. A copy of the project's Stormwater Pollution Prevention Plan (SWPPP)
2. Specifications — Site prep and erosion control plans and drawings, if not contained in the SWPPP document. Highlight or bubble notes on plans that refer to the SWPPP.

Resources

U.S. Environmental Protection Agency. *Construction General Permit*.
http://cfpub1.epa.gov/npdes/stormwater/cgp.cfm

U.S. Environmental Protection Agency. *Stormwater Management for Construction Activities*.
http://cfpub.epa.gov/npdes/stormwater/swppp.cfm

New York State Department of Environmental Conservation (NYSDEC)
http://www.dec.state.ny.us/index.html

1.2.2 CREDIT: POST-CONSTRUCTION STORMWATER MANAGEMENT

1 Point	Comply with both of the following requirements: 1. Implement a stormwater management plan that results in a 25% decrease in the peak runoff rate for the 2-year, 24-hour storm from existing to developed conditions. 2. Design a stormwater system that results in a 25% decrease in runoff volume for the 100-year, 24-hour storm from existing to developed conditions.

Stormwater runoff is precipitation that flows over surfaces on the site and enters either the stormwater system or receiving waters. Stormwater carries sediment and pollutants from the site into the storm system and any local bodies of water. In addition, the cumulative runoff throughout the local area requires significant investments in municipal infrastructure to handle peak runoff loads.

Reducing the amount of runoff is the most effective way to minimize its negative impacts. Many strategies exist to limit stormwater runoff, including the following:

- Significantly reduce impervious surfaces by using semi-permeable surfacing materials, maximize on-site stormwater infiltration, and retain pervious and vegetated areas.
- Capture rainwater from impervious areas of the building for groundwater recharge or reuse within the building.

Documentation

Develop a Stormwater Management Plan showing a net decrease in peak rate of discharge of at least 25% from existing to developed conditions as demonstrated by the 2 year-24 hour storm, and show that the volume runoff from the 100-year, 24-hour storm is 25% less than the same storm event for existing conditions.

Resources

LEED-NC *Reference Guide, Version 2.2*: Site Credit 6.1: Stormwater Design, Quantity Control.

EPA Stormwater Information: http://www.epa.gov/ebtpages/watestormwater.html

1.3 Outdoor Surfaces

Purpose: Reduce heat islands to minimize impact on microclimate, and human and wildlife habitat.

1.3.1 Credit: Design to Reduce Heat Islands

<table>
<tr><td>2 Points</td><td>Comply with both of the following requirements:

1. Use roofing materials having a Solar Reflectance Index* (SRI) as listed below for roof type for a minimum of 75% of the roof surface.

Roof Type | Slope | SRI
Low-Sloped Roof | <=2:12 | 78
Steep-Sloped Roof | >2:12 | 29

2) Provide shade (within five years) on at least 30% of non-roof, impervious surfaces on the site, including parking lots, walkways, plazas, etc.; OR use light-colored/ high-albedo materials (a Solar Reflectance Index* (SRI) of at least 29) for 30% of the site's non-roof, impervious surfaces; OR use a combination of shading and high-albedo materials for 30% of the site's non-roof surfaces.

*SRI or Solar Reflectance Index is calculated according to ASTM E 1980. Reflectance is calculated according to ASTM E 903, ASTM E 1918 or ASTM C 1549. Emittance is calculated according to ASTME E 408 or ASTM C 1372. Product information is available from the Cool Roof Rating Council website at: http://www.coolroofs.org/</td></tr>
</table>

Roof Areas

A white roof was installed on this elementary school to reduce heat island effect.

Cool roofs can significantly reduce school cooling loads and urban heat island effects by reflecting the sun's energy, instead of absorbing, retaining, and radiating it into the occupied spaces below. Both the reflectivity and emissivity are important characteristics of cool roofs. A solar reflectance of 0.0 means that all the solar energy hitting the surface is absorbed and none is reflected. Emissivity is the ability of a material to shed infrared radiation.

Schools that do not have significant cooling loads may not wish to pursue this credit. In these cases, a cool roof can actually result in more energy use in the heating season than it will offset in cooling loads during the summer. Energy modeling can help predict which facilities would be likely to experience an energy benefit from a cool roof.

Documentation

1. Roof plan highlighting roofing areas with appropriate SRI ratings.
2. Specifications — Roofing Material, showing compliance with SRI's of 29 or 78, according to the slope of the roof.
3. Calculation:
   - Sum the total roof square footage.
   - Sum the total cool roof square footage. Divide by total — result must be 75% for cool roofs.

Resources

- LEED-NC *Reference Guide Version 2.2:* Site Credit 7.2: Heat Island Effect, Roof.
- Cool Roof Rating Council — http://www.coolroofs.org/

Non-Roof Areas

Note that the "heat island effect" is largely an urban phenomenon. Dark surfaces, such as pavement, cladding, and roofing absorb heat and radiate it back to surrounding areas. In a city, where there are many dark, heat absorbing surfaces, infrared radiation can easily boost temperatures by 10˚F or more. The heat island effect increases the need for air conditioning (and therefore electricity consumption) and is detrimental to site plantings, local wildlife, and maintaining comfortable temperatures.

Employ design strategies, materials, and landscaping designs that reduce heat absorption of exterior materials. Note: Solar Reflectance Index (SRI) requirements in the drawings and specifications. Provide shade using native or climate-tolerant trees and large shrubs, vegetated trellises, or other exterior structures supporting vegetation. Substitute vegetated surfaces for hard surfaces. Explore elimination of blacktop and the use of new coatings and integral colorants for asphalt to achieve light colored surfaces.

Documentation

1. Site plan or landscaping plan showing trees that contribute to shade and highlight light-colored, non-roof impervious surfaces.
2. Calculations

   Shading

   Identify all non-roof impervious surfaces on the project site and sum the total area.

   Identify all trees that contribute shade to non-roof impervious surfaces. Highlight these trees on the plan the school district develops.

   Calculate the shade coverage provided by these trees after five years of growth on the non-roof impervious surfaces on June 21st at solar noon to determine the maximum shading effect.

   Determine the total area of shade provided for non-roof impervious surfaces. Divide by total — the result must be 30%.

   For use of light-colored/ high-albedo materials:

   Identify all non-roof impervious surfaces on the project site and sum the total area.

   Calculate the total area of non-roof impervious surfaces designed with light-colored/high-albedo materials. Divide by total — the result must be 30%.

If light-colored / high-albedo materials are used to achieve this credit, develop specifications showing an SRI of 29 or better.

Note: Applicants may achieve 30% coverage by adding together the areas of shading and the areas of light-colored / high-albedo materials to total 30%.

1.4 OUTDOOR LIGHTING

Purpose: Minimize light pollution and energy waste by controlling light output, uplight, glare, and light trespass, while providing for the safe and comfortable nighttime use of the school. Improve nighttime visibility and safety through glare reduction and high quality lighting.

1.4.1 CREDIT: EXTERIOR LIGHT POLLUTION

2 Points	Comply with all eight (8) of the following requirements: 1. Only light areas where exterior lighting is clearly required for safety and comfort. Do not install light fixtures whose main purpose is to light building façades or landscape features. 2. Provide light levels that meet the minimum recommendations of the Illuminating Engineering Society of North America (IESNA) in RP-33 Lighting for Exterior Environments, IESNA/ANSI RP-8 American National Standard Practice for Roadway Lighting, and IESNA RP-20 Lighting for Parking Facilities. Designers may specify slightly higher initial light levels to account for lamp depreciation over time. 3. Specify IESNA Cutoff or IESNA Full Cutoff for all exterior-site and building-mounted lighting fixtures greater than 13 watts. Specify IESNA Full Cutoff for all exterior-site and building-mounted lighting fixtures greater than 70 watts. Cutoff and Full Cutoff fixtures may not be of the adjustable type. 4. Where the school property line abuts residential properties, parks, or natural wildlife areas, light levels must not exceed 0.1 footcandles five feet over the property line. This can be achieved by shielding fixtures and therefore preventing unwanted light trespass. 5. All exterior-lighting fixtures that are only needed when the school is open for nighttime use (i.e., not needed all night and/or every night) must be controlled with easily accessed manual switch controls. 6. Lamp types and controls: Do not install mercury vapor lamps. Incandescent and incandescent halogen sources must not be used for exterior lighting unless controlled by a motion sensor. 7. Signs, monuments, and flags: Fixtures for school signs, monuments, and flags are limited to 50 watts per fixture, and they must incorporate shielding devices such as hoods, louvers, and source shields. The fixtures are exempt from the cutoff and full cutoff requirements of #3 — as defined by IESNA RP-33. 8. Sports field lighting design must follow IESNA RP-6. Fixtures must incorporate extensive shielding to minimize and redirect stray light. Controls must be provided that encourage the shutting off of the lights when the sports field is not in use. Fixtures specifically for lighting sports fields are exempt from the full cutoff requirements listed in #3.

Good outdoor lighting supports the comfort and safety of the school community. Low glare, appropriate light levels, optical guidance, and good color rendition are attributes of good outdoor lighting. Good lighting also prevents light pollution that impacts the night sky or trespasses onto neighboring properties.

There are some simple ways to avoid light pollution from school signs and flagpoles. Signs should be lighted from the top down if feasible and use spot lighting fixtures, not flood light fixtures. Self-lit signs, such as fluorescent signs, are not encouraged, but they are not prohibited. If flags are not lowered each night, then protocol dictates that they must be lighted. This may be accomplished with a maximum of two fixtures of 50 watts. Fixtures with narrow beam distribution should be used in order to concentrate light onto the flag.

Documentation

1. A photometric site plan produced by computer modeling with the following information:
   - Horizontal illuminances at ground level on a minimum ten-foot by ten-foot grid with the property line clearly and boldly marked on photometric plan and abutting residential properties, parks, or natural wildlife areas noted.
   - Average, maximum, and minimum illuminances for each area (walkways, parking lots, driveways, building entries, etc.).
   - The location and mounting height of all site and building mounted exterior fixtures clearly indicated, with fixture type designations relating to the lighting fixture schedule.
   - Light loss factors used for each fixture type.

2. Specifications for exterior lights, showing that Cutoff and Full Cutoff requirements are met. Also supply an exterior lighting fixture schedule with manufacturers and model numbers, and manufacturer's spec sheets, with a clear description of the specified lamping, wattage, IESNA cutoff classification (where applicable), and shielding accessories for each fixture.
3. Develop a letter signed by the project's site lighting designer verifying that items 1 through 8 will be executed on this project. All eight (8) points must be addressed.

Resources

Illuminating Engineering Society of North America: http://www.iesna.org/

Illuminating Engineering Society of North America, Lighting for Exterior Environments, An IESNA Recommended Practice, RP-33-99

Illuminating Engineering Society of North America, Lighting Parking Facilities, RP-20-98

Illuminating Engineering Society of North America, Recommended Practice for Sports and Recreational Area Lighting, IESNA RP-6-01

Illuminating Engineering Society of North America, Roadway Lighting, IESNA RP-8-00

The International Dark Sky Association: http://www.darksky.org/

LEED-NC *Reference Guide, Version. 2.2*: Site Credit 8: Light Pollution Reduction: http://www.usgbc.org/

National Lighting Product Information Program, Lighting Answers, vol. 7 issue 2, Light Pollution: http://www.lrc.rpi.edu/programs/NLPIP/

1.5 TRANSPORTATION

Purpose: Reduce pollution and land development impacts from automobile use.

1.5.1 CREDIT: LOCATE NEAR PUBLIC TRANSIT

1 point	Locate the building within ¼ mile of a commuter rail, light rail or subway station, or within $^{1}/_{8}$ mile of one or more bus lines.

The energy-use and pollution associated with transportation often dwarfs the total lifetime energy used by the school itself. Locating the site close to public transportation, encouraging use of public transportation and carpooling by minimizing parking, and creating bike facilities and safe walking / biking access all reduce the automobile-related pollution.

Documentation

Area map locating transportation lines with distance to school noted. Show station locations for commuter rail, light rail, or subway lines.

1.5.2 CREDIT: PEDESTRIAN/BIKE ACCESS

1 point	Provide sidewalks or walkways that extend at least to the school entrance at the public way; AND, provide suitable means for securing bicycles for 5% or more of building occupants. For elementary schools, count only students in the 4th grade and above as building occupants. Staff should be included in all calculations regardless of the age of the school's students.

When available, public transportation is a very efficient method of transportation. Some school districts offer reduced or subsidized fares for students and staff using public transportation. If sufficient capacity exists, schools can use public transportation to replace school district-provided bus service. Schools located near high traffic areas must ensure safe student access.

The purpose of this credit is to provide safe access to the school by students and staff who choose to walk or ride their bicycles to school. To protect pedestrians, sidewalks or walkways must extend to the end of the school entrance at the public way.

Documentation

1. Site plan highlighting bike racks and details regarding how many bikes each rack can accommodate.
2. Site plan highlighting all sidewalks extending to the end of the school entrance at the public way.
3. Complete calculation for necessary number of bike racks.

1.5.3 CREDIT: MINIMIZE PARKING

1 point	**New Buildings and Additions**: Develop paved parking areas to: Provide preferred parking for 5% of total parking spaces for carpools, vanpools, and low-emitting, fuel-efficient vehicles (e.g. hybrids and vehicles using bio-diesel, CNG or other low-emitting fuel or technology); AND, size parking capacity not to exceed: • High schools: 2.25 spaces per classroom plus parking for 20% of students • Elementary and Middle: three spaces per classroom; AND, restrict parking passes for students (e.g., for honor students); AND, provide permeable (gravel or concrete grid with drainage) lots for event parking. **Major Renovations:** Add no new parking compared to existing conditions; AND, provide preferred parking totaling 5% of total parking spaces for carpools or vanpools and for low-emitting, fuel-efficient vehicles (hybrids, vehicles using bio-diesel, CNG or other low-emitting fuel or technology); AND, restrict parking passes for students (e.g., for honor students); AND, provide permeable lots for event parking.

Excess parking spaces encourage increased automobile use, contribute to urban heat island effects, and can increase pollution from stormwater runoff. Design parking lots so that parking spaces do not exceed listed amounts and include clearly marked, preferred parking areas for carpools, vanpools and low-emitting, fuel-efficient vehicles. For the purposes of making calculations for this credit, classrooms include:

- General classrooms;
- Art rooms;
- Music classrooms;
- Computer labs;
- Science labs; and
- Special needs collaborative, and remedial classroom space.

Documentation

New Construction

1. Site plan showing parking layout (indicate total number of parking spaces). Highlight preferred parking spaces.
2. Signage schedule highlighting Preferred Parking signage.
3. Indicate number of classrooms (as defined for this credit) and total number of students.

Major Renovation

1. Existing site plan showing existing parking conditions (indicate total number of parking spaces).
2. Site plan of new parking layout (indicate total number of parking spaces). Highlight preferred parking spaces.
3. Signage schedule highlighting Preferred Parking signage.

Resources

CHPS. "Guideline SP3: Safe and Energy Efficient Transportation," in *Best Practices Manual.* Vol. 2, *Design*. San Francisco: CHPS, 2005.

LEED-NC *Reference Guide Version 2.2*: Site Credit 4.4: Alternative Transportation – Parking Capacity.

2 Water (3 points, 2%)

2.1 OUTDOOR SYSTEMS

Significant amounts of potable water are currently used to irrigate landscaping and playing fields. Expanding development increases the demand for potable water. As more and more water is withdrawn, aquifers and rivers can be stressed to the point of creating water shortages and ecological changes to rivers and streams. Summer dry spells can cause the most stress to underground and surface waters as water is withdrawn for irrigation and other outdoor activities but is not replaced by rainfall.

The use of potable water for irrigation can be minimized by specifying native species and water conservative plants and grasses, collecting and using rainwater for irrigation and using highly water-efficient irrigation systems where irrigation is absolutely necessary (e.g., playing fields). When specifying draught tolerant plants, determine soil composition and ensure that existing soils will support the plants to be specified. Consider all operating and maintenance costs of any irrigation equipment specified. If irrigation is necessary, make arrangements to irrigate during early morning hours to maximize irrigation efficiency and minimize evaporation.

2.1.1 CREDIT: NO IRRIGATION FOR LANDSCAPING

1 point	Do not install permanent irrigation systems for watering non-playing field landscaped areas; AND specify native species and water-conservative plants or grasses in these areas so that irrigation is not needed at all.

Documentation

A letter signed by a landscape architect certifying that permanent irrigation systems have not been specified for non-playing field areas; AND that only water conservative plants and grasses have been specified for these areas. The letter must clearly state that no irrigation, manual or otherwise, will be needed in these areas after plants are established. The letter must also indicate the species of draught tolerant plants and grasses that have been specified.

Resources

LEED-NC *Reference Guide Version. 2.2:* Water Credit 1.1: Water Efficient Landscaping.

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (http://www.irrigation.org/), and Master Gardeners are also good resources for helping achieve this credit.

2.1.2 CREDIT: REDUCE POTABLE WATER FOR LANDSCAPING

1 point	Reduce potable water consumption for irrigation of playing fields by 50% below water budget baselines with the use of draught tolerant plantings, high-efficiency irrigation technologies, soil moisture meters/rainfall sensors, and/or captured rainwater. Note: Use of well water, ground water, or surface water (ponds, streams) does not qualify for reductions under this credit.

Calculating a Water Budget

Calculate a water budget for the playing fields. Playing field needs vary according to many factors including: amount of solar radiation, temperature, humidity, grass species and rate of growth, rooting depth, and soil texture. Lawns and playing fields require approximately one inch of water a week from all sources, both natural and human. This amount may vary slightly depending on the soil type.

The best types of soil for playing fields are 3% to 7% organic content and fall into the following U.S. Department of Agriculture soil categories:

Table 1—Watering Requirements by Soil Type

Soil Type	Watering Requirements
Loamy sand	1 in. per week
Sandy loam	1 in. per week
Loam	1 in. per week

Calculate the total water needed per week with the following data:

X = Number of square feet of turf being irrigated.

SF = Soil Factor. For soils with organic content between 3%-7%, the Soil Factor is 1. For soil with less than 3% organic content and coarser than loamy sand, use a Soil Factor of 1.25.

Gallons required per week = (Plant Watering Requirement of 1 inch/week) * (1 ft/ 12 inches) * (X ft^2 of turf) *(SF) * (7.48 gallons/ft^3).

If the growing season in this example's area is roughly 28 weeks, calculate the total watering need per growing season by multiplying by 28 weeks to determine the water budget.

Water Budget = Gallons required per week * 28 weeks.

Artificial Turf

If the project is installing artificial sports turf, then the water that would have been required to irrigate the original grass turf area may be subtracted from the water budget. If the synthetic field is being watered for cooling, then subtract the difference between that amount and what a natural field would require. Some brands of artificial turf can be semi-impermeable. If the turf sheds too much rainwater, it may be considered impermeable and thus the project may have to include a groundwater recharge system on the site.

Rainwater Contribution to Irrigation

To find rainfall data on the NOAA, World Meteorological website, see the following link:
http://www.worldweather.org/093/c00273.htm
Average monthly effective rainfall can be estimated from Table 2-43 in part 623 of the *National Engineering Handbook*, produced by the Natural Resources Conservation Service of the U.S. Department of Agriculture From Brian Vinchesi.

Two 25,000 gallon tanks were installed underground at this middle school. The tanks will store rainwater collected from the school roof. The rainwater catchment system was sized so that it can provide 100% of the water needed for sewage conveyance for the whole building and 100% of water needed to irrigate a small ball field on the site. No potable water will be used for irrigation or toilet flushing.

Rainwater Collection and Water Storage

In order to reduce potable water demand for sewage conveyance and irrigation, some schools opt to use rainwater catchment systems with cisterns or underground storage tanks. These supplementary systems can significantly decrease water demand by drawing on stored water instead of municipal water supplies or drinking water wells.

A rainwater catchment system should be designed with a water storage capacity for sewage conveyance and/or irrigation in typical years under average conditions. In other words, oversizing water storage to meet drought conditions may be costly and could increase maintenance requirements. On the other hand, undersizing storage may simply result in a system that is too small to significantly offset potable water consumption. Rainwater collection and storage systems should be designed to avoid mold growth, bacterial accumulation and stagnation.

The underground storage tanks and cisterns could at times run dry during drought conditions. Therefore, it is acceptable for tanks and cisterns to connect to wells or municipal water supplies. Note that sizing calculations must support use of rainwater collection for 50% of playing field irrigation needs during an average year.

Documentation

1. Calculations of turf watering needs showing how much irrigation water must be added to the playing fields in gallons/week.
2. Comprehensive narrative signed by the project's landscape architect, civil engineer, or irrigation designer describing how 50% reduction of potable water will be achieved including irrigation technologies and/or native plantings.
3. Irrigation plans and details.
4. Specifications for irrigation and/or native plantings.

Resources

LEED-NC *Reference Guide Version 2.2:* Water Credit 1.2: Water Efficient Landscaping.

Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (http://www.irrigation.org/), and Master Gardeners are also good resources for helping achieve this credit.

2.2 INDOOR WATER SYSTEMS

Purpose: Maximize water efficiency within buildings to reduce the burden on municipal water supply, aquifers, and wastewater treatment systems.

The growing value of potable water underscores the importance of lowering demand. Efficient water consumption naturally reduces the amount of water pumped from the ground or transported from reservoirs to cities and towns. In addition, efficiency and water conservation reduce the cost and amount of sewage needing treatment after use. Since water-efficient devices can vary in quality and performance, specify only durable, high performance fixtures.

2.2.1 CREDIT: INDOOR WATER USE REDUCTION

1 point	Use strategies that, in aggregate, reduce potable water use by 20% beyond the baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992's fixture performance requirements.

This credit awards reductions in total water use; therefore all water uses are included in the calculations. To quantify water use reductions, create spreadsheets showing baseline and design water uses. Each water-using appliance or fixture must be listed with the amount of daily uses, number of occupants, and total water use. Note: To determine the net amount of water used in the calculations, the amount of reclaimed water used for sewage conveyance is subtracted from the total amount of water used. A water-efficient design for the school is shown below in Tables 2 and 3.

Develop a water use baseline including all water-consuming fixtures, equipment, and seasonal conditions according to methodology outlined below. Specify water-conserving plumbing fixtures that exceed the Energy Policy Act (EPAct) of 1992's fixture requirements in combination with ultra high efficiency or dry fixture and control technologies. Specify high water efficiency equipment (e.g., dishwashers, faucets, cooling towers).

Table 2—Design Indoor Water Consumption Calculation

Fixture Type	Flow-rate	Duration	Automatic Controls??	Occupants	Daily uses per occupant	Water use
Low-flow Toilet (male)	1.6 gal/flush	1 flush	-	500	1	800
Waterless Urinal (male)	0.0 gal/flush	1 flush	-	500	2	0
Low-flow Toilet (female)	1.6 gal/flush	1 flush	-	500	3	2400
Bathroom Sink	0.5 gal/min	0.17 min	-	1000	3	255
Low-flow Shower	1.8 gal/min	5 min	-	100	1	900
Low-flow Kitchen Sink	1.8 gal/min	45 min	-	2	2	324
Efficient Clothes Washer	20 gal/load	1 load	-	-	10	200
					Total Daily Volume	4879
					Number of School Days	180
					Subtotal	878,220
					Minus Collected Rainwater	(396,000)
					Design Total Annual Volume	482,220

For the baseline calculation, create a similar spreadsheet but change only the type of fixture and its associated design details. The baseline calculation for this example would therefore be:

Table 3—Baseline Indoor Water Consumption Calculation

Fixture Type	Flow-rate	Duration	Automatic Controls	Occupants	Daily uses per occupant	Water use
Conventional Toilet (male)	1.6 gal/flush	1 flush		500	1	800
Conventional Urinal (male)	1.0 gal/flush	1 flush		500	2	1000
Conventional Toilet (female)	1.6 gal/flush	1 flush		500	3	2400
Bathroom Sink	0.5 gal/min.	0.5 min		1000	3	750
Conventional Shower	2.5 gal/min	5 min		100	1	1250
Kitchen Sink	2.5 gal/min	45 min -		2	2	450
Clothes Washer	40 gal/load	1 load -		-	10	400
					Total Daily Volume	7,050
					Number of School Days	180
					Baseline Total Annual Volume	1,269,000

Comparing the two spreadsheets, the water-efficient fixtures reduced potable water use by:

% Savings = 1 – (Design Total Annual Volume / Baseline Total Annual Volume)
= 1 – (482,220/1,269,000) = 0.62 = 62%

This design would earn a point because overall potable water use has been reduced by over 20%.

Documentation

1. Perform calculations as outlined above.
2. Develop a specification section on plumbing fixtures and include fixture schedule.

Post-Construction Documentation

Approved submittals for all plumbing fixtures.

Resources

LEED-NC *Reference Guide Version 2.2*: Water Credit 3: Water Use Reduction.

3 Energy (26 points, 20%)

3.1 Energy Efficiency

Purpose: Reduce environmental impacts and operational costs associated with excessive energy use.

Energy-efficient schools save money while conserving non-renewable energy resources and reducing atmospheric emissions of pollutants and greenhouse gases. The New York State Energy Conservation and Construction Code (ECCC) supports the construction of energy-efficient schools whether facilities projects are renovations, additions, or new construction. The requirements of the ECCC, while effective, can be easily met and exceeded using numerous cost-effective, practical, and straightforward measures.

Energy modeling is an effective tool for achieving energy savings and is a critical part of an integrated design approach. Various combinations of building systems can be modeled using specialized software to show payback calculations for different energy saving measures. The most effective energy modeling is an iterative process. This means that different combinations of measures, such as daylighting, HVAC systems controls, lighting systems and controls, and energy recovery equipment, are modeled to determine the best payback and to minimize operational costs.

Commissioning, maintenance, and training are vitally important to the performance of the school and its systems, and are critical to maintaining energy efficiency. Commissioning involves a rigorous quality assurance process that ensures the building and its systems are designed, built and operated as designed and that the school district receives the proper training and documentation needed to operate and maintain the building. No building can perform optimally without adequate maintenance. Training is critically important for maintenance staff to thoroughly understand how to maintain and operate the building systems. When staff turnover occurs, appropriate documentation must be on hand in order to train new team members.

3.1.1 PREREQUISITE: MINIMUM ENERGY PERFORMANCE

Prereq.	20% reduction in total energy use compared to Energy Conservation Construction Code. (ECCC)

Model the school using the energy savings calculations protocol in Chapter 8 of the ECCC to show that the building will achieve 20% less energy cost than an ECCC building, for regulated loads only.

Regulated Loads: all loads other than "process" loads.

Process loads are defined here and in LEED®-NC Version 2.2 as office and general miscellaneous equipment, computers, elevators, kitchen cooking and refrigeration, and laundry washing/drying. The process loads default is 25% of the total energy cost for the baseline building energy cost unless supporting documentation is developed to substantiate that process energy loads are less than 25%. Normally, process loads must be identical for both the baseline building and for the proposed building.

However, project teams should also consider measures that reduce process loads. Some improvements in process loads will have a positive impact on HVAC cooling loads, which are part of regulated loads. These types of reductions in process loads may benefit your savings calculations.

The following are acceptable energy modeling software programs:

- BLAST (although very powerful, Blast is no longer under development and no new versions have been released since 1998)
- DOE-2.1E
- DOE-2.2 (or PowerDOE)
- EnergyPlus (the result of the merger between DOE-2 and Blast)
- eQUEST (nice user interface that uses the DOE-2.2 engine)
- HAP (by Carrier), also called E20II
- TRACE (by Trane)
- TRNSYS; or
- an equivalent hourly computer simulation program.

Contribution from on-site renewable (solar and wind only) generation can be counted towards energy savings.

When modeling your building, you will usually be able to achieve compliance with this Energy Prerequisite if you choose to incorporate the package of energy measures listed below. These measures have been studied and modeled by the Massachusetts Technology Collaborate (MTC) and are expected to achieve at least 20% greater building energy efficiency than a comparable baseline building that meets the requirements of the ECCC.

If you plan, however, to apply for 3.1.3 Credit: Superior Energy Performance, you will normally need to go beyond the design criteria in the package below.

1. *Lighting Power Density (LPD):* Average installed lighting equipment power density must not exceed 1.0 Watts/ft^2 for the entire school.

2. *Automatic Light Reduction*: Control systems, such as occupancy sensors, timed lighting schedules, or timed switches, that shut interior lights off when spaces are unoccupied for 15 minutes or more must be employed in all spaces.

   Exceptions:

   - Emergency lighting;
   - Security lighting;
   - Task lighting;
   - Spaces with only one luminaire; and
   - Corridors.

3. *Dimming/Switching/Bi-Level Control for Lighting*: Light switches must be installed such that more than one level of artificial illumination is possible.

   Each perimeter and non-perimeter regularly occupied space enclosed by ceiling-height partitions must have a manual control to allow the occupant to uniformly reduce the connected lighting load by at least 50% in all spaces.

   Exceptions:

   - Emergency lighting;
   - Security lighting;
   - Task lighting;
   - Spaces with only one luminaire;
   - Corridors; and
   - Rest rooms.

4. *Daylight Responsive Lighting Control*: Incorporate daylighting throughout the school building such that 15% of the installed electrical lighting wattage is dimmed or turned off when sufficient natural light is present.

   Exceptions: Theatrical lighting, specialty lighting, and task lighting.

5. *Fenestration Performance*: The U-Factor of the window assemblies must not exceed 0.45 for metal-framed window systems and 0.35 for non-metal-framed window systems. For further information, see Advanced Buildings Benchmark Version 1.1, pp.62–63.

6. *Premium Efficiency Motors*: For all motors greater than or equal to ½ horsepower, install premium efficiency motors as defined by the National Electrical Manufacturers Association (NEMA). Link: http://www.nema.org/stds/complimentary-docs/upload/MG1premium.pdf

7. *Mechanical System Design*: Employ best practices design techniques to improve system performance and meet ASHRAE *Standard 55-2004*. The design engineer must document the following actions in the design process.

   When sizing the heating and cooling equipment, perform load calculations using interior load assumptions that are consistent with sustainable design practices. To avoid oversizing heating and cooling equipment, use the actual design interior lighting power density, account for the actual glazing characteristics, provide credit for displaced loads or if under-floor systems are used, and base miscellaneous loads on field-verified measurements or field-based research rather than typical assumptions. Where not feasible, document the non-standard load assumptions for owner concurrence.

   When sizing the fan and air distribution systems, document fan-sizing calculations with zone-by-zone load calculations. Perform calculations to determine critical path supply duct pressure loss. Compare fitting selections for oval duct where feasible to lower leakage and reduce pressure loss. Separate all fittings in medium and high–pressure ductwork by several duct diameters to reduce system effects wherever feasible. Where possible, provide automatic dampers on exhaust in lieu of barometric dampers to reduce fan power and increase barometric relief.

   Perform a second set of calculations using part-load conditions (maximum <u>likely</u> load and/or standard operating conditions). This includes using benchmark data, average daytime temperatures and non-peak solar gain, and other assumptions to define part-load conditions for the heating and cooling system. Include diversity factors for interior loads and other factors that will allow proper assessment of part-load operation.

   Describe the system operation at these conditions and describe features of the design that will facilitate efficient operation at these part-load conditions. Document how the system will deliver ventilation air, maintain comfort in accordance with ASHRAE *Standard 55-2004* and operate in an energy efficient manner.

   Source: *Advanced Buildings Benchmark* Version 1.1, New Buildings Institute

8. *Boilers/Burners Selection and Sizing:* When the school design includes a boiler plant, the size of any single boiler must not exceed 50% of the calculated design building heating load. For power burners larger than 400,000 Btu/hr, fully modulating burners must be used.

   Boilers are typically sized to meet the building heat loss and ventilation air heating loads at winter design temperature conditions without taking credit for internal heat sources such as lights, equipment, and people. This results in the boilers that are oversized for most of their operating conditions. Oversized boilers are inefficient due to fixed losses, such as radiative heat losses. Radiative heat losses, which can be as little as 1% at full load, can become 5% to 20% at partial load.

   On top of fixed losses, inefficiencies also result when boilers “short cycle”; which occurs when an oversized boiler quickly satisfies the heating load, cycles off for a brief period, and then cycles on again. Larger boilers with power burners that have pre- and post- purge cycles are particularly inefficient when they undergo short cycling, since with each cycle, air used to flush the boiler during purging is heated and vented to the chimney. Short cycling also adversely affects the boiler life because the boiler is rapidly heated then cooled, and burner motors are cycled on and off, reducing the longevity of the boiler heat exchanging surfaces and burner motors.

To avoid these problems, size the boiler plant and provide controls to efficiently meet both the peak and part load heating requirements of the building. Provide multiple boilers, each sized at some fraction less than 50% of the design building heating load, and use modulating burners on larger boilers so that they can operate over a wide load range without short cycling.

Exception: Boiler plants that utilize condensing boilers or plants where each boiler capacity is smaller than 300,000 Btu/hr.

9. *Boiler Efficiency*: If installing gas-fired boilers, they must have a rated thermal efficiency of at least 80% or a rated combustion efficiency of at least 83%. If installing oil-fired boilers, the boilers must have a rated thermal efficiency of at least 83% or a combustion efficiency of 85%.

10. *Efficient Cooling Equipment*: Install air conditioning equipment in accordance with Advanced Buildings — Benchmark Version 1.1 prescriptive criteria "Mechanical Equipment Efficiencies Requirements" addressing package terminal air conditioners, heat pumps, electric chillers, and absorption chillers. Refer to Appendix B. Tables listing heat pump efficiencies and unitary air conditioning and condensing unit efficiencies are provided by the Consortium for Energy Efficiency (CEE), which developed specifications for use in voluntary energy-efficiency programs. Tables for package terminal air conditioners and chillers were developed by the New Buildings Institute for their Advanced Buildings—Benchmark efficiency criteria. Be sure to check the web links for updated versions of the efficiency tables.

    Source: Advanced Buildings -Benchmark, New Buildings Institute Version 1.1: http://www.poweryourdesign.com/ABbenchmark.pdf

    Consortium for Energy Efficiency: http://www.cee1.org/com/hecac/hecac-tiers.pdf

11. *CO_2-Based Demand Controlled Ventilation*: Install CO_2-based demand controlled ventilation systems in large volume areas with variable occupancy, such as gymnasiums, cafeterias, and auditoriums.

    Demand controlled ventilation is a ventilation strategy for spaces with varying levels of occupancy throughout the day. For example, the school cafeteria may be occupied sparsely most of the school day except for lunch periods when occupancy reaches maximum levels. Carbon dioxide sensors installed in the occupied spaces measure the CO_2 in the air, compare the CO_2 levels to levels measured by outdoor CO_2 sensors, and continuously adjust the amount of fresh air delivered based on the number of people in the room. When more people are in the room, the ventilation rate of airflow increases, when there are fewer, the ventilation rate decreases proportionally. This ventilation control method avoids heating and cooling large quantities of outside air when few people are using the space. Gymnasiums and auditoriums are also examples of spaces that can have high design ventilation air volumes but, for most of the time, are not fully occupied. Demand controlled ventilation is appropriate for these spaces as well.

    When siting the outdoor CO_2 sensor, it is critical to locate the sensors away from other sources of CO_2, such as exhaust vents, which would provide a false reading of ambient carbon dioxide levels. If a CO_2-based demand controlled ventilation system is implemented, it is critical that the CO_2 sensors are recalibrated at intervals according to the manufacturer's recommendations. This recalibration of the sensors must be written into the school's maintenance manual.

Use the language below to guide design assumptions.

Systems with design outside air capacities greater than 3,000 cfm serving areas having an average design occupancy density exceeding 50 people per 1,000 ft^2 must automatically reset outside air rates based on the CO_2 concentration levels in the space as compared to the outdoor CO_2 level.

Exceptions: Systems with heat recovery that have a minimum effectiveness of the heat recovery system of 50% for total energy recovery or 65% of sensible heat recovery.

12. *Variable Speed Control:* Individual pumps serving variable flow systems and VAV fans having a motor horsepower of 7.5 hp or larger must have controls or other devices (such as variable speed control) that will result in pump or fan motor demand of no more than 30% of design wattage at 50% of design flow.

13. *Building Envelope:* Follow the "Minimum Insulation Requirement R-Values and Maximum Insulation U-Factors" found in Appendix C.

Documentation

The energy modeling report developed must include the following key elements:

Spray foam insulation was used in this child center to create a tighter building envelope that will save energy and money.

- The facility and site description must include a narrative describing the type of construction, hours of operation, size and configuration of building. Also describe the mechanical system, lighting system and equipment loads, domestic hot water system, and any renewable energy systems.

- Narrative summarizing the analysis methodology, the baseline design, and results of energy modeling.

- Table summarizing and comparing the differences between 'as designed' case and the baseline case.

- Table summarizing the annual energy consumption for the design case and the base case (see example table below).

- Table summarizing cost savings (see example tables below). Try to use actual retail utility rate structures and schedules.

Table 1—Annual Energy Consumption, Design Case versus Base Case

Item	Annual Energy Consumption			
	Electricity (kWh)	Natural Gas, oil, other (therms, gallons, other)	Total site Btu (MM Btu)	Total Energy Costs ($)
Base case				
Design case				
Savings subtotal				
Contribution from on-site generation				
Total Savings				
Total % Savings				

Table 2—Cost Savings Summary

Measure	Units	Baseline Building	As Designed Building	Savings
Electricity consumption	kWh			
Electricity consumption/ft²	kWh/ft²			
Electricity cost	$			
Electricity cost/ft²	$/ft²			
Natural gas, oil or other fuel consumption	Therms, gallons, other			
Natural gas, oil or other fuel consumption/ft²	Therms, gallons, other/ft²			
Natural gas, oil or other fuel cost	$			
Natural gas, oil or other fuel cost/ft²	$/ft²			
Total site energy consumption	MMBtu			
Total site energy consumption/ft²	kBtu/ft²			
Total site energy cost	$			
Total site energy cost/ft²	$/ft²			

An electronic version of all input and output data from the school building energy model must be developed to demonstrate NY-CHPS compliance.

Paper copies of each of the following energy modeling reports for both the base case and the as-designed case should also be made available.

> *Building Energy Consumption per End Use (BEPU)*: This report shows annual building energy use according to energy type (electricity, natural gas, etc) and energy end use (lights, space heating, space cooling, fans, etc.). The energy use should be shown in the actual units of consumption, such as kWh for electricity, therms for gas, etc. The DOE-2 simulation output report that contains this information is called BEPU.
>
> *Building Energy Consumption per End Use (BEPS)*: This report is very similar to the BEPU report described above. The difference is that the values in this report are all converted into the same units (MBtu), allowing a direct comparison of end-use intensities.
>
> *Energy Cost Summary (ES-D or ES-E)*: This report summarizes the yearly energy consumption and cost for all utility rates that are defined for/applicable to the project

(electric rate, gas rate, etc).

Summary of Spaces Occurring in the Project (LV-B): This report provides a list of all the zones occurring in the model along with the assigned lighting wattage, number of people, equipment wattage, infiltration amount, square footage, and volume.

Building Peak Load Components (LS-C): This report provides a breakdown of the building cooling and heating peak loads according to the source of the loads (walls, roof, windows, occupants, light, equipment, infiltration, etc.). This report does not include the loads from ventilation air.

Equipment Loads and Energy Use for Central Plant Components (PS-C): This report would be required only for projects that include central plant equipment such as boiler(s) or chiller(s). For each central plant component this report provides annual heating and/or cooling load, the electrical and fuel consumption, and performance information in a bin format, including hours of operation at different part loads, and the total annual hours of operation.

Resources

Energy Conservation Construction Code of New York State, New York State Department of State, 41 State Street, Albany, NY 12231, 518-474-4073.

Advanced Buildings E-Benchmark Version 1.1 by New Buildings Institute, Inc. January 2005 Edition. http://www.newbuildings.org

ANSI/ASHRAE/IESNA Standard 90.1-2001 Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA.

ANSI/ASHRAE/IESNA Standard 90.1-2004 Energy Standard for Buildings Except Low-Rise Residential Buildings. Informative Appendix G Performance Rating Method. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA.

Massachusetts Collaborative for High Performance Schools (MA-CHPS) Best Practices Manual, Volume II -Design. Energy efficiency is affected by most of the guidelines. In particular, consult the Daylighting, Electric Lighting, HVAC, Building Envelope, and Site Planning Chapters.

ENERGY STAR® — http://www.energystar.gov/ — ENERGY STAR is a federal government-sponsored program helping businesses and individuals protect the environment through superior energy efficiency.

Rebuild America — http://www.rebuild.gov/sectors/ess/index.asp?MktID=2 — Rebuild America manages the Energy Smart Schools program.

LEED-NC *Reference Guide Version 2.2:* Energy and Atmosphere Credit 1: Optimize Energy Performance.

3.1.2 Prerequisite: HVAC System Sizing

Prereq.	Design all major HVAC components such that they are correctly matched to loads to avoid system over-sizing.

Develop documentation that all major HVAC components (primary and secondary) are correctly sized in a manner that precludes unnecessary over-sizing, yet maintain adequate redundancy/backup and ensured energy efficient operation during part load conditions. Show sizing and calculation procedures. Develop at least three alternatives that were analyzed to illustrate the thought process that led to selecting the most efficient system size and configuration.

Systems must be sized and configured to efficiently handle peak/design load conditions, but more importantly operate in an energy efficient manner during a wide range of part load conditions, which are the operating ranges that HVAC systems handle most of the time.

3.1.3 Credit: Superior Energy Performance

Integrate the design of all significant building systems including HVAC, lighting, and building envelope to reduce energy of the proposed design below what is required by the ECCC.

1 point	22.5% reduction in total energy use compared to ECCC
2 points	25% reduction in total energy use compared to ECCC
3 points	27.5% reduction in total energy use compared to ECCC
4 points	30% reduction in total energy use compared to ECCC
5 points	32.5% reduction in total energy use compared to ECCC
6 points	35% reduction in total energy use compared to ECCC
7 points	37.5% reduction in total energy use compared to ECCC
8 points	40% reduction in total energy use compared to ECCC
9 points	42.5% reduction in total energy use compared to ECCC
10 points	45% reduction in total energy use compared to ECCC

Documentation

To obtain credit, the school must achieve at least **22.5%** less energy cost than an ECCC building, based on regulated loads (defined above) only. Points are awarded for higher percentages of savings as indicated in the table above. No partial points are allowed.

Be sure to follow the same instructions for documentation as in Energy Prerequisite: Minimum Energy Performance. The energy modeling report must follow the same format, and an electronic version of all input and output data from the school building energy model must be included with NY-CHPS documentation.

Model the school using the energy savings calculations protocol in Chapter 8 of the ECCC. The following are acceptable energy modeling software programs:

- BLAST (although very powerful, Blast is no longer under development and no new versions have been released since 1998);
- DOE-2.1E;
- DOE-2.2 (or PowerDOE);
- EnergyPlus (the result of the merger between DOE-2 and Blast);
- eQUEST (nice user interface that uses the DOE-2.2 engine);
- HAP (by Carrier), also called E20II;
- TRACE (by Trane);
- TRNSYS; or
- an equivalent hourly computer simulation program.

Contribution from on-site renewable generation (for technologies with no fuel cost) can be counted towards energy savings.

3.2 Alternative Energy Sources

Use on-site alternative energy sources for electricity production or heating/cooling. The table below shows the point levels corresponding to the percentage of energy cost savings supplied by alternative energy sources as compared to the cost of the as-designed school, regulated loads (defined under 3.1Energy Efficiency) only.

Using renewable energy generated on-site has many benefits. Alternative energy sources such as photovoltaics, and wind turbines use the sun and wind instead of non-renewable, polluting sources, such as coal, oil or natural gas. Producing energy on-site also eliminates the environmental impacts of transmission losses associated with remote sources and transportation emissions associated with fuel delivery. On-site sources can be very effective components of school curricula, educating students on a wide variety of energy and science issues. In addition, on-site alternative energy production has the added advantage of increasing fuel diversity and reduces the need to import fuels into New York State. Utilizing indigenous resources such as woody biomass, biogas, wind and solar energy is increasingly important as New York is becoming more dependent upon natural gas and as fossil-fuel prices become increasingly volatile.

As reported by the U.S. Department of Energy, the average school in the "cool and humid" climate zone, which includes northern areas of New York State, uses energy for heating, cooling and lighting in the following proportions:

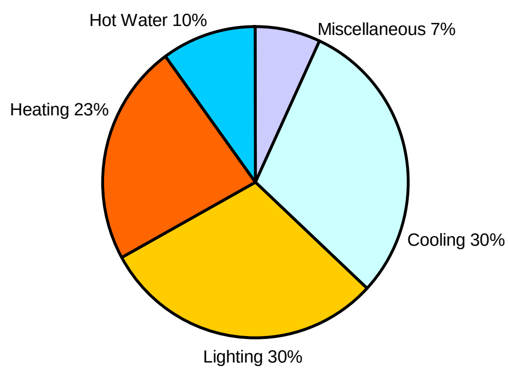


Figure 2—School Energy Use Distribution

School Energy Use for schools in the "cool and humid" climate zone, which includes northern New York State. Source: Energy Design Guidelines for High Performance Schools: Cool and Humid Climates; US DOE, Office of Building Technology

When considering the contributions of renewable energy technologies on the school's energy loads, it is helpful to know what and when the greatest loads are and why. Clearly, a building with partial air-conditioning would narrow the slice of the energy pie for the consumption of electricity for air-conditioning. It is typical for schools to consume one-third of their energy on heating and hot water and just shy of two-thirds on electricity.

3.2.1 CREDIT: ON-SITE ELECTRICITY GENERATING RENEWABLES

Electricity-Producing Renewables	Percentage of As-Designed Energy Costs
2 points	1.0%
3 points	3.0%
4 points	5.0%
5 points	10.0%

For purposes of this credit, on-site, electricity-generating renewables are defined as follows:

- Photovoltaics;
- Wind;
- On site micro-hydropower; and
- Low emission, advanced biomass power conversion technologies, such as woodchip-based biomass, biodiesel, bio-oil, and bio-gas.

A 56 kW solar photovoltaic array was installed on this middle school's south-facing roof. The array will supply 9.9% of the school's as-designed energy needs.

A 34 kW solar photovoltaic array was installed on the roof of this school's swimming pool building. The array supplies 2.3% of the school's as-designed energy needs.

A small 400 Watt wind turbine was installed on the roof of this school's garden shed for demonstration and instructional purposes.

Financial Benefits Beyond CHPS: Net-Metering

Electricity consumers in some areas that install certain types of on-site generating systems may be eligible for net metering. Since this is a newly developing issue, check with the local utility or the New York State Public Service Commission to determine what the current rules are. Under net metering, the output of such a system is either consumed immediately by the loads active within the building or sent to the utility grid. This energy sent back into the grid spins the electric meter backwards and effectively avoids purchases of electricity from the utility at its retail rates. This is particularly helpful for wind and solar systems, which are intermittent in nature. In certain installations, surplus output during any billing period (for net metered systems) or instantaneously (for other systems) will be bought by the utility at its wholesale rates.

Documentation

Calculations showing the percentage of facility electricity usage to be developed with on-site renewables.

Resources

CHPS *Best Practices Manual*, Volume II: Guideline OS1: Photovoltaics.

LEED-NC *Reference Guide Version 2.2:* Energy and Atmosphere Credit 2: On-Site Renewable Energy.

3.2.2 CREDIT: ON-SITE THERMAL ENERGY RENEWABLES

Thermal Energy-Producing Renewables	Percentage of As-Designed Energy Costs
1 point—Solar thermal	1.0%
2 points—Solar thermal	2.0%
1 point—*Biomass/Biodiesel/Ethanol heating/cooling	10%
2 points—*Biomass/Biodiesel/Ethanol heating/cooling	20%
See Glossary for definitions of biomass, bio-gas, biodiesel, and bio-oil.	

Schools can use solar thermal collectors and passive solar design elements to provide heated air or water for space heating, lavatories, showers, kitchens, and pools. Although solar thermal systems will be most productive in the summer months, collector technologies are also advanced enough to work effectively during the winter months in cold climates.

Conveyor belt for a biomass fired heating system.

Woody biomass heating systems are commercially available for school heating and are widely used in Vermont. These biomass heating systems serve as the primary heating system for the schools with smaller conventionally-fueled boilers as backup and for shoulder seasons. Systems are fully automated.

Biodiesel is a renewable bio-based fuel that can be blended with conventional heating oil and used in a heating boiler or furnace. Typically, biodiesel is blended at a 10% or 20% rate. The use of biodiesel requires no modifications to the boiler and improves system performance and maintenance, and reduces emissions.

Biomass Systems

If the biomass system is designed to co-fire with a non-renewable fuel (i.e., accommodate less than 100% biofuel), the points claimed must be pro-rated accordingly. For example, if plans call for use of 20% bio-oil and 80% conventional fuel, only 20% of energy generated by the system can be counted as renewable for purposes of calculating points.

To Determine Renewable Energy Savings

1. Model the baseline school building to estimate the annual energy cost for the baseline building design, regulated loads only. Use values from Energy Prerequisite: Minimum Energy Performance or Energy Credit: Superior Energy Performance if the performance approach was used.
2. Calculate the amount of energy the particular on-site renewable energy systems are expected to supply annually and calculate total annual cost savings associated with renewable energy (if energy modeling was done for Energy Prerequisite: Minimum

Energy Performance or Energy Credit: Superior Energy Performance, use the energy unit cost assumptions in the energy modeling report).

3. Calculate the percentage of energy cost savings contributed by renewables (annual cost savings associated with on-site renewables/annual total regulated energy costs).

Documentation

Calculations showing the percentage of facility energy costs to be avoided with on-site thermal energy renewables.

Resources

LEED-NC *Reference Guide Version 2.2:* Energy and Atmosphere Credit 2: On-Site Renewable Energy.

3.3 COMMISSIONING & TRAINING

Purpose: Verify that fundamental building elements and systems are designed, installed, and calibrated to operate as intended, and provide for the ongoing accountability and optimization of building energy performance over time.

Do not underestimate the value of commissioning. Buildings, even simple structures, are complex systems of electrical, mechanical, and structural components. High performance buildings are healthy, efficient, environmentally sensitive structures whose performance can be significantly affected if the building has not been designed following the school district's intent or constructed according to the designers' specifications. Commissioning is a rigorous quality assurance process administered by a knowledgeable third party that ensures the building performs as intended.

3.3.1 Prerequisite: Third-Party Commissioning

Prereq.	Implement ALL of the following fundamental best practice commissioning procedures: 1. Engage an independent, third-party Commissioning Authority (CA). The CA may be hired by an entity other than the owner, such as the architect, engineering team, or construction manager, but must report simultaneously to the owner and the holder of the contract. The CA must be responsible for commissioning the following critical building systems: • Lighting controls (daylight, occupancy, timing switches, etc.); • HVAC systems (such as heating, cooling, ventilating systems and their controls) under actual operating conditions; • Domestic hot water systems; • Energy Management System; • On-site renewable energy systems; • Special systems such as kitchens, pools, etc; and • Emergency power systems. 2. Review design intent and basis of design documentation. 3. Include commissioning requirements in the construction documents. 4. Develop and utilize a commissioning plan. 5. Verify installation, functional performance, training, and operations and maintenance documentation. (A minimum 15% sampling strategy for testing terminal units and repetitive units is permissible. All major systems must be tested.) 6. Complete a commissioning report.

Commissioning is extremely cost effective over the life of a building. Based on experience in 2003-2004, commissioning typically adds approximately ¼ % to ½ % to the construction cost of a project. This prerequisite requires the following commissioning procedures. For a more thorough discussion of the requirements, see the LEED-NC *Reference Guide Version 2.2:* Energy and Atmosphere Prerequisite 1: Fundamental Commissioning.

1. *Engage a Commissioning Authority (CA)*: The CA directs the commissioning process and should be engaged as early in the design as possible. The commissioning services should be performed by an independent third party. The CA may be hired by an entity other than the owner, such as the architect, engineering team, or construction manager, but must report simultaneously to the owner and the holder of the contract.
2. *Develop design intent and basis of design documentation*: The architect and the design engineer are the most appropriate people to create this document, which should list the owner's requirements and design intent for each of the systems or features to be commissioned. The CA must review this document and a copy must be provided to the owner.
3. *Include commissioning requirements in the construction documents*: All commissioning requirements must be integrated into the construction documents to clearly specify the

responsibilities and tasks to be performed. Of particular importance is the delineation of the contractors' responsibilities regarding documentation, functional performance testing, occupant and operator training, and the creation of the operations and maintenance manuals.

4. *Develop commissioning plan*: The commissioning plan must include a list of all equipment and systems to be commissioned, delineation of roles for each of the primary commissioning participants, and details on the scope, timeline, and deliverables throughout the commissioning process.
5. *Verify installation, functional performance, training, and operations and maintenance documentation for each commissioned system and feature*: This is the heart of the commissioning process.
6. *Complete a commissioning report*: The report must show that the building's systems: have met the design intent and specifications; have been properly installed; are performing as expected; and that proper operations and maintenance (O&M) documentation and training have been provided. The report should include a compilation of all commissioning documentation described in this credit, including complete functional testing results and forms, and should note any items that have not been resolved at the time the report is issued.

Documentation

1. Copy of signed contract with Commissioning Authority, including scope of work or, if unavailable, copy of commissioning services RFP. The commissioning scope of work, as documented in either the RFP or the commissioning services contract, should clearly outline the systems to be commissioned, the services to be performed by the Commissioning Authority, including development of a commissioning plan, verification of installation, functional performance, training, and provision of maintenance manuals, and should reference preparation of a final commissioning report.
2. Copy of design intent document, or, if unavailable, supply either commissioning specifications; OR commissioning authority scope of work showing that a design intent document will be acquired.
3. Commissioning specifications, or if commissioning specifications are embedded in separate divisions of the project manual, include the relevant specifications (e.g., lighting systems, HVAC, Building Automation System, plumbing, renewable energy systems).

Post-Construction Documentation

Provide a copy of the commissioning report to the owner. This will be reviewed with the expectation that the commissioning process was completed to the fullest extent possible. The commissioning report must at a minimum contain:

- An executive summary that describes issues identified during the commissioning process.
- Design intent document.
- A summary table listing equipment tested, dates of tests, and results of tests.
- Operations and Maintenance Documentation — cover sheet and table of contents with a letter stating that a review of the O&M manuals were completed by the commissioning authority AND that the school district received the manuals. Please note where the manuals are kept (central school district workshop, individual school custodian office, etc.). O&M manuals should be reviewed for systems that have been commissioned.
- A syllabus from O&M training sessions.

- Corrective action log summarizing deficiencies and actions taken to correct them. Include any items that were identified but not corrected.

Resources:

CHPS *Best Practices Manual*, Volume II: Guideline GC5: Contractor Commissioning Responsibilities.

LEED-NC *Reference Guide Version 2.2:* Energy and Atmosphere Prerequisite 1: Fundamental Commissioning.

ASHRAE Guideline 1-1996: The HVAC Commissioning Process

ASHRAE Guideline 4-1993: Preparation of Operations & Maintenance Documentation for Building Systems

NYSERDA: http://www.nyserda.org/programs/Commissioning/default.asp

Model Commissioning Plan and Guide Specifications: Portland Energy Conservation, Inc. http://www.peci.org/library/mcpgs.htm

3.3.2 Prerequisite: Third-Party Training

Prereq.	A third party must verify that effective and complete training and documentation on the operation and maintenance of the building systems identified in the previous requirement was provided. This must include a complete guide for maintenance staff and a user's guide for all classrooms. The third party or school district official must verify that training programs for school maintenance staff, administrators, teachers, and other staff will be developed and completed. Training is an essential step to protect indoor environmental quality and maintain superior energy performance.

A third party or school district official must verify that the following required actions are planned to help ensure that the facilities staff, teachers, and others understand their roles:

- Compile Operations & Maintenance Manuals: provide detailed operations and maintenance information for all equipment and products in use in the school, specifically written for maintenance and facility staff.

- Create a short, classroom "user's guide" for teachers and administration staff explaining how to operate their room lighting and HVAC systems.

- Conduct Operations & Maintenance Training: Provide a short introduction for all school staff, and then feature a special hands-on workshop for training facility and maintenance personnel. Training must include the interaction of the equipment operating together as a system.

Documentation:

Develop a letter of intent signed by the school district's facility manager and Superintendent of Schools explaining: (1) who will provide the operations and maintenance manuals for maintenance staff and the classroom "users guides;" for administrative and teaching staff; and (2) who will prepare and conduct training for school staff and a special workshop for facility personnel.

Post-Construction Documentation

Include: 1) a copy of the maintenance manuals; and 2) a copy of the user's guide created for the classrooms and teachers.

Resources

CHPS *Best Practices Manual*, Volume II: Guideline GC5: Contractor's Commissioning Responsibilities.

ASHRAE Guideline 1-1996: The HVAC Commissioning Process

ASHRAE Guideline 4-1993: Preparation of Operations & Maintenance Documentation for Building Systems

3.3.3 Prerequisite: Identify an Energy Manager

Prereq.	Develop a formal policy to appoint an energy manager responsible for the school district.

The energy manager keeps energy issues in school district focus. Having an energy manager is one personnel action where school districts actually get a return on investment. This may include assigning responsibilities to existing employees or hiring a new person for one or more school districts.

Resources

School Energy Costs - A Matter of Leadership (2003 Edition)
http://geology.utah.gov/sep/energy_efficiency/pdf/school_energy2003.pdf

3.3.4 Prerequisite: Track Energy Costs

Prereq.	Use NYSED's Capital and Maintenance Planning (CMP) Tool to track energy costs and energy systems expenditures. If the school uses another energy tracking tool, enter summary data from the tracking tool into the CMP to develop linkages between energy costs, O&M costs, and expected capital expenses.

Documentation:

Develop a letter of intent signed by the school district's facility manager <u>and</u> Superintendent committing the school district to using the CMP Tool monthly to track energy costs and related system expenditures.

Resources

A copy of the Excel spreadsheet used to produce the plan can be obtained at the NYSED website at: http://www.emsc.nysed.gov/facplan/

3.3.5 Prerequisite: Energy Management System Controls

Prereq.	Install an open protocol energy management system (EMS) that controls the following systems throughout the school: • HVAC (heating, cooling, fans): • Exterior lighting; and • Hot water systems.

While energy management systems (EMS) are typically installed with new HVAC and heating systems, care must be taken to specify and install an appropriate system for the school district and its maintenance staff. The best EMS for a school district is the simplest system that still addresses the school's energy management needs. Increased complexity does not always mean increased value for the school district. Also, specify graphic interfaces that help O&M staff to use the EMS effectively.

Documentation

Reference specification sections that show compliance with this requirement. Please designate the CSI number, section, and page number.

3.3.6 Credit: Additional Commissioning

3 points	In addition to Prerequisite 3.3.1, implement the following commissioning tasks: • Conduct a focused review of the design prior to the construction documents phase; • Conduct a focused review of the construction documents when close to completion; • Conduct a selective review of contractor submittals of commissioned equipment; • Develop a system management manual; and • Have a contract in place for a near-warranty end, or post-occupancy, review.

This credit expands the role of the CA to include review of the design, construction documents, and submittals beyond the tasks required by Prerequisite 3.3.1. In addition, the CA must develop a system and energy management manual to help school facility staff understand the equipment and operating procedures. The commissioning services must be performed by an independent entity — one that is separate from both the design firm and the contractors. For continuity in the commissioning process, NY-CHPS recommends that the same CA be selected to perform all commissioning-related tasks.

1. *Conduct a focused review of the design prior to the construction documents phase*: This review early in the design process should be focused on an assessment of how well the design meet's the owner's design intent. An assessment should be made as to how the design meets the functionality, utility performance, maintainability, sustainability, cost and indoor environmental quality requirements outlined in the design intent. Evidence of the review must be documented in the commissioning report.

   It is important to include maintenance personnel and facility managers in this review. These are the staff who are familiar with design elements that affect operability and maintainability are sometimes overlooked, but they often add tremendous insights into the process.

2. *Conduct a focused review of the construction documents when close to completion*: This review should be conducted prior to issuing the construction documents for bid. This review should at a minimum address the following questions:

- Does the design meet the owner's design intent? (as described above)
- Does the design allow for proper maintenance access?
- Do the construction documents clearly detail the construction requirements?
- Do the construction documents clearly define the commissioning requirements?

3. *Evidence of the review is to be documented in the commissioning report.*
4. *Conduct a selective review of contractor submittals of commissioned equipment*: Contractor submittals for the systems and equipment included in the commissioning scope must be reviewed by the CA in conjunction with the designer's review. The review must focus on the ability of the submitted product to meet the owner's requirements and review comments must be provided to the owner and the design team.
5. *Develop a systems management manual*: This manual is intended to help future operating staff to understand and optimally operate the commissioned systems. The facility staff should be trained in the use and function of this manual.
6. *Conduct a near-warranty end, or post-occupancy, review*: This review is intended to bring the design, construction, commissioning and O&M staff together to solicit the O&M staff comments, suggestions, and areas of concern regarding the systems in their first year of operation. Any warranty items should be identified and a plan for resolution developed.

Documentation

Copy of the signed commissioning services contract documenting that the commissioning authority will: a) conduct a focused review of the design prior to the construction documents phase; b) conduct a focused review of the construction documents when close to completion; c) conduct a selective review of contractor submittals of commissioned equipment; d) develop a systems manual; and e) conduct a near-warranty end, or post-occupancy, review.

Note: A systems manual must contain the items below (as recommended by LEED Version 2.2). Some items may be provided by the Commissioning Authority in the commissioning report. If this is the case, then those items need not be repeated in the systems manual:

- Final version of the owner's project requirements and basis of design.
- As-built sequences of operations for all equipment as provided by the design professionals and contractors, including time-of-day schedules and schedule frequency, and detailed point listings with ranges and initial set points.

- Ongoing operating instructions for all energy- and water-saving features and strategies.
- Functional performance tests results (benchmarks), blank test forms, and recommended schedule for ongoing benchmarking.
- Seasonal operational guidelines.
- Recommendations for recalibration frequency of sensors and actuators by type and use.
- Single line diagrams of each commissioned system.
- Troubleshooting table for ongoing achievement of the owner's project requirements.
- Guidelines for continuous maintenance of the owner's project requirements (operational requirements) and basis of design (basis of operation).

Post-Construction Documentation

In addition to Post-Construction Documentation of Energy Prerequisite: Third-Party Commissioning, add to the commissioning report the following items:

- A copy of the systems manual.
- A letter or field report documenting the 10-month warranty meeting, issues identified, date, people in attendance, and outstanding issues.

Resources:

CHPS *Best Practices Manual*, Volume II: Guideline GC5: Contractor Commissioning Responsibilities.

LEED-NC *Reference Guide Version 2.2:* Energy and Atmosphere Credit 3: Enhanced Commissioning.

ASHRAE Guideline 1-1996: The HVAC Commissioning Process

ASHRAE Guideline 4-1993: Preparation of Operations & Maintenance Documentation for Building Systems

3.3.7 Credit: Energy Management System Monitoring

2 points	Install parts of an open protocol energy management system (EMS) that provides enhanced monitoring capabilities. Ensure that the system has the following attributes: sensors (as defined below), points matrix, trend capabilities, system architecture (as defined below), data storage, and operator interface (as defined below). Develop a plan addressing trend logging, operator training, and data analysis as detailed in the documentation requirements for this credit. The plan should explain how the collected data will be used to improve building operation as related to energy efficiency.

Energy management systems can potentially save significant energy, but only if the staff understands how to operate them. With EMS installation, proper training of school district staff is absolutely critical. The school district must be prepared to budget for staff training and for training new staff when those knowledgeable about the EMS leave employment.

Monitoring capabilities of the EMS should allow for comparison between various types of building loads throughout all spaces of the school. This information is valuable and can be used to manage and optimize energy use. By trending and monitoring the building operation, any deviation from the design operation can be identified and corrected before an impact on occupant comfort and energy performance of the building is created. Building performance can also be optimized by longer-term trending, observation of performance characteristics, and benchmarking performance against expected operation.

The EMS should comprise the following:

1. Sensors should be provided as follows:
   - Sensors to trend outdoor air temperature and indoor space temperatures.
   - Sensors to monitor and trend equipment status for all equipment with motors greater than ½ hp.
   - Indication and trending of damper and valve commanded position.
   - Sensors to monitor building electrical, natural gas, and heating oil demand and consumption.
   - Sensors to monitor indoor and outdoor CO_2.
   - Sensors to monitor and *trend* (create trend logs) controlled variables at the operator interface. Control variables may include air and/or water flow, temperature, pressure, CO_2, and pump or fan speed.
   - Relevant multiplexed data from microprocessors located in chillers, boilers, humidifiers, VAV box controllers, variable speed drives, and other HVAC equipment with multiplexing capabilities may be used in lieu of specifying separate sensors.
   - Wells and other ports must be specified for the installation of calibration devices to facilitate calibration of sensors.
2. *Points Matrix*: A *points matrix* including all hardwired input and output devices connected to the automation system, all set points, and upper and lower control limits.
3. *Trend Capabilities*: Trend requirements including a trend point list and preprogrammed sample of point (performed by controls contractor), sample rate, storage interval, upload interval, custom trend abilities, alarms, and automated trend data review and notification (automated diagnostics).
4. *System Architecture:* A system architecture capable of allowing sampling of these points to facilitate building commissioning and diagnostics without significantly affecting system performance.
5. *Data Storage*: A data storage system with adequate capacity to record trend data for use by building operators. Data export requirements must facilitate user-friendly data access and manipulation.
6. *Operator Interface*: An operator interface designed for remote/web access, monitoring requirements, trend-log reporting and diagnosing building problems through a user-friendly interface. This includes providing a visual (non-text based) operations and reporting interface to facilitate rapid system assessment that utilizes color coding, diagrams of floor plans and graphing capabilities.

Exceptions:

- The EMS does not need to address unit heaters, cabinet heaters, radiation or convectors located in vestibules, storage rooms, janitor closets, and other unoccupied areas.
- Natural gas and heating oil demand sensors are not required on buildings less than 50,000 ft^2.

Source: Advanced Buildings Benchmark Version 1.1, by the New Buildings Institute, Inc. pp. 38–39.

Documentation

1. Reference specification sections that show compliance with this requirement. Designate the CSI number, section, and page number.
2. Letter of intent signed by the Superintendent and the maintenance department head explaining: (a) who will be trained on the EMS; (b) who will do the training; (c) what trend-logging data will be collected; and (d) plans for training the next EMS operator in case of staff turnover.
3. Copy of a plan for monitoring and taking action based on data collected. That is, a plan explaining how the data collected from the system will be used for improving the efficiency and maintenance of the HVAC and hot water systems while maintaining Indoor Air Quality and occupant comfort levels, signed by the facility or maintenance department head.

3.3.8 CREDIT: SUBMETERING

2 points	Install a submetering system for major fuel loads such as boilers and hot water heaters, as well as major electrical loads such as lighting loads and plug loads. Integrate the data collected from the submetering systems with the energy management system. Develop a plan explaining how submetered data will be used to improve energy system management. The plan may be included as part of the documentation required for the above.

Documentation

Develop a plan for monitoring loads and taking action based on data collected—signed by the facility or maintenance department head. This may be included as part of the EMS documentation requirements (#3 above).

Resources

School Facilities Manual, Washington State Office of the Superintendent of Public Instruction, 4th Edition, March 2000, available online at: http://www.k12.wa.us/SchFacilities/pubdocs/SFMANUAL/intro.pdf

Case Study: Early Childhood Center

All major electrical, natural gas and water systems within the building are submetered. The purpose of the submetering system is: (1) to provide a basic understanding of the amount of natural gas, electricity and water used in various building systems; (2) to confirm that systems are functioning as designed and modeled; (3) to provide a benchmark for each system's performance for maintenance staff; (4) to educate maintenance staff, teaching staff, and students regarding changes in energy demand; (5) to enable competitive energy conservation; (6) to provide input into the school's environmental curriculum; and (7) to provide input for the Building Management System.

4 MATERIALS (26 Points, 20%)

Overall Purpose of this Section: Increase building components durability; reduce the amount of construction and occupant waste entering the landfill; and promote the efficient reuse of materials and buildings. To divert the considerable amount of construction and demolition (C&D) waste, produced from construction and renovation projects, from landfills to beneficial uses and increase the market for construction and demolition waste-derived materials.

4.1 MATERIALS DURABILITY

Purpose: Select buildings materials based upon a life-cycle cost (LCC) analysis, using the total cost of ownership including maintenance and replacement costs. Decisions should not be based solely on initial cost (possible costs associated with emissions produced during manufacturing or disposal are not included the LCC analysis described here). School bonds to build school facilities extend over long period, often up to 30 years. The buildings must last much longer than the time necessary to repay the loans. School facilities must be durable and easy to maintain. Durable and low-maintenance flooring and wall finishes in high traffic areas are particularly important.

School districts may use a variety of programs to help calculate the LCC of various options. A particularly good program — available free, in the public domain and used for many years — is BLCC 5.3-06. The Building Life-Cycle Cost Program BLCC 5.3-06 is a program developed by the National Institute of Standards and Technology (NIST) to provide computational support for the analysis of capital investments in buildings. BLCC 5.3-06 is a windowed version of its predecessor, the DOS-based BLCC 4.9-06. It can be downloaded at:

http://www1.eere.energy.gov/femp/information/download_blcc.html

The BLCC computer programs conduct economic analyses by evaluating the relative cost effectiveness of alternative buildings and building-related systems or components. Typically, BLCC software is used to evaluate alternative designs that have higher initial costs, but lower operating-related costs over the project life than the lowest-initial-cost design. The LCC of two or more alternative designs are computed and compared to determine which has the lowest LCC and is therefore more economical in the long run. BLCC also calculates comparative economic measures for alternative designs, including: Net Savings, Savings-to-Investment Ratio, Adjusted Internal Rate of Return, and Years to Payback. The software can evaluate federal, state, and local government projects for both new and existing buildings.

4.1.1 PREREQUISITE: WALLBOARD AND ROOF DECK PRODUCTS

Prereq	All interior and exterior wallboard and roof deck products must be mold resistant according to published test results using ASTM test procedures listed below.

Since many different types of water damage may occur — from roofs, windows, water pipes or flooding — some types of wall systems and roof deck materials can grow mold in areas that cannot be seen. During the life of a school, student health and maintenance costs will both benefit from wall and roof systems that are mold resistant. Specifying mold-resistant products will increase durability by reducing the frequency of having to tear out and rebuild wall and roof systems that have become damp and started to grow mold.

Resources

G21-02 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

D4300-01 Standard Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi

D3273-00(2005) Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

D6329-98(2003) Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers

D2020-92(2003) Standard Test Methods for Mildew (Fungus) Resistance of Paper and Paperboard

C1338-00 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings

G21 and D3273 are the ones most frequently used by gypsum board manufacturers.

Documentation

Copy of the wallboard mold-resistance certification.

4.1.2 CREDIT: FLOOR SYSTEMS BASED ON LCC

2 points	High traffic-area flooring: Select high traffic-area flooring materials based on the lowest LCC analysis. Select materials that are durable (to withstand heavy use without requiring frequent replacement) and that are easy to clean to limit maintenance costs.
1 point	Classroom flooring: Select classroom flooring materials based on the lowest LCC analysis. Select materials that are durable and easy to maintain. Consider also materials that reduce background noise and that provide thermal insulation for the floor.
1 point	Special use classrooms or other special-use flooring: Select special use room flooring materials based on the lowest LCC analysis. Select materials that are appropriate for the special needs of the space. Select materials that are durable and easy to maintain. Special use areas include cafeterias, gyms, science rooms, art, dance, shop, or other special needs areas with high traffic or subject to frequent material spills.

Flooring in high performance schools should be durable to withstand heavy use without requiring frequent replacement. It should be easy and inexpensive to maintain. Flooring materials should contribute to healthy indoor air quality – materials, adhesives, waxes, and cleaners should produce low VOC emissions, and flooring materials should not contribute to mold growth or air-borne contaminants. Designers should seek to match the appropriate product to use and need. High traffic areas such as hallways and corridors often require different flooring materials from classrooms or other special use rooms. Whenever possible, choose materials made of recycled content and that can be recycled.

The LCC of flooring materials is particularly important in schools as the total cost of floor maintenance can be significantly more than the initial or replacement cost of the flooring materials. Over the lifespan of a floor, maintenance costs can exceed the initial installation costs by a factor of ten. Replacement costs are also dependent on the useful life of each product. Materials such as broadloom carpet or vinyl composition tile (VCT) may be much less expensive to install initially, but they require more frequent replacement and more maintenance, so their LCC is often higher than products such as epoxy terrazzo or vinyl composition tufted textile (VCTT) carpet.

Match Traffic Patterns

Flooring selection in schools must match traffic patterns. High traffic zones in schools include entryways, main circulation corridors, and cafeterias. Medium to low traffic zones may include: classrooms, special use classrooms, gymnasiums, bathroom and locker rooms, assembly halls, and administrative offices. Each of these spaces may require flooring with specific attributes.

1. Identify high traffic areas including primary connectors and multifunction spaces.
2. Understand the usage patterns of a typical classroom. A typical classroom is generally considered to be a medium to high use area.
3. Identify special use classrooms or other spaces with special and unique flooring needs. These may include music rooms, art classrooms, shop classrooms, dance rooms, or others spaces where the performance of the flooring material must differ from a typical classroom.
4. Consider maintenance and serviceability for all floors.
5. As required in the prerequisite of the IEQ section below, walk-off mats will trap part of the dirt that normally enters a school and will extend the life of all flooring.

LCC Factors

- **Carpet:**

1. Traditional broadloom carpet has a low first cost but needs to be cleaned often with a quality vacuum cleaner. It allows moisture to penetrate the backing and tends to grow mold once it becomes moist. It will act as a reservoir for allergens, dust, mold spores and other toxins. Broadloom carpet almost always needs replacement in less than 15 years.
2. Current manufacturing technologies allow the production of carpeting with smaller, tighter weaves that trap less dirt and debris. They can be manufactured with a waterproof backing to resist moisture penetration, and produce low or no VOC's. Some are fully recycled at the end of their useful life as a new carpet product, thereby minimizing waste. One example of current technology is Vinyl Composite Tufted Textile. VCTT carpet is more expensive but it meets the above criteria, and is available with a 25 year non-prorated limited warranty.

Schools face constant pressure on maintenance and operations budgets, and if regular and effective carpet maintenance cannot be assured, carpeting should not be used. In those situations where it's acoustical, thermal, and other benefits outweigh its potential environmental costs, it is recommended that a product with no or low VOC content, manufactured with a waterproof backing in a low pile, dense loop fashion be selected. This will help prevent trapped allergens, and resist mold growth.

All carpeting must be cleaned regularly with a Certified High Performance Vacuum Cleaner meeting the Green Label criteria developed by the Carpet and Rug Institute, and mandated by the *Guidelines for the procurement and use of environmentally sensitive cleaning and maintenance products for all Public and Nonpublic elementary and secondary schools in New York State.*

- **VCT:** Vinyl composition tile (VCT) is inexpensive to install and relatively easy to clean. It usually requires replacement within 15 years and also requires periodic finishing.
- **Ceramic tile/terrazzo:** Ceramic tile and terrazzo are the most expensive to install but can last the life of the building, often more than 50 years. They require very little maintenance and hold up very well in areas with moisture (including moisture from beneath the slab). Where "softer" surfaces are desired for sound deadening, such as in classrooms, it may be desirable to use area rugs (which can be easily washed or replaced) and acoustic ceiling panels. Epoxy terrazzo floors often have the lowest LCC.

- **Other:** Wood or bamboo floors have a higher first cost, but often have low maintenance and a good LCC. Quarry tiles in kitchens and rubber flooring in gyms can also be good alternatives. Concrete flooring has a relatively high first cost, but depending on the type of sealing and maintenance designed into the specific concrete floor, it can have a very good LCC. Linoleum can be an excellent substitute for VCT. However, some linoleum products do produce a noticeable smell, even after years of use. Availability of linoleum can be limited in the United States.

Documentation

1. Use the NIST analysis program BLCC5.3-06 or another LCC model to perform an LCC analysis for all high traffic flooring, classroom flooring, and special use classroom flooring. Print and attach a copy of the completed reports.
2. Include a short description of the flooring materials selected. If the flooring selected for an "exception" area does not have the lowest LCC, develop a brief explanation of why the flooring was selected.
3. Include a floor plan identifying the location of individual floor finishes. Identify all high traffic areas. Identify any special use classrooms/rooms with special flooring needs.

Resources

http://www1.eere.energy.gov/femp/information/download_blcc.html

NCEF: National Clearinghouse for Educational Facilities. Life Cycle Cost Estimating for Educational Facilities (http://www.edfacilities.org/rl/lifecycle.cfm)

Flooring in High-Traffic Zones by Thomas Neff, REFP (http://www.peterli.com/archive/spm/883.shtm)

National Best Practices Manual for Building High Performance Schools, U.S. Department of Energy (http://www.energysmartschools.gov).

4.1.3 CREDIT: INTERIOR WALL SYSTEMS BASED ON LCC

2 points	High traffic-area interior walls: Select high traffic-area interior finishes based on the lowest LCC analysis. Select materials that are durable (to withstand heavy use without requiring significant maintenance) and that are easy to clean to limit maintenance costs. Materials must be capable of withstanding moisture to reduce the likelihood of mold.
1 point	Classroom interior walls: Select interior finishes for classrooms based on the lowest LCC analysis. Select materials that are durable and capable of withstanding moisture to reduce the likelihood of mold. Avoid paper-faced gypsum products wherever possible.
1 point	Special Use Classroom Interior Walls: Select special use classroom interior finishes based on the lowest LCC analysis. Select materials that are appropriate for each special use classroom. Explain how the materials are durable and easy to maintain. Special use classrooms may include gyms, science rooms, art, dance, shop, or other special use areas.

The selection of materials for interior walls can have a significant impact on both the maintenance requirements and indoor air quality in schools. Materials selections and wall systems must be selected using an LCC analysis as the periodic maintenance and replacement costs associated with interior walls can easily outweigh savings from a lower initial cost. Interior finish selections in high traffic areas such as hallways are particularly important to control maintenance costs. Interior wall systems must also have the ability to recover from accidental exposure to moisture in the event of a roof or plumbing leak.

LCC Factors

- **Gypsum:** Gypsum interior walls usually have the lowest first cost, but because they can be scratched or damaged relatively easily, and because they are sometimes susceptible to damage and mold growth, they often have a higher LCC.
- **Masonry:** Masonry construction usually has a higher first cost than gypsum. It usually resists mold and damage very well, contributing to a lower LCC. Designers should work with construction cost estimators to determine accurate construction cost estimates. In some cases masonry construction is no more costly than steel stud walls with gypsum.

Avoid Paper Faced Gypsum Wall Board

Interior wall assemblies must have the ability to recover from exposure to moisture in the event of a roof or plumbing leak. Moisture must be controlled regardless of whatever wall material is selected, however, not all materials can recover easily from exposure to moisture. Concerns about mold and its impact on IAQ have increased in recent years. Given the right conditions, mold will grow on just about any surface. However, the increased use of paper-faced gypsum sheet products in school construction has provided a source of food for mold growth. Even the mold-resistant paper-faced gypsum products may experience mold growth when exposed to moisture for extended periods of time.

Alternatives to traditional paper faced gypsum sheet products include those specifically designed to withstand mold. A number of manufacturers are producing paperless interior wallboard products that are suited for moisture-prone interior applications.

Documentation

1. Use the NIST analysis program BLCC5 or another LCC model to perform an LCC analysis for all major interior wall systems. Print and attach a copy of the completed reports.
2. Include a short description of the wall systems selected. If the interior walls selected for an "exception" area do not have the lowest LCC, develop a brief explanation of why the system was selected.
3. Include a floor plan identifying the location of wall finishes. Identify all high traffic areas. Identify any special use classrooms / rooms with special interior wall needs.

Resources

http://www1.eere.energy.gov/femp/information/download_blcc.html

NCEF: National Clearinghouse for Educational Facilities. Life Cycle Cost Estimating for Educational Facilities (http://www.edfacilities.org/rl/lifecycle.cfm)

National Best Practices Manual for Building High Performance Schools, U.S. Department of Energy (http://www.energysmartschools.gov/sectors/ess/index.asp).

4.1.4 Credit: Exterior Wall Systems Based on LCC

2 points	The selection of exterior wall systems must be based on the lowest LCC analysis, including maintenance and replacement costs. Exterior wall systems must be moisture resistant.

LCC Factors

Many different exterior wall systems are available. The following are some of the most common:

- **Concrete Masonry**: Concrete masonry, single width or brick faced cavity wall is a material-efficient, high strength, durable system that provides energy-efficient mass, high fire and sound transmission resistance, and low maintenance. The initial cost may be higher, but the durability and low-maintenance result in very good life-cycle costs.

- **Metal Stud with Brick Veneer**: Metal stud construction has an initial lower cost, but this type of construction is less durable and is prone to moisture issues, which can result in mold growth and loss of insulating value. Due to maintenance costs, this system has a higher life cycle cost.

- **Exterior Insulation Finish System (EIFS):** EIFS walls include exterior insulation over metal studs or masonry. Initial costs are moderate, but life cycle costs tend to be higher due to low durability and higher maintenance costs.

- **Pre-cast Concrete:** Pre-cast panels with gypsum on the inside are usually slightly more expensive than walls built with brick using steel studs or CMU. They require re-caulking, patching and cleaning, but generally, their maintenance costs are low compared to many alternatives.

Vapor Barriers

The importance of well designed and correctly installed vapor barrier systems cannot be overstated. Prevention of moisture migration through walls is critically important to a high performance building. Moisture in wall cavities can render insulation ineffective and promote mold growth, leading to increased maintenance and utility costs as well as leading to poor indoor air quality.

Avoid Paper Faced Gypsum Wall Board

Exterior wall assemblies must have the ability to recover from exposure to moisture. Moisture must be controlled regardless of material, however, not all materials can recover easily from exposure to moisture. Concerns about mold have increased in recent years. Given the right conditions, mold will grow on just about any surface. However, the increased use of paper-faced gypsum sheet products in school construction has provided a source of food for mold growth. Even the mold-resistant paper-faced gypsum products may experience mold growth when exposed to moisture for extended periods of time.

Alternatives to traditional paper faced gypsum sheet products include those specifically designed to withstand mold. A number of manufacturers are producing paperless exterior wallboard products that are suited for moisture-prone applications.

Documentation

1. Use the NIST analysis program BLCC5 or another LCC model to perform an LCC analysis for all exterior wall systems. Print and attach a copy of the completed reports.
2. Include a short description of the wall materials selected.

Resources

http://www1.eere.energy.gov/femp/information/download_blcc.html

NCEF: National Clearinghouse for Educational Facilities. Life Cycle Cost Estimating for Educational Facilities (http://www.edfacilities.org/rl/lifecycle.cfm)

National Best Practices Manual for Building High Performance Schools, U.S. Department of Energy (http://www.energysmartschools.gov/sectors/ess/index.asp).

4.1.5 Credit: Roof Systems Based on LCC

2 points	Select roof systems based upon the lowest LCC analysis.

The selection of roofing systems must 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.

LCC Factors

- 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

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.

Resources

http://www1.eere.energy.gov/femp/information/download_blcc.html

CEF: National Clearinghouse for Educational Facilities. Life Cycle Cost Estimating for Educational Facilities (http://www.edfacilities.org/rl/lifecycle.cfm)

National Best Practices Manual for Building High Performance Schools, U.S. Department of Energy (http://www.energysmartschools.gov/sectors/ess/index.asp).

4.1.6 Credit: Other Systems Based on LCC

2 to 6 points	Select other systems based upon the lowest LCC analysis. Other major systems may benefit from the same lowest LCC analysis used above. Up to three additional major systems (each at least three percent of total construction cost) may be chosen based on the lowest LCC for two points each.

As with the major systems above, the selection of other major systems based on LCC will improve the performance of the facility over time.

This credit must not duplicate any credit earned for superior energy performance. Simply choosing a high-efficiency chiller or boiler, for example, will not earn credit here. By including maintenance and replacement costs, however, this LCC analysis can earn credits for major

HVAC and other systems. For example, if a high-efficiency modular boiler system has a low operating cost and an expected life of 15 to 20 years, it might not have an LCC as good as a high-efficiency geothermal heat pump system with even lower maintenance costs and a well-field life of more than 40 years. Similarly, aluminum-clad wood, high-efficiency windows may have a combination of low maintenance, long life and energy efficiency that would have the lowest LCC.

Documentation

1. Use the NIST analysis program BLCC5 or another LCC model to perform an LCC analysis for the additional major systems. Print and attach a copy of the completed reports.
2. Include a short description of the systems selected.
3. Include a floor plan identifying the location of the systems.

Resources

http://www1.eere.energy.gov/femp/information/download_blcc.html

NCEF: National Clearinghouse for Educational Facilities. Life Cycle Cost Estimating for Educational Facilities (http://www.edfacilities.org/rl/lifecycle.cfm)

National Best Practices Manual for Building High Performance Schools, U.S. Department of Energy (http://www.energysmartschools.gov/sectors/ess/index.asp).

4.2 Waste Reduction

4.2.1 Prerequisite: Storage & Collection of Recyclables

Prereq.	The building/school must meet local requirements for recycling; AND, provide an easily accessible area serving the entire school that is dedicated to the separation, collection, and storage of materials for recycling, including — at a minimum — paper (white ledger and mixed), cardboard, glass, plastics, and metals. Display posters near the recycling area for education. Ensure that receptacles are sealed to exclude pests.

Attempt to remove the following materials from the solid waste stream: aluminum cans, white paper, corrugated cardboard, single polymer plastics, glass bottles, and discarded cathode ray tubes (i.e., televisions and computer monitors). Designers should designate areas in the school where these materials can be handled and sorted. For guidelines on spaces for storage and handling of recyclable material, see the California Integrated Waste Management Board's *Recycling Space Allocation Guide* — go to: http://www.ciwmb.ca.gov/publications/localasst/31000012.doc

Early in the building occupancy programming, be sure to reserve space for recycling functions and show areas dedicated to the collection of recycled materials on floor plans. Consider the question of how recyclable materials will be collected and removed from classrooms, teachers' prep rooms, and offices. When recycling bins are used, they should be able to accommodate a

75% diversion rate (from normal waste basket contents) and be easily accessible to students and teachers as well as custodial staff and recycling collection workers. Consider bin designs that allow for easy cleaning to avoid health issues.

Documentation

1. Plans showing recycling collection area and storage bins and/or dumpsters
2. A description of how recyclable materials will be removed from classrooms, teachers' prep rooms, and offices, and how directions for separating recyclable materials will be communicated to teachers, students, and custodians.

Resources

California Integrated Waste Management Board Recycling Space Allocation Guide

http://www.ciwmb.ca.gov/publications/localasst/31000012.doc

4.2.2 CREDIT: SITE CONSTRUCTION WASTE MANAGEMENT

1 point	Recycle, reuse, or salvage at least 50 % (by weight) of non-hazardous construction and demolition waste, not including land clearing and associated debris.
OR 2 points	Recycle, reuse, or salvage at least 75 % (by weight) of non-hazardous construction and demolition waste, not including land clearing and associated debris.

This credit encourages a reasonable percentage of 50 % diversion of non-hazardous construction and demolition wastes from new construction and renovation projects. For an additional point, the credit sets a slightly more ambitious but achievable diversion rate of 75 %.

Waste Management Plans

Successful salvage, recycling, and diversion of construction and demolition materials is usually the result of a well thought out waste management plan and on-site training for contractors and subcontractors. Develop and specify a waste management plan that identifies:

1. The diversion percentage goals for construction and demolition (C&D) wastes, e.g., 50% or 75% of all construction and demolition waste materials.
2. Deconstruction, salvage, and recycling/reuse strategies and processes, e.g., scheduling of different stages of deconstruction to best remove recyclable or salvageable materials intact, for example.
3. Methods of on-site communication directing the contractors and sub-contractors about what, how, when, and where to recycle.
4. Licensed haulers and processors of recyclables.
5. Documents needed to show waste diversion, e.g., weight tickets for all wastes removed from the site including recycled and salvaged materials.
6. A method for collecting all recycling and waste data and organizing for an audit of the achieved recycling rates on the project.

See the *Recycling Construction and Demolition Wastes, a Guide for Architects and Contractors*, (http://www.architects.org/emplibrary/CD_Recycling_Guide.pdf). The Vermont Waste Management Division also provides tips for handling C&D wastes: http://www.anr.state.vt.us/dec/wastediv/recycling/planning.htm

Compliance calculations for this credit must be based on weight. Many recycling and landfill facilities weigh incoming materials. Shipments that cannot be weighed can be estimated based on their volume and density.

Recycle Rate (%) = [Recycled Waste [Tons] / (Recycled Waste [Tons] + Garbage [Tons])] x 100

Note: DO NOT include materials classified as hazardous wastes in these calculations.

Documentation

1. Specifications: Specify that a Construction Waste Management Plan will be completed by the general contractor and that it will detail the following components:

   The diversion percentage goals for C&D wastes, e.g., 50% or 75% of all C&D waste materials.

   Deconstruction, salvage, and recycling/reuse strategies and processes, e.g., scheduling of different stages of deconstruction to best remove recyclable or salvageable materials intact, for example:

   - Methods of on-site communication directing the contractors and sub-contractors about what, how, when, and where to recycle.
   - Licensed haulers and processors of recyclables.
   - Documents needed to show waste diversion, e.g., weight tickets for all wastes removed from the site including recycled and salvaged materials. If items are removed, and no weight tickets are generated, be sure to document the materials and date, estimate the weight and volume of the materials, and add them into the overall total for waste or salvaged/recycled material removed from the site.
   - A method for collecting all recycling and waste data and organizing for an audit of the recycling rates on the project.
2. Specifications must also state a target construction and demolition recycling rate.

Post-Construction Documentation

Collect and supply all weight tickets for construction and demolition debris removal. For material that is removed from site, and does not generate a waste ticket, provide an estimate of the weight and volume of materials removed. The documentation should support the level of waste diversion claimed in the point.

Resources

Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors (http://www.architects.org/emplibrary/CD_Recycling_Guide.pdf)

CHPS *Best Practices Manual*, Volume II: Guideline GC2: Construction and Demolition Waste Management.

LEED-NC *Reference Guide Version 2.2:* Materials Credit 2: Construction Waste Management.

4.3 SUSTAINABLE MATERIALS

4.3.1 CREDIT: BUILDING REUSE 75%

1 point	Reuse large portions of existing structures during renovation or redevelopment projects. Maintain at least 75% of existing building structure and shell (exterior skin and framing, excluding window assemblies). Hazardous materials that are remediated as part of the project scope, and elements requiring replacement due to unsound material condition must be excluded from the calculation of the percent maintained.

Reusing parts of the building can save significant money and resources, while greatly reducing the amount of construction waste. When materials are re-used, the environmental benefits begin with resource savings and extend through the entire lifecycle of the material. This includes the fact that less energy is spent extracting, processing, and shipping the materials to the site. Depending on the amount of building reused, school districts can significantly reduce their construction and material costs. It is important to remember that the building envelope will significantly affect many important high performance areas, such as space programming, energy performance, opportunities for daylighting, and indoor air quality. In addition, care must be taken to ensure that any environmental hazards such as toxins, lead, and asbestos have been identified and their removal addressed. Develop a list of benefits and tradeoffs, and make the decision based upon the overall, integrated design tradeoffs.

Percentage of reused structural materials (foundation, slab on grade, beams, floor and roof decks, etc.) and shell materials (roof and exterior walls) should be estimated in square feet. Average together the structural and shell reuse percentages. The average is used to determine the overall reuse percentage for the building.

Building Reuse (%) = 100 x [Reused (floor + roof area + ground floor/slab) + Reused (exterior wall area excluding window assemblies)] ÷ [Total (floor + roof area + ground floor/slab) + Total (exterior wall area excluding window assemblies)].

Documentation:

1. Demolition plans.
2. Floor plans showing existing elements.
3. Calculations showing amount of reused structural and shell elements.

Resources

LEED-NC *Reference Guide Version 2.2:* Materials Credit 1: Building Reuse.

4.3.2 CREDIT: COMBINED MATERIALS ATTRIBUTES

1–5 points	Record rapidly renewable, salvaged, recycled content, and certified wood materials attributes in a single materials credit. Up to 5 points are available.

“Combined attributes” is the term used to recognized the many facets of environmentally-friendly materials including recycled-content, previously used (salvaged), bio-based, and Forest Stewardship Council certified materials. The credit is designed to capture the value of environmentally-friendly materials even if they are applied to the school project in modest amounts. Materials specified for a school construction project may have more than one environmental attribute and this credit simplifies the process of claiming points for multiple attributes. A spreadsheet and instructions for this credit are both found in the Application Template, which was created to organize documentation for NY-CHPS.

To earn points, fill out the material cost information required in the spreadsheet found in the Applications Template. Calculating a total materials budget can be difficult for projects where labor and materials costs are combined in the cost estimate. To navigate this difficulty, NY-CHPS uses the LEED method of deriving the materials’ cost by assuming that it is 45% of the construction budget. For the particular materials with environmental attributes added to the spreadsheet, you may only insert the materials costs — no labor costs may be included.

Where the percentages total for the combined attributes is less than X.5, then the total should be rounded down to X. Where the credit total is greater than or equal to X.5, then round up to the next whole number. To see how this works, look at an example of a truncated spreadsheet shown on the following page.

Table 1—Sample Materials Attributes Calculation Spreadsheet

Note that bio-based and salvaged materials are not included as attributes due to lack of space.

Materials (by CSI category)	Type of Material with Attribute	Dollar Value of Material ($)	Post-Consumer Recycled Material			Post-Industrial Recycled Materials			Forest Stewardship Certified Wood			Percent Total Cost (%)
Division 6—WOOD AND PLASTICS												
Rough Carpentry	Wood	-		0.2	0.00%		0.1	0.00%		0.6	0.00%	0.00%
Finish Carpentry	Wood	$2,300		0.2	0.00%		0.1	0.00%	100%	0.6	0.14%	0.14%
Architectural Millwork	Wood	$28,100		0.2	0.00%		0.1	0.00%	50%	0.6	0.84%	0.84%
Architectural Casework	Wood	$10,000		0.2	0.00%		0.1	0.00%	50%	0.6	0.30%	0.30%
Division 7—THERMAL & MOISTURE												
Metal Roofing Metal Wall Panels	Aluminum	$20,000	85%	0.03	0.05%		0.03	0.00%		0.6	0.00%	0.05%
Rigid Insulation Homosote Roof Decking	-	$4,700		0.03	0.00%		0.1	0.00%		0.6	0.00%	0.00%
Division 8—DOORS AND WINDOWS												
Doors	Steel	$12,800	85%	0.03	0.03%		0.03	0.00%		0.6	0.00%	0.03%
Doors	Wood	$5,000		0.03	0.00%		0.03	0.00%	100%	0.6	0.30%	0.30%
Windows	Aluminum	$5,000	95%	0.2	0.10%		0.1	0.00%		0.6	0.00%	0.10%
Windows	Wood	$5,000		0.2	0.00%		0.1	0.00%	100%	0.6	0.30%	0.30%
Division 9—FINISHES												
Gypsum Wallboard	Gypsum	$20,500		0.2	0.00%	28%	0.1	0.06%		0.6	0.00%	0.06%
Gypboard—Paper backing	Paper	$5,000	100%	0.2	0.10%		0.1	0.00%		0.6	0.00%	0.10%
Acoustical Ceiling Tiles	Mineral Fiber	-		0.2	0.00%		0.1	0.00%		0.6	0.00%	0.00%
Acoustical Ceiling Tracks	Steel	$5,000	85%	0.03	0.01%	75%	0.03	0.01%		0.6	0.00%	0.02%
	Total:	**$131,000**			**0.30%**			**0.07%**			**1.88%**	**2.25%**

Total NY-CHPS Points Achieved: The 2.25% total achieves a total of 2 points.

Resource Reuse/Salvaged Material

Re-used materials or products are defined as salvaged from a previous use or application and then used in a new use or application with only superficial modification, finishing, or repair. Commonly salvaged building materials include wood flooring/paneling/cabinets, doors and frames, mantels, ironwork and decorative lighting fixtures, brick, masonry, and heavy timbers. Ensure the salvaged materials, especially structural elements, comply with all applicable codes.

Recycled Content Materials

The number and variety of products using recycled-content materials expands every year. Using these materials closes the recycling loop by creating markets for materials collected through recycling programs across the country. It also reduces the use of virgin materials and landfill waste. Recycled-content alternatives exist for all major building materials and surfaces. Recycled content is either a post-consumer (collected from end users) or a secondary material. Secondary (also known as post-industrial or pre-consumer) material is collected from manufacturers and industry. The objective of these materials is to maximize post-consumer recycled content.

Definition of Recycled Post-consumer content from ISO 14021: Material generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of materials from the distribution chain.

Bio-Based Materials

Bio-based materials contain a significant amount of materials from natural fibers, plants stalks and leaves, and plant extractions. Ideally, these materials are grown sustainably and do not result in significant biodiversity loss, increased erosion, and air quality impacts. Products in this category include, but are not limited to, bamboo products, wheat grass cabinetry, and linoleum. Ensure that the products protect indoor air quality and are durable. Wood materials are not available for points as bio-based materials but are available for credit as certified wood.

Certified Wood

Refer to the Forest Stewardship Council guidelines for wood building components that qualify for compliance to the requirements and incorporate them into the material selection for the project.

Other Considerations

Some research indicates harmful health effects attributable to use of vinyl flooring products. New York State's Green Building Tax Credit prohibits vinyl flooring products. There is disagreement nationally about the health effects associated with the manufacture and disposal of vinyl products, including vinyl flooring and other building materials. Since this issue can change quickly as manufacturing and disposal practices evolve, the designer should inquire about these practices at the time of design.

Documentation

Fill out the spreadsheet for Credit: Combined Materials Attributes, which is included in the Application Template. The total value of all the attributes, i.e. the total percentage summed at the far right of the template, is the amount of credit that can be received for Credit: Combined Materials Attributes. Up to 5 points may be achieved under this credit.

For each material listed, include the portion of the specifications calling for environmental attributes of the material. For example, if Forest Stewardship Council (FSC) certified wood is used for all casework on the project, provide the specification calling for the FSC wood in the casework, so that the claim on the template may be verified.

Salvaged material

Exclude all labor costs, all mechanical and electrical material costs, and project overhead and fees. If the cost of the salvaged or refurbished material is below market value, use replacement cost to estimate the material value; otherwise use actual cost to the project. Include the specifications for the salvaged material.

Recycled Materials

Specifications for each recycled material.

Bio-based Materials

Specifications for each bio-based renewable material.

Forest Stewardship Council Certified Wood

Specifications for each certified wood product.

Post-Construction Documentation

- Purchase orders or written estimates for all salvaged material.
- Purchase orders or written estimates for all recycled content materials and for all bio-based materials.
- Purchase orders or written estimates for all wood-based materials indicating which are FSC certified purchases and which are not.

Resources

Old to New: Design Guide, Salvaged Building Materials in New Construction, 3rd Edition (2002) http://www.gvrd.bc.ca/BUILDSMART/pdfs/OldtoNewDesignGuideFull.pdf

CHPS *Best Practices Manual*, Volume II: Material Selection and Research Section;

LEED-NC *Reference Guide Version 2.2:* Materials Credit 3: Materials Re-use.

LEED-NC *Reference Guide Version 2.2:* Materials Credit 4: Recycled Content.

State Agency Buy Recycled Campaign (SABRC) at http://www.ciwmb.ca.gov/BuyRecycled/StateAgency/

California Integrated Waste Management Board (CIWMB) Recycled-content Products Database: http://www.ciwmb.ca.gov/rcp

Forest Stewardship Council web site at: http://www.fscus.org

LEED-NC *Reference Guide Version 2.2:* Materials Credit 7: Certified Wood.

5 Indoor Environmental Quality (32 points, 24%)

5.1 Daylighting & Views

5.1.1 Prerequisite: Access to Views, 70%

Purpose: To improve student productivity through high-quality daylighting designs that minimize glare and direct sunlight penetration. Also, to provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building (views provided by windows contribute to eye health by providing the opportunity for frequent changes in focal distance, which helps to relax eye muscles). Finally, to promote improved visual performance through a high-efficacy, glare-free ambient lighting strategy.

Prereq.	Provide direct line of sight to view glazing from 70% of the floor area of classrooms and administration areas. To qualify, a space must have view glazing area equal to or greater than 7% of the floor area. View glazing only includes window area above 2.5 ft and below 7.5 ft from the floor. The total width of view glazing must be greater than 1% of the floor area. *Exception:* School buildings that share at least two sides with other buildings are exempted from this requirement.

Use the following types of glazing to balance the benefits of views with the need to control energy losses.

View Glazing Types by Exposure	
South	Clear, double, low-e
North	Clear, double, low-e
East/West, unshaded	Tinted, double, low-e
East/West, shaded	Clear, double, low-e

Determine the total floor area of spaces for which this requirement applies by creating a table listing the classrooms and administrative areas. Like spaces may be listed just once. A like space is one with the same physical configuration, including windows.

For each space in the list determine how much of the floor area qualifies for the view credit. Two considerations come into play: the view window area and the total width of the view windows in aggregate. Each of these limits how much of the area qualifies, as explained below:

- To determine the maximum qualifying area based on the view window area, divide the view window area by 7%.

- To determine the maximum qualifying area based on the width of the view windows, divide the total width of view windows by 1%.

For each space, the qualifying floor area is the lesser of the total floor area, either: a) the maximum floor area based on view window area; or b) the maximum floor area based on view window width. Sum the qualifying areas for classrooms and administrative spaces and compare to the total area of these spaces. If it is greater than 70%, then the school qualifies, otherwise it does not.

Documentation

1. Complete the "Access to Views" spreadsheet in the Applications Template. To complete this spreadsheet, you will need the square footage of each classroom and administrative space, the area of view windows per space, and the width of the view windows (added together for each space). Similar spaces may be listed just once. A similar space is one with the same physical configuration, including windows.

   The template will divide the area of view windows by 7% and the width of the view windows by 1%. The template will automatically select the lower value of the two figures and create a sum based on the number of rooms with the same dimensions. Once all the data has been input into the spreadsheet, the template will calculate whether the view space meets the 70% threshold. The same process is used for "Credit: Access to Views 90%," where view access must meet a 90% threshold in order to obtain credit.

For the purposes of this credit, the following rooms are included:

- General classrooms
- Art rooms
- Music rooms
- Science rooms
- Computer rooms
- Special needs, remedial, and collaborative space
- Administration spaces

2. Include drawings of each floor. Classroom and administrative spaces should be labeled to match their names as input into the template.

3. Include a narrative that describes how glare will be avoided, electric lights will be turned off automatically, and proper contrast will be achieved.

Example

Q

A new school has 30 similar classrooms each with a floor area of 960 ft². Each classroom has view windows with a total area of 60 ft² and a total width of 9 ft. The school also has 6 larger 1,040 ft² classrooms with 70 ft² view windows with a total width of 10.5 ft. The 2,600 ft² multi-purpose room has 200 ft² of view windows with a total width of 25 ft. The 2,000 ft² administration area has 150 ft² of view windows with a total width of 18 ft. Does this school qualify for the view windows credit and how much of the floor area qualifies as having view windows?

A

The total floor area of classrooms, administration areas and the multi-purpose room is 39,640 ft² (see column D in Table 9). To qualify for this credit, at least 70% of the floor area of these spaces must have view windows, or a total of 27,748 ft². The qualifying floor area must be determined for each space based on the total view window area and the total width of the view windows. For the smaller classrooms, the maximum qualifying floor area based on view window area is 857 ft² or 60 ft² divided by 7%. The maximum qualifying floor area based on window width is 900 ft or 9 ft divided by 1%/ft. The qualifying area is the smaller of these numbers or 857 ft². For the larger classrooms, the qualifying area is 1,000 ft², 2,500 ft² for the multi-purpose room, and 1,800 ft² for the administration areas. The total qualifying area is 36,010 ft² or 91%. See the table below for details of the calculation.

Space	Size (ft²)	Number of spaces	Total area (ft²)	View window area (ft²)	Maximum Floor Area based on view window area (ft²)	Total width of view windows (ft)	Maximum floor area based on view window width	Qualifying floor area per space (ft²)	Total qualifying floor area (ft²)
Classroom Type 1	960	30	28,800	60	857	9	900	857	25,710
Classroom Type 2	1040	6	6,240	70	1,000	10.5	1,050	1000	6,000
Multi-Purpose Room	2600	1	2,600	200	2,857	25	2,500	2500	2,500
Admin-istration Area	2000	1	2,000	150	2,142	18	1,800	1800	1,800
Totals			39,640						36,010
							Percent Qualifies:		91%

5.1.2 CREDIT: ACCESS TO VIEWS 90%

2 points	Provide direct line of sight to view glazing from 90% of the floor area of classrooms and administration areas. To qualify, a space must have view glazing equal to or greater than 7% of the floor area. View glazing must be clear and only include window area above 2.5 ft and below 7.5 ft from the floor. The total width of view glazing must be greater than 1% of the floor area.

Documentation

The documentation requirements are exactly the same as IEQ "Prerequisite: Access to Views, 70%," with the exception that the threshold for this credit is 90% access to views. Use the Application Template for documentation.

Resources

CHPS *Best Practices Manual*: Volume II: Daylighting and Fenestration Design Chapter.

LEED-NC *Reference Guide Version 2.2*: IEQ Credit 8.2: Views for 90% of Spaces.

5.1.3 CREDIT: DAYLIGHTING IN CLASSROOMS

5 points	To earn this credit, 75% of the classrooms in the school must have a Daylight Autonomy Ratio of at least 40%. For the purposes of this calculation, the Daylight Autonomy Ratio (DAR) is the percent of daytime hours per year when daylight provides adequate illumination and no electric lighting is needed. The DAR is weighted both spatially and temporally.

Daylighting provides significant benefits including:

- Opportunities for improved academic performance.
- Energy savings from decreased lighting loads.
- Improved health: Views provided by windows contribute to eye health by providing frequent changes in focal distance, which helps to relax eye muscles.

California's Public Interest Energy Research Program (PIER) has developed software under its Lighting Research Program to help project designers quantify the daylight entering their buildings. The software was originally developed to guide the placement of photo-sensors in daylit rooms, hence the name, Sensor Placement and Orientation Tool (SPOT). However, this software is now being altered to capture the DAR of all the spaces in the building. The software may be found and tested at: http://www.archenergy.com/SPOT/index.html

Daylighting in classrooms should be uniformly distributed, avoid direct sunlight penetration and provide occupant control of daylight intensity and glare. The MA-CHPS *Best Practices Manual* (Volume II) thoroughly discusses different approaches to classroom daylighting, including the use of clerestories, daylight control devices, and skylighting. Refer to the guidelines in the Daylighting Chapter to create a suitable daylighting strategy. As explained, be sure to design daylighting systems to balance the specific school's lighting, heating and cooling needs.

A large skylight brings natural light into the stairwell of this elementary school and creates an attractive and comfortable environment for students and teachers.

Documentation

Use the SPOT software to show that 75% of the classrooms have a DAR of 40%. For this credit, classrooms are:

- General classrooms;
- Art rooms;
- Music rooms;
- Science rooms;
- Computer rooms; and
- Special needs, remedial, and collaborative space.

Resources:

CHPS *Best Practices Manual*: Volume II: Daylighting and Fenestration Design Chapter.

LEED-NC *Reference Guide Version 2.2*: IEQ Credit 8.1: Daylight 75% of Spaces.

5.2 Lighting Quality

5.2.1 Credit: Visual Performance

2 points	Install an artificial lighting system to enhance occupants' visual performance with pendant-mounted or ceiling mounted direct-indirect, semi-indirect, or totally indirect luminaires mounted parallel to the window wall. Luminaires must use high-efficacy T-8 or T-5 fluorescent lamps with a minimum color-rendering index of 80. Lighting of task areas (chalkboard and whiteboards) can be supplemented with luminaires with a minimum initial system efficacy of 60 lumens per watt.

Glare-free ambient lighting provides an excellent visual environment in which students and teachers can read, write, and interact with their peers. Pendant-mounted and ceiling-mounted "direct-indirect," "semi-indirect," and "totally indirect" luminaires offer low-brightness while providing good definition of objects in the teaching space. The luminance of these lamps is enhanced by white or light colored ceilings, which reflect the light down into the learning space.

This design approach is very energy efficient, using high-efficacy T-8 fluorescent lamps (known also by the name "Super T-8s") and "program start" electronic ballasts. This type of T-8 lamp is readily available through major lamp manufacturers and offers higher light output per watt than standard T-8 lamps. They also have better lumen maintenance over the life of the lamp.

T-5 fluorescent lamps and electronic ballasts are also a good alternative. The T-5 lamps supply higher lumen output than the high performance T-8's. Both types of lamps provide good color quality so that all of the brightly colored projects on the walls show their resilience. If specifying T-5 fixtures, be careful to avoid creating high contrast areas on the ceiling.

In many cases, chalkboard/whiteboard lighting is not needed. When it is used, a fluorescent wall-wash luminaire, with initial efficacy of 60 lumens per watt, provides efficient illumination and enhances the visual quality of the teaching surface.

Energy efficient, direct-indirect lighting reduces lighting power density (LPD) by using less energy to deliver a better quality of light to the space. The recommended approach is to install three rows of "Super T-8" two-lamp suspended direct/indirect luminaires in a typical classroom. In the case of T-5 systems, the recommended approach is to install three rows of T-5 single-lamp suspended direct/indirect luminaires. See MA-CHPS Volume II for more specific direction on lamp layout.

Documentation

Include lighting schedule for all lamps in the following spaces:

- General classrooms;
- Science rooms;
- Computer rooms;
- Special needs, remedial, and collaborative space; and
- Administration areas.

Include plans showing the lamp layout with T-8 and/or T-5 fixtures and rooms highlighted from the list above. If lighting of whiteboards or chalkboards is specified, provide information showing that the luminaires have a minimum initial system efficacy of 60 lumens per watt.

Resources

Advanced Lighting Guidelines: 2003 Edition, http://www.newbuildings.org/lighting.htm

DesignLights™ Consortium Classroom Knowhow™ guide, http://www.designlights.org

5.3 Indoor Air Quality Design

Supplying non-polluted outdoor ventilation air to classroom areas is critical to the protection of good indoor air quality. Ensure that the ventilation system's outdoor air capacity can meet standards in all modes of operation. Note that compliance with code minimums will not ensure good indoor air quality. The following prerequisites and credits are critically important to protecting and maintaining indoor air quality.

5.3.1 PREREQUISITE: WALK-OFF GRILLS/MATS

Prereq.	Provide a three-part, walk-off system for all high volume entryways, and all those adjacent to playing fields and locker rooms, to capture dirt, particulates, and moisture before they enter the building. Outside high-volume entrances, provide grills, grates, etc. to remove dirt and snow. If there is a vestibule, provide a drop through mat system within the vestibule. Inside the entranceway, provide walk-off mats. The recommended length of interior walk-off mats is 15 feet.

Particles tracked into the school on shoes are one of the chief sources of contamination of carpets and floors. Research on school carpeting in particular shows that it can be a reservoir of pesticides, heavy metals, and dirt tracked in on students' shoes.

The best way to keep the school free of dust, dirt, and contaminants is to prevent these unwanted items from entering the building in the first place. It is especially important to protect young school children since they are more likely to sit and play on classroom floors and therefore be exposed to contaminants.

Documentation

1. Specifications — Permanent entryway systems, walk-off mats, and frames (if applicable).
2. Drawings showing location of grates, grills and walk-off mats at all high volume entrances.

5.3.2 PREREQUISITE: FILTER EFFICIENCY

Prereq.	Specify MERV 10 HVAC filtration media.

Filtration media must have a Minimum Efficiency Reporting Value (MERV) of 10 or higher, except for unit ventilator systems, which must have a MERV of 7 or higher.

Note: If IEQ *Credit: Pollutant Source Control: High Efficiency Filters* for MERV 13 filters is fulfilled, it supersedes this filter rating requirement.

Documentation

Specify filters with MERV 10 or higher and, in unit ventilator systems, MERV 7 or higher. This documentation is unnecessary if *IEQ Credit: Pollutant Source Control: High Efficiency Filters* for MERV 13 filters is fulfilled.

Post-Construction Documentation

Photographs during construction, describing compliance with this requirement, and a count of all units requiring filters accompanied by copies of purchase orders for MERV 10 and MERV 7 filters for each unit.

5.3.3 Prerequisite: Drainage

Prereq.	All surface grades, drainage systems, and HVAC condensate drainage systems must be designed to prevent the accumulation of water under, in, on top of, or near buildings. Condensate systems that rely on gravity drainage are strongly preferred to systems that use pumps to move condensate due to the reduced maintenance associated with gravity draining systems. *Note:* If specifying unit ventilator systems, drip pans using evaporation as means of collecting and removing condensate are prohibited.

Due to health risks that can be caused by mold and microbial growth, all surface grades, drainage systems, and HVAC condensate must be designed to prevent the accumulation of water under, in, or near buildings.

Documentation

1. Site plan that shows the grading plan.
2. Diagram of condensate system.
3. Typical detail of condensate drains showing drain trap and gravity drainage system.
4. For univent systems with air conditioning equipment, provide specification language that prohibits evaporation trays.

5.3.4 Prerequisite: Irrigation Design

Prereq.	Irrigation systems must not spray on buildings or equipment.

Permanent irrigation systems that spray on buildings can cause structural damage and mold growth. Do not design irrigation systems in locations where they spray directly on buildings.

Documentation

Plan of irrigation system showing that sprinkler ranges do not intersect with buildings.

5.3.5 Prerequisite: Electric Ignition Stoves

Prereq.	Install only electric ignitions for all gas-fired cooking appliances.

Electric ignition stoves are preferable to stoves that maintain pilot lights burning for ignition purposes. Under certain conditions, the accumulation of carbon monoxide from pilot lights can cause dangerous air quality conditions.

Documentation

Provide specifications for cooking appliances that use electric ignitions to light gas burners.

5.3.6 PREREQUISITE: AIR INTAKE LOCATION: 25 FEET

Prereq.	Locate outside air intake openings a minimum of 25 feet from any hazard or noxious contaminants such as vents, chimneys, plumbing vents, exhaust fans, cooling towers, streets, alleys, parking lots, loading docks, dumpster/recycling areas, bus loops or idling areas. When locating an intake opening within 25 feet of a contaminant source is unavoidable, such opening must be located a minimum of 10 feet horizontal distance and 2 feet lower than the contaminant source. Make sure to locate air intakes at least 2 feet above grade and away from areas of potential snow buildup and away from plantings. Locate with regard to prevailing winds. Be particularly careful to locate air intakes away from areas where school buses and other vehicles may be idling.

Locating air intakes away from sources of potential air pollution will ensure that indoor air quality is not compromised by diesel fumes or exhaust air from ventilation, kitchen, or HVAC systems. Consider both current and future traffic and development patterns and consult the local board of health to locate nearby emission sources.

Documentation

Drawings showing that all air intake openings are more than 25 feet from hazardous and noxious contaminant sources.

5.3.7 PREREQUISITE: DUCT INSULATION

Prereq.	Internally insulated ductwork is prohibited. *Exceptions*: Duct insulation is acceptable if it is between double-walled ductwork that does not expose the insulation to the air stream inside the duct. Also, perforated interior duct walls with interstitial insulation are acceptable for limited distance sound attenuation units for fans.

Duct insulation should be located on the outside of ductwork. Duct insulation found on the inside of ductwork has been known to deteriorate over time, leading to particles in the ducts that can cause indoor air quality problems.

Documentation

Include a brief statement about the ducts that are being specified for the project. Describe how ducts will be insulated on the outside or, alternatively, will be insulated between two linings to prevent IAQ problems.

5.3.8 Prerequisite: Pollutant Source Control, Ducted HVAC Returns

Prereq.	Design ducted HVAC returns to avoid dust and microbial growth issues. The use of ceiling plenum return vents is not acceptable as part of an HVAC system design.

Plenum returns are easily contaminated with dust and microbial growth. Ducted returns help prevent such problems and reduce maintenance and repairs. The performance of plenum returns also tends to degrade over time as access points and cable, pipe or conduit runs are installed, patched and fire rated.

Exception: If an entrance area or another area has unique architectural features (such as vaulted ceilings) that make it extraordinarily difficult to include ducted returns, you may claim an exception for such an area. This exception cannot be used for more than 5 % of the total area of the building. Also, exposed ductwork — such as spiral round painted ductwork — must be considered for these exceptional areas to try to comply with this prerequisite.

Documentation

Specifications for HVAC duct returns. Although it is not typical to write into the specifications that all returns will be ducted, this documentation is required for ease of review.

5.3.9 Credit: Air Intake Location: 50 Feet

1 Point	Locate outside air intake openings a minimum of 50 feet from any hazard or noxious contaminants such as vents, chimneys, plumbing vents, exhaust fans, cooling towers, streets, alleys, parking lots, loading docks, bus loops or idling areas. Make sure to locate air intakes at least 2 feet above grade and away from areas of potential snow buildup and away from plantings. Be particularly careful to locate air intakes away from areas where school buses and other vehicles may be idling.

Locating air intakes away from sources of potential air pollution will ensure that indoor air quality is not compromised by diesel fumes or exhaust air from ventilation, kitchen, or HVAC systems. Consider both current and future traffic and development patterns and consult the local board of health to locate nearby emission sources.

Documentation

Drawings showing that all air intake openings are more than 50 feet from hazardous and noxious contaminant sources.

5.3.10 Credit: Low-Emitting Materials

1–5 points	Specify materials that adhere to CHPS Material Specifications Section 1350 or that are certified by the GREENGUARD Environmental Institute™ in one or more of the categories listed below. One point is possible in each category, with a maximum of five points for this credit. • Adhesives, sealants, and concrete sealers (at least 50% of specified products in this category must comply with Section 1350 to obtain a point); • All carpet systems and associated adhesives; • All resilient flooring and associated adhesives; • All paint that covers interior walls, floors and ceilings; • All building insulation (excluding insulation exterior to the building envelope's vapor barrier); • All acoustical ceiling tiles or wall panels; and • All wood flooring, composite wood boards.

Many common indoor building and surfacing materials contain a variety of potentially carcinogenic or toxic chemicals. These chemicals are released into the air and can cause a variety of health problems, from minor irritation to major health problems. Since a single material can off-gas enough toxins to cause health problems, it is important to evaluate and specify materials that are low emitting, non-irritating, nontoxic, and chemically inert. This is especially important in schools because children can be more sensitive to indoor air pollutants than adults.

CHPS has developed sample material specifications to identify materials that will not compromise the health of students and staff. The CHPS material specifications identify over 79 specific chemicals that have been found to impact human health and the maximum emission levels for each. Materials that have been tested and approved are listed in the Compliant Materials Table on the CHPS web site. See: http://www.chps.net/manual/lem_overvw.htm Products that are not listed in the Compliant Materials Table may be tested and added.

GREENGUARD Certification for Children & Schools provides an easy-to-use resource for finding low-emitting products and materials for use in schools. Products, which become certified under GREENGUARD for Children & Schools and the GREENGUARD emissions standard will be listed in the online GREENGUARD product directory at: http://www.greenguard.org/DesktopDefault.aspx

Documentation:

Include specifications showing brand names of products that are 1350 or GREENGUARD compliant:

1. Adhesives, Sealants, Concrete Sealers: Provide a list of all products in this category; indicate which ones comply with 1350 or GREENGUARD, and show that the number of products that comply is at least 50% of the total.
2. Carpet systems and associated adhesives.
3. Resilient flooring and associated adhesives.
4. Paint covering interior walls, floors and ceilings.
5. Interior insulation.
6. Acoustical Ceiling Tile and Wall Panels.
7. Wood Flooring and Composite Wood Boards.

Post-Construction Documentation

Include purchase orders of all low-emitting materials.

Resources

http://www.chps.net/manual/lem_manufacturers.htm

Greenguard Certification Product Guide (http://www.greenguard.org/DesktopDefault.aspx)

Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, by the California Department of Health Services.

5.3.11 Credit: Pollutant Source Control: Off-Gassing

2 points	Where chemical use occurs, including housekeeping areas, chemical mixing areas, copying/print rooms, photolabs, vocational spaces, science labs, and art rooms, use deck-to-deck partitions with dedicated outside exhaust at a rate of at least 0.50 cubic feet per minute per square foot, no air recirculation, and adequate make up air. These spaces must have negative air pressure, which is defined as an outside exhaust at a rate of at least 0.50 cubic feet per minute per square foot. The spaces must maintain a negative pressure relative to the surrounding rooms and cavities between 5 Pa (0.02 inches of water gauge) and 1 Pa (0.004 inches of water) when the doors are closed. In photolab areas, specify table vents to draw chemical vapors away from the breathing zone of dark room users.

Design to physically isolate activities associated with chemical contaminants from other locations in the building, and provide dedicated systems to contain and remove chemical pollutants from source emitters at source locations. Eliminate or isolate high hazard areas and design all housekeeping chemical storage and mixing areas (central storage facilities and janitors closets) to allow for secure product storage. Design copy/fax/printer/printing rooms with structural deck-to-deck partitions and dedicated outside exhaust systems.

Documentation

1. Specifications — Specialty Exhaust Ventilation Equipment (e.g., table vents) and Floor Plans.
2. A letter signed by a professional engineer explaining how the spaces stated in this IEQ credit are ventilated to maintain a 1–5 Pa negative pressure and exhaust rate of 0.50 cfm/ft^2

Post-Construction Documentation

Measure and document the pressure differences between the room and the surrounding rooms and cavities after commissioning.

5.3.12 Credit: Pollutant Source Control: High Efficiency Filters

3 points	Design the HVAC system with particle arrestance filtration rated at Minimum Efficiency Reporting Value (MERV) of 13 in all mechanical ventilation systems. Install clean filters immediately prior to occupancy.

Filters rated at MERV 13 will ensure very good quality ventilation air by blocking minute particles and allergens. Note: MERV 13 filters do not fit into unit ventilators. Therefore, schools with unit ventilator systems will not qualify for this credit point. Note that the pressure drop may be greater with MERV 13 filters versus filters with lower MERV ratings, and therefore, more energy may be required to draw air through filters. There is often a trade-off between incremental indoor air quality improvements and energy efficiency that design teams should bear in mind. This credit may be especially desirable in environments where outdoor air quality is a serious concern (e.g., close proximity to industrial activity or high vehicle traffic thoroughfares).

Documentation

Specifications for MERV 13 filters in all HVAC systems.

Post-Construction Documentation

Purchase orders of all MERV-13 filters.

5.3.13 CREDIT: AIR FLOW STATIONS

2 points	Provide air flow stations on all outside air intakes of central heating, ventilating and air-conditioning equipment. This system must include data accumulation and be down loadable for print out. Data to accumulate on cubic feet per minute basis at no more than 15 minute intervals. Air flow stations must be calibrated on a yearly basis or as indicated by manufacturer recommendations. Data must be provided to the school district's Health and Safety Committee on a quarterly basis. Information must be kept for at least three years from the date of collection and must be made available to the public upon request.

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Documentation

Design documents that include air flow stations.

5.3.14 CREDIT: CONTINUOUS AIR MONITORING

2 points	Provide a means to collect and analyze air samples in the breathing zone of at least 10 percent of the classrooms on a continuous basis. Components of concern to be analyzed include, but are not limited to carbon monoxide, particulates, radon, total volatile organic compounds, formaldehyde, ozone, and carbon dioxide. The system must include data accumulation and be down loadable for print out. The system must provide for audible and visual alarms where concentrations exceed the following:
	
	• Carbon monoxide: 9 parts per million (ppm.) (8hr. avg.) and/or 35 ppm. (1-hr. avg.)
	• Particulates: 150 micrograms per cubic meter (PM 10) (24hr. avg.)
	• Radon: 4 Pico curies per liter
	• Total volatile organic compounds: 200 micrograms per cubic meter above background (outside air)
	• Formaldehyde: 50 parts per billion
	• Ozone: 0.12 ppm. (1 hr. avg.)
	• Carbon dioxide (Concentrations dependent upon metabolic rate and required volumetric outside air flow rates.):
	    o General classrooms (15 cfm/occupant). Not to exceed 700 ppm. above background (outside air).
	    o Laboratories (20 cfm/occupant). Not to exceed 530 ppm. above background (outside air).
	
	Continuous air monitoring equipment must be calibrated on a quarterly basis or as provided by manufacturer recommendations, whichever is sooner. The school district must investigate and resolve situations where concentrations of contaminant(s) exceed allowable levels. Data must be provided to the school district's Health and Safety Committee quarterly or upon receiving an alarm. Information must be kept three years from the date of collection and must be made available to the public upon request.

Air monitoring is not intended to be indoor air quality monitoring. It is intended to be an indicator of potential problems that require evaluation for resolution. Air sampling on a continuous basis allows school districts to identify potentially unhealthy conditions and assist them in determining if specific changes in building operations or conditions resulted in the change in air quality.

Documentation

Design documents must include equipment for collecting and analyzing air samples on a continuous basis.

5.3.15 Credit: Interior Air Handling Units

2 points	All heating ventilating and air conditioning (HVAC) equipment and supply and return ductwork, with the exception of exhaust fans, must be located within the building. Rooftop units are not allowed. In addition, all spaces in which HVAC equipment is located, which can not be accessed from the same level as the occupied space, must be accessible through the means of a permanent stair. Clearance for maintenance of all equipment must be provided.

Interior HVAC equipment and ductwork will not deteriorate due to weather, including freeze damage and water penetration. Interior air handling units provided with room for maintenance and access are easier to maintain, and thus more likely to be maintained.

Documentation

Design documents must include all provisions required for credit above.

5.4 IAQ During Construction

5.4.1 Prerequisite: Construction IAQ Management Plan

Prereq.	Develop a Construction IAQ Management Plan to be followed during new construction or renovations. This will include pre-conditioning of materials for out-gassing of VOCs.

The school must prepare a Construction IAQ Management Plan. This must be based on material referenced here from the New York State Green Building Tax Credit, SMACNA IAQ Guidelines for Occupied Buildings Under Construction, and LEED-NC *Reference Guide Version 2.2*: IEQ sections.

I. Coordination

A. A coordination system must be established for communication and notification between the owner or owner's representative, architect engineer of record, the construction manager, general contractor and other parties as appropriate to prevent and effectively resolve problems related to construction-related air pollution control.

B. Specific authority must be designated by the owner for the development, supervision, direction and enforcement of the Construction IAQ Management Plan.

II. Construction IAQ Management Plan

A. There must be a written Construction IAQ Management Plan that meets or exceeds the minimum requirements of the "IAQ Guidelines for Occupied Buildings Under Construction" published by SMACNA.

B. The Construction IAQ Management Plan must include measures to protect the ventilation system components and air pathways against contamination during construction. The plan must include cleaning procedures to be employed prior to the building being occupied in the event that ventilation system components and air pathways are not adequately protected. The plan must include control measures as defined in SMACNA for:

1. HVAC protection;
2. Contaminant source control;
3. Interruption of moisture/pollutant pathway;
4. Housekeeping; and
5. Scheduling of events to protect indoor air quality by:
   a) Permitting adequate airing out of new materials;
   b) Sequencing the installation of finish materials;
   c) Proper curing of concrete before covering;
   d) Installation during unoccupied periods; and
   e) Avoidance of building occupancy while construction related pollutants are still present.

Documentation

Include a letter, signed by the general contractor or responsible party, declaring that a Construction IAQ Management Plan has been developed and implemented, and listing each air filter used during construction and at the end of construction. Include the MERV value, manufacturer name and model number.

AND EITHER

Include 18 photographs – six photographs taken on three different occasions during construction, along with identification of the SMACNA approach featured by each photograph, in order to show consistent adherence to the credit requirements

OR

Include documentation for the five Design Approaches of SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3, which were used during the building construction. Include a brief description of some of the important design approaches employed.

Resources

Executive Order No. 111, *"Green and Clean" State Buildings and Vehicles Guidelines,* http://www.nyserda.org/programs/exorder111.asp

6NYCRR Part 638 Green Building Tax Credit, http://www.dec.state.ny.us/website/ppu/grnbldg/index.html

5.4.2 Prerequisite: Mold Protection

Prereq.	In specifications and during construction, meet or exceed the following minimum requirements: Building materials, especially wood, porous insulation, paper, and fabric, should be specified to be kept dry to prevent the growth of mold and bacteria. During construction, cover these materials to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials. Provide site drainage as needed. Schedule deliveries so that materials that are susceptible to mold growth are installed after the enclosure is watertight. Water damaged materials must be dried within 24 hours. Due to the possibility of mold and bacterial growth, materials that are damp or wet for more than 24 hours may need to be discarded. Immediately remove from the site materials showing signs of mold and mildew, including any with moisture stains, and properly dispose of them. Replace moldy materials with new, undamaged materials.

Construction activities affect indoor air quality, so mold protection is a prerequisite.

Documentation

Specifications — Protection of building materials from water damage (use specification language in Appendix D of this document as sample language for your bid specifications).

Post-Construction Documentation

Photographs taken during construction demonstrating compliance with this requirement.

5.4.3 Prerequisite: Filters During Construction

Prereq.	Provide all specified HVAC filtration media during construction and replace immediately prior to occupancy.

Construction activities affect indoor air quality, so filter replacement is a prerequisite.

Post-Construction Documentation

Photographs during construction, describing compliance with this requirement, and a count of all units requiring filters.

5.4.4 Prerequisite: Construction IAQ: Ventilation of VOCs

Prereq.	Continuously ventilate during installation of materials that emit Volatile Organic Compounds (VOCs) and after installation of those materials for at least 72 hours or until emissions dissipate. Ventilate directly to outside areas; do not ventilate to other enclosed spaces that are occupied. If continuous ventilation is not possible using open windows and temporary fans, then the building's HVAC system may be utilized on full exhaust provided that MERV 8 or higher filtration media are installed at each return air grille.

This construction practice improves indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Documentation

Specifications showing that temporary ventilation will take place in accordance with the requirements of this prerequisite.

5.4.5 Prerequisite: Construction IAQ: HEPA Vacuuming

Prereq.	Vacuum carpeted and soft surfaces with a high-efficiency particulate arrestor (HEPA) vacuum prior to substantial completion. For phased, occupied renovations, HEPA vacuum the carpet daily in occupied areas.

This construction practice improves indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Documentation

Specifications for HEPA vacuuming of carpeted floors prior to full building occupancy. For phased, occupied renovations, obtain letter from Superintendent stating that carpeting in occupied areas of the school will be HEPA vacuumed daily.

5.4.6 PREREQUISITE: CONSTRUCTION IAQ: DUCT PROTECTION

Prereq.	Turn the ventilation system off, and protect HVAC supply and return openings from dust infiltration during dust producing activities (e.g., drywall installation or wood floor sanding). Provide temporary ventilation as required. If installing a new duct system, follow SMACNA guidelines "*Duct Cleanliness for New Construction Guidelines*" according to **advanced** levels of cleanliness. Oil film on sheet metal must be removed before shipment to site. Inspect ductwork to confirm that no oil film is present and remove if it is present. Make sure to fully wrap and protect ductwork ends prior to its installation. Never leave ductwork interiors exposed to the air.

This construction practice will improve indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Documentation

Specifications for duct protection, oil film removal on sheet metal, and temporary ventilation including reference to SMACNA Duct Cleanliness Guidelines Advanced Levels.

Post-Construction Documentation

Include photographs during construction, demonstrating compliance with SMACNA Duct Cleanliness guidelines.

5.4.7 Prerequisite: Construction IAQ: Building Flushout

Prereq.	Prior to flushout, filters must be replaced with at least Minimum Efficiency Reporting Value (MERV) 10 filters and replaced again after flushout with a minimum of MERV 10 filters. For unit ventilator systems, a minimum of MERV 7 filters must be installed and then replaced with MERV 7 filters after flushout. AND, Flushout Options: Option 1: The entire building must be flushed out continuously (24 hours/day) with 100% outside air for at least 10 days prior to receipt of certificate of occupancy. OR, Option 2: Flushing of each space begins only after all major finish materials have been installed on floors, wall, and ceilings. This includes all casework. At that time, each space may be flushed out separately and occupied once 3,500 ft^3 of outdoor air per ft^2 of floor area of the space has been delivered. The space may then be occupied provided that it is ventilated at a rate of 0.30 cfm/ ft^2 of outside air or the design minimum outside air rate, whichever is greater, a minimum of three hours prior to occupancy and during occupancy, until the total of 14,000 ft^3/ft^2 of outside air has been delivered to the space. *NOTE:* Option 2 is recommended if flushout dates coincide with time periods when relative humidity levels are typically high (e.g., 70 percent or greater during hot, humid weather). Water vapor can warp wood and cause mold growth problems on building materials.

Use of 100% outside air is intended to remove odors and volatile organic compounds (VOCs) that accumulate during the construction process. Use of 100% outside air will prevent particles from continuing to recirculate throughout the building. Do not "bake out" the building by increasing the temperature of the space.

Documentation

Specifications calling for installation of MERV 10 filtration media prior to building flushout and post flushout. MERV 7 filters are required for unit ventilators systems both prior to and following building flushout.

Option 1

A copy of the build-out schedule indicating when the 10 days of 100% outdoor air flushout would begin. In an accompanying narrative, explain how equipment is sized to condition 100% outside air, or that weather conditions at the time of year that the flushout will start will allow for 100% un-tempered air to be introduced into the building. Please also note in this narrative that utility services will be ready to complete the flushout.

Option 2

Provide calculations from the HVAC engineer showing: a) the settings needed to provide 3,500 ft^3/ft^2 of outside air to each space in the school; b) the amount of time the ventilation system needs to run for each space to reach the minimum threshold of 3500 ft^3/ft^2; c) the settings for delivering outside air at a rate of 0.30 cfm/ ft^2 of outside air or the design minimum outside air rate, whichever is greater; and d) the amount of time the ventilation system needs to run for each space to reach the minimum threshold of 14,000 ft^3/ft^2.

5.5 ACOUSTICS

Purpose: To design HVAC systems and classrooms to provide acoustic levels that do not interfere with occupant productivity.

Case Study: High School

The building was designed to achieve NC30 (35 dBA). The acoustical consultants describe the "5 ft to 7 ft. long silencers in the main supply and return ducts at the connections to the units that control fan noise transmission down the ducts" and the use of completely lined ductwork downstream of the terminal boxes (the developed length of lined duct between the terminal boxes and the diffusers is 15 to 20 ft.) as the primary noise control treatments.

According to the consultants, "Together, the main duct silencers and the lining downstream of the terminal boxes are expected to be sufficient to attenuate fan noise below 35 dBA for even the spaces that are closest to the air handling units, where the noise level is typically highest." Sound attenuation strategies for other school projects may vary.

Student learning suffers in acoustically poor environments. Excess noise from exterior sources, loud HVAC systems, or other nearby rooms can make it difficult, and sometimes impossible, for students and teachers to communicate.

Poor acoustics affects more children than just those with permanent hearing impairments. Children with learning disabilities, language impairments, or children for whom English is a second language, and children with ear infections are also adversely affected by poor acoustics. In addition, children in general have not fully developed their language and auditory skills (especially younger children), making quality acoustics very important for learning.

School officials and designers are strongly encouraged to move beyond the prerequisite and achieve the background noise levels, reverberation times, and sound isolation standards recommended by the ANSI (American National Standards Institute) Standard entitled "Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools" (ANSI S12.60-2002) for all core learning areas.

It may not be possible to reach 35 dBA with unit ventilator systems. Consider HVAC options that do not require unit ventilators. If you do opt for unit ventilators, it is important to select quieter models or those that can operate at low speeds.

Important aspects of classroom acoustical design include: isolation from exterior noise (wind loads, traffic, and other loud outdoor activities); elimination of interior noise (from HVAC systems, foot traffic, and other classrooms); and the use of appropriate wall assembly, window systems, and interior surface materials to minimize sound propagation and reduce reverberation times in the classrooms. The most common sources of interior mechanical noise are the air conditioning and air-handling systems, including ducts, fans, compressors, condensers, and dampers. The selection, location, and isolation of this equipment should be reviewed to minimize its impact on sound-sensitive spaces within school facilities.

Note: The acoustic measures listed in this section are not suitable for the learning environment required for hearing-impaired children, which requires even further enhancements of the acoustical environment for suitable conditions. Refer to the American Speech-Language-Hearing Association for guidance on these environments.

5.5.1 PREREQUISITE: MINIMUM ACOUSTICAL PERFORMANCE

Prereq.	Kindergarten through 6th Grade Classrooms must be designed to have: • 35 dBA maximum (unoccupied) background noise levels at any location where a student may be situated. 7th through 12th Grade Classrooms must be designed to have: • 40 dBA maximum (unoccupied) background noise levels at any location where a student may be situated. All classrooms must have: 0.6-second maximum (unoccupied) mid-frequency (average of 500, 1,000 and 2,000 Hz) reverberation times for classrooms with volumes of up to 10,000 ft³; 0.7-second maximum (unoccupied) mid-frequency reverberation time for classrooms of 10,000 to 20,000 ft³; consult ANSI S12.60-2002 standard for requirements with spaces larger than 20,000 cu.ft.

For purposes of this prerequisite and the acoustics credits, classrooms are defined as:

- General classrooms;
- Group Instruction;
- Art rooms;
- Music rooms;
- Science rooms;
- Computer rooms; and
- Special needs, remedial, and collaborative space.

Documentation

Include design criteria in design documents. Include a report from a qualified acoustical consultant verifying that classrooms have been designed to meet the relevant requirements.

Post-Construction Documentation

A report from a qualified acoustical consultant verifying that classrooms have met the relevant requirements.

Resources

"Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools" (ANSI S12.60-2002)

National Clearinghouse for Educational Facilities: http://www.edfacilities.org/

Acoustical Society of America:
http://asa.aip.org/
http://asa.aip.org/classroom/booklet.html
American National Standards Institute: http://www.ansi.org/
American Speech-Language-Hearing Association: http://www.asha.org/default.htm

5.5.2 CREDIT: SOUND ISOLATION

2 points	Design classrooms in accordance with the noise isolation requirements referenced in American National Standards Institute's (ANSI) classroom acoustics standard entitled, "Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools" (ANSI S12.60-2002). This credit is applicable for schools with 7th through 12th grade classrooms because it is stricter than the prerequisite above for those types of classrooms. Project designers may want to increase sound transmission class (STC) levels in exterior walls beyond the ANSI standard if local noise pollution from trains, highways, pedestrians, industrial noise sources, etc. will degrade the interior learning environment.

The diagrams below are schematic representation of ANSI's noise isolation requirements. Effective space planning should be used to avoid conflicting adjacencies where possible. Please consult the full ANSI standard for complete details.

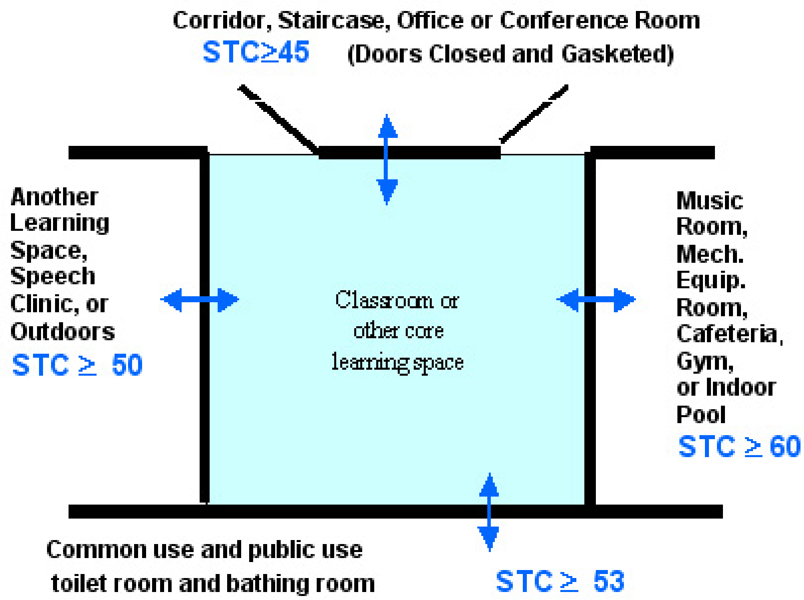
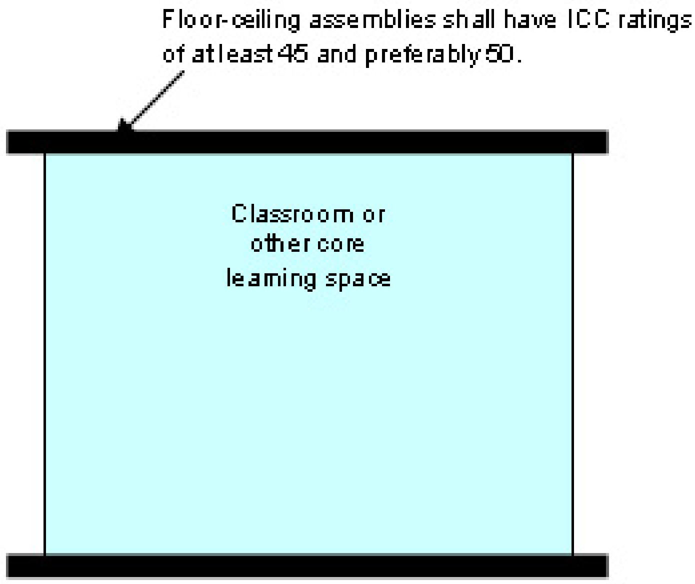


Figure 3— Noise Isolation (STC) Requirements (plan view)

Source: CHPS, Inc. PowerPoint presentation—modified based on requirements in ANSI S12.60-2002.



3.

Figure 4— Impact Insulation Class (IIC) Rating (side view)

Source: CHPS, Inc. PowerPoint presentation—modified based on requirements in ANSI S12.60-2002.

Please note correction to Figure: Floor-ceiling assemblies shall have **IIC** ratings of at least 45 and preferably 50.

Documentation

Include a report from a qualified acoustical consultant verifying that classrooms have been designed to meet the relevant requirements.

Post-Construction Documentation

A report from a qualified acoustical consultant verifying that classrooms have met the relevant requirements.

Resources

National Clearinghouse for Educational Facilities: http://www.edfacilities.org/

Acoustical Society of America:

http://asa.aip.org/

http://asa.aip.org/classroom/booklet.html

American National Standards Institute: http://www.ansi.org/

5.5.3 CREDIT: IMPROVED ACOUSTICAL PERFORMANCE

2 points	All classrooms will achieve the background noise levels (35 dBA in most cases), reverberation times, and sound isolation standards recommended by ANSI (the American National Standards Institute) Standard entitled "Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools" (ANSI S12.60-2002).

Documentation

Include a report from a qualified acoustical consultant documenting that measured sound levels and reverberation times will meet the ANSI requirements, and verifying that classrooms have been designed to meet the sound isolation requirements.

Post-Construction Documentation

A report from a qualified acoustical consultant verifying that classrooms have met the relevant requirements.

Resources

National Clearinghouse for Educational Facilities: http://www.edfacilities.org/

Acoustical Society of America:

http://asa.aip.org/

http://asa.aip.org/classroom/booklet.html

American National Standards Institute: http://www.ansi.org/

American Speech-Language-Hearing Association: http://www.asha.org/default.htm

5.6 THERMAL COMFORT

Purpose: To provide a high level of thermal comfort with individual teacher control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort conditions.

5.6.1 PREREQUISITE: ASHRAE STANDARD *55-2004* COMPLIANCE

Prereq.	Comply with ASHRAE *Standard 55-2004* for thermal comfort standards within established ranges per climate zone. Note that winter humidification and summer dehumidification must not be required.

Although this prerequisite exempts HVAC engineers from considering humidification and dehumidification systems, there are design choices such as direction of air supply and air supply velocity, which can affect the humidity levels experienced by occupants. When designing the layout of the HVAC system, keep humidity impacts in mind.

Displacement ventilation is being used in this high school as an efficient means of providing ventilation and dehumidification for interior spaces. The supply air will be delivered through floor or wall-mounted diffusers (see gray diffuser on right wall in picture), designed to deliver air at low velocity. Supply air will typically be 100% outside air.

Documentation

Include a letter signed by the project's professional engineer (P.E.) certifying that ASHRAE *Standard 55-2004* guidelines will be achieved and how they will be achieved.

Resources:

ASHRAE Standard 55-2004

CHPS *Best Practices Manual*, Volume II: HVAC Chapter.

5.6.2 Prerequisite: Controllability of Systems

Prereq.	One hundred percent (100%) of all classrooms on an exterior wall must have a minimum of one operable window per classroom that is reasonably accessible to the occupants, i.e., precludes use of ladders to adjust the window opening.

Operable windows are important for personal comfort, and have been shown to improve student performance. Provide at least one operable window in each classroom. Train teachers how to properly use the HVAC controls in their rooms and how opening doors and windows affect ventilation and comfort.

Documentation

Operable Windows

Operable window specifications and floor plans highlighting operable windows in each classroom.

5.6.3 Credit: Thermal Control

1 point	Provide temperature controls for each classroom.

Individual classrooms will vary in temperature depending on their orientation and other building conditions, as well as occupant preferences. Provide individual or integrated controls systems to allow teachers to regulate the temperature of their classrooms within limits established by the school district administration.

Documentation

Specifications showing adjustable thermostats in all classrooms.

6 O&M (15 Points, 11%)

6.1 Operations

6.1.1 Prerequisite: Energy Plan

Prereq.	The school must prepare a comprehensive Energy Plan that addresses best operating practices to reduce energy costs while maintaining comfort and essential IAQ goals.

The school must 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.

The single most important energy cost management tool is a well conceived school district Energy Plan 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.

Documentation

1. A comprehensive Energy Plan.
2. A formal school board policy stating that the school district will maintain and enforce the Energy Plan.

Resources

School Operations and Maintenance: Best Practices for Controlling Energy Costs - A Guidebook for K-12 School System Business Officers and Facilities Managers, August, 2004

http://www.schools.utah.gov/finance/facilities/references/maintenance.htm

School Energy Costs - A Matter of Leadership (2003 Edition).

6.1.2 Prerequisite: No Fossil-Fuel-Powered Equipment Indoors

Prereq.	Do not acquire fossil-fuel-powered machinery that is mobile and whose specific function is for use inside the building. This is to prevent accumulation of exhaust inside the building from equipment such as polishers and burnishers. This does not include stationary equipment such as gas stoves, chemistry equipment, and vocational equipment.

Prohibit mobile equipment that burns fossil fuels inside the building. This is to prevent accumulation of exhaust from equipment such as polishers and burnishers.

Documentation

Formal board policy stating that no indoor mobile fossil fuel burning equipment will be used in the new or renovated facility.

6.1.3 Credit: Energy Benchmarking

2 points	The school must develop a formal policy to update the ENERGY STAR® Portfolio Manager or NYSERDA's energy benchmarking quarterly.

Benchmarking school energy use can be one of the most straightforward and simple methods available to help keep a school operating efficiently. Energy benchmarking shows how a school is operating compared to its peers — and with multiple years of utility data — and shows how well a school operates from year to year. Good benchmarking systems account for yearly changes in weather and track energy use per square foot per year. NYSERDA's benchmarking service (available free from NYSERDA) also tracks changes in electricity and heating fuel per square foot and per student.

Resources

Call for NYSERDA services toll-free at 1-866-NYSERDA or visit:
http://www.nyserda.org/programs/Schools/Benchmarking.pdf

The US Environmental Protection Agency (EPA's) portfolio manager is available at http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

6.1.4 Credit: Indoor Environmental Management Plan

2 points	The school must develop a formal policy to implement the EPA's Tools for Schools Program or an equivalent indoor health and safety program for the new or renovated school. Designate a trained staff person as a point of contact for the EPA Tools for Schools program, or its equivalent. AND The school must address all IAQ complaints through the health and safety committee required under Commissioner's regulation 155.4.

EPA's Tools for Schools Program is designed to identify, address and prevent indoor air quality problems in schools. It is well known that prevention and comprehensive planning for indoor air problems are far less costly to a school system than a crisis-reaction approach. The Tools for Schools kit provides a basic set of operations and maintenance guidelines that will help prevent IAQ problems in schools. It establishes responsibilities and clear communication channels so that indoor air problems can be prevented and problems can be quickly identified and solved. In addition, the Tools for Schools system can be used to address other environmental health and safety conditions that arise.

IAQ complaints periodically arise, even in well-designed and operated schools. It is important to have formal policies and health and safety committee members (with IAQ experience) in place to address complaints.

Documentation

A resolution from the school committee or letter from the Superintendent declaring participation in EPA's Tools for Schools (or an equivalent program) for the school. Documentation must include the name of the designee who will be the point of contact for the EPA or equivalent program.

A copy of the school's IAQ formal policy and taskforce members' names.

Resources

EPA: http://www.epa.gov/iaq/schools/

6.1.5 Credit: U.S. Green Building Council LEED®-EB Updates

2 points	The school must develop a formal policy to submit every three years for re-certification with the U.S. GBC LEED® for Existing Buildings (EB) Program or with another green building program for existing buildings.

The U.S. Green Building Council's LEED for Existing Buildings (LEED-EB) is applicable to existing buildings that are seeking LEED Certification for the first time as well as projects previously certified under LEED standards for new construction. LEED-EB provides the opportunity for building owners and operators to meet their sustainable operations goals and to reduce the impacts of their buildings on the environment and occupant health over their entire life cycle.

The LEED-EB rating system is designed to recognize those buildings that maximize operational efficiency while minimizing environmental impacts. It provides a recognized, performance-based benchmark for building owners and operators to measure operations, improvements and maintenance on a consistent scale. LEED-EB is a road map for delivering economically profitable, environmentally responsible, healthy, productive places to live and work.

Resources

http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221&

6.1.6 Credit: BOC Training

2 points	The school must develop a formal policy requiring a minimum of 2 maintenance staff to be trained through a nationally recognized program, such as the Building Operator Certification Program, or equivalent.

Building Operator Certification is a nationally recognized training program designed to educate facilities personnel in the energy and resource efficient operation and maintenance of building systems.

Operators earn certification by:

- Attending the required number of days of training;
- Completing 5 project assignments in their facilities; and
- Passing exams given at the end of each session.

Instructors personally trained in facility maintenance and operation conduct training sessions on the following topics:

- Building Systems Overview;
- Energy Conservation Techniques;
- HVAC Systems and Controls;
- Efficient Lighting Fundamentals;
- Environmental Health and Safety Regulations;
- Indoor Air Quality; and
- Facility Electrical Systems.

Resources

http://www.neep.org/boc/

Documentation

Copy of Board policy or copy of certification of employees, if currently available.

6.1.7 Credit: Certified Superintendent of Buildings and Grounds

2 points	The school must develop a formal policy to require Superintendent of Buildings and Grounds to be a Certified Director of Facilities in accordance with School Facility Management Institute's standards.

There are multiple objectives for certification of Facility Directors. These include:

- To develop professional knowledge, growth and recognition.
- To provide a clear understanding of the disciplines included in the profession of Facility Director. This clarification is for the use of the public employers of Facility Directors and persons practicing the profession or portions of it.
- To provide a means of verifying the level of knowledge and skills utilized by practicing professionals.
- To furnish a comprehensive goal for the practicing professional toward learning the intricacies encompassed in the profession.
- To offer a series of goals for motivated supervisory employees of an educational facility operations and maintenance department seeking upward mobility toward more responsible positions.

Resources

http://www.sbga.org/mn_professional/cdf.html

Documentation

Copy of school district policy or copy of certification if already obtained by Superintendent of Buildings and Grounds.

6.1.8 Credit: Continuous Commissioning

2 points	The school must develop a formal policy to follow a Continuous Commissioning Plan. It is recommended that the school follow the process outlined in PECI's, *A Practical Guide for Commissioning Existing Building,* which can be obtained at: http://eber.ed.ornl.gov/commercialproducts/RetroCommissioningGuide-w-cover.pdf The plan must be developed by the Commissioning Authority before building is occupied. The continuous commissioning activities must be used to help complete each 5-year building condition survey as required by Commissioner's regulation 155.3.

Continuous commissioning (or retro-commissioning, RCx) applies a systematic process for improving an existing building's performance. It entails a rigorous investigation using a whole building systems approach to identify problems and integration issues. The primary focus is identifying operational improvements to obtain comfort and energy savings. RCx may be performed alone or in concert with a retrofit project. Typical energy cost savings for RCx are between 5% and 20%, often achieving a simple payback of less than two years.

Too often, building owners inherit building automation systems (BAS) that are installed and programmed improperly, and building documentation is incomplete and components and equipment are missing or incorrectly installed. Furthermore, common airflow problems result in too much or too little building ventilation. RCx is increasingly recognized as an effective process to improve building performance, reduce energy use, and improve indoor air quality, occupant comfort, and productivity.

Commissioning prior to performing the building condition survey allows minor adjustments and repairs to be made to return systems to proper operating condition. It also provides survey information for needed capital improvements to systems for inclusion in the subsequent 5-year capital plan.

Resources

http://peci.org/commissioning.htm

6.2 MAINTENANCE

6.2.1 PREREQUISITE: MAINTENANCE PLAN

Prereq.	The School Board must develop a formal policy to use NYSED's Capital and Maintenance Planning (CMP) Toolbox to prepare and update annually a formal operations and maintenance (O&M) plan. Part of the plan must show how the school will address and monitor IAQ conditions. The plan must also include an inventory of all equipment in the new or renovated school and its preventive maintenance needs. The inventory should cover the following systems: • HVAC; • Plumbing; • Non-HVAC mechanical systems; • Lighting; • Building Control Systems; • Life and Safety System; • Roof systems; and • Switchgear. The plan must address the preventive maintenance needed and include staff time and materials costs for each maintenance task and clearly define who is responsible for performing the task, as well as the overall management of maintenance activities. If the school uses another software tool for O&M, enter summary data from the tool into the CMP to develop linkages between energy costs, O&M costs, and expected capital expenses.

Regular maintenance is critically important to the operation and performance of schools. Every school district has unique maintenance needs, but school districts should invest sufficient staff and resources to ensure that the school's building systems continue to operate as they were designed.

High performance schools should not be maintenance-intensive compared to schools designed to standard practice. However, all buildings and building systems require preventive — not deferred — maintenance. This credit aims to encourage school districts to plan for preventive maintenance tasks, and invest adequate funds in the maintenance of their school facilities. Preparation of a maintenance plan, implementation of maintenance budget or purchase of a Computerized Maintenance Management System (CMMS) will require a commitment to staff training.

A maintenance plan goes beyond deferred maintenance to include all regularly scheduled preventive maintenance tasks and their frequency over the lifetime of the building system or equipment. These tasks include cleanings, calibrations, component replacements, and general inspections. A commissioning plan with the required maintenance documentation is an excellent starting point and reference for developing the maintenance plan. The plan must include staff time and material costs for each maintenance task and must clearly define who is responsible for performing the task, its frequency, and the overall management of maintenance activities.

The Maintenance Plan must include:

- The HVAC system must be inspected at least annually, and problems found during these inspections must be corrected within a reasonable time. Air conditioning systems must be inspected twice each year — before the cooling season and again after the cooling season.

- Inspections and maintenance of the HVAC system must be documented in writing. The facilities manager (or individual responsible for oversight of facilities maintenance and operation) must record the name of the individual(s) inspecting and maintaining the system, the date of the inspection and maintenance, and the specific findings and actions taken. The facilities manager must ensure that such records are retained for at least five years.

- Calibrations of all sensors that are part of the HVAC system on a routine basis including CO_2 sensors for CO_2 demand controlled ventilation. Sensors must be calibrated in accordance with manufacturers' instructions.
- Means to monitor and address any IAQ issues.
- Ongoing training for maintenance staff.

Documentation

(1) Copy of the CMP filled out with the maintenance plan; (2) Copy of School Board policy outlining who will update the preventive maintenance plan and the inventory; (3) Title of person who will conduct periodic HVAC systems inspections and sensor calibrations after building occupancy; (4) Description of procedures that will be used for the HVAC systems inspections; and (5) Description of how the HVAC system inspections and sensor calibrations, AND any completed follow-up actions will be documented.

6.2.2 Prerequisite: Green Cleaning

Prereq.	The school must develop a formal policy establishing agreement with and support for utilizing the New York State Office of General Services approved green cleaning and maintenance products in accordance with Education Law 409-I and State Finance Law 163-b.

Appropriate use of least toxic cleaning products that achieve the same function and utility as more toxic traditional cleaning chemicals is critical to the success of a high performance school and will contribute significantly to improved indoor air quality. A clear statement of support by the Board of Education will make clear to all staff that green cleaning is an important part of a high performance school.

Documentation

Copy of School Board policy committing the school to use green cleaning products.

6.2.3 Prerequisite: Integrated Pest Management

Prereq.	The school must design new/renovated buildings for Integrated Pest Management (IPM) and create, update and support a formal IPM plan each year that emphasizes a least-toxic approach to IPM in accordance with Commissioner's regulation 155.4.

Design exterior walls, foundations, attics, roofs; interior partitions and ceilings in food storage areas, food preparation and disposal areas, utility chases and penetrations for IPM by including the following design elements to make it difficult for pests to enter the building:

- To exclude mice, rats, squirrels, bats, starlings and English sparrows:
    - Block all openings in the enclosure larger than ¼ inch by 3/8 inch.
    - Use copper or stainless mesh or screen if the opening must allow air flow, metal, concrete or mesh reinforced caulk if air must be stopped.
- To exclude larger insects (e.g., yellow jackets, American roaches) use 1/8 inch screen or caulking.
- To exclude smaller insects caulk cracks larger than 1/16 inch.
- To exclude termites, use solid concrete, metal, and fine-gauge stainless mesh.
- Keep shrubs three feet from buildings.
- Plan façades so pigeons can not roost.
- Select dumpsters that seal tightly and are easy for people to open and close, and locate them 50 feet from buildings.

- Make all kitchen surfaces easy to degrease.

An appropriate IPM plan, specified to be a least-toxic approach, reduces the need to apply chemical sprays or deploy bait traps in order to control pest populations. A successful plan eliminates food, water, and shelter for pests, thereby decreasing the likelihood that pests will enter school facilities. The control of food and its restriction to appropriate locations in the facility decreases pest problems, and increases Indoor air quality through the elimination of pest contaminants and chemical control agents.

Documentation

(1) Narrative from the project architect describing specific IPM elements included in the building design.
(2) Copy of School Board policy committing the school to follow a formal IPM plan.

6.2.4 Prerequisite: Purchase Green Label Vacuums

Prereq.	The school must purchase only Green Label certified high performance vacuums to be used by facilities staff.

The Carpet and Rug Institute (CRI) Green Label standard for vacuum cleaners are a set of stringent testing processes that measure three key performance factors: soil removal, dust containment, and carpet appearance retention. Vacuum cleaners that meet this standard are certified high performance vacuum cleaners, and their use is mandated in all schools by the *Guidelines for the procurement and use of environmentally sensitive cleaning and maintenance products for all Public and Nonpublic elementary and secondary schools in New York State*. This document can be found at: http://www.ogs.state.ny.us/bldgadmin/environmental/default.html

Post-Construction Documentation

Documentation showing purchase of certified high performance vacuums.

6.2.5 Credit: Computerized O&M Plan, CMMS

3 points	The school district must purchase and use a Computerized Maintenance Management System (CMMS) in the new or renovated school.

A Best Management Practice for preventative maintenance is a CMMS. Options exist for implementing a CMMS with stand-alone software or web based services.

Documentation

Copy of signed contract for purchase of CMMS or receipt for purchase of CMMS.

7 Extra Credit (16 Points, 12%)

7.1 PERFORMANCE MONITORING

7.1.1 CREDIT: PERFORMANCE MONITORING

1 point	Develop a formal policy to track and monitor health and productivity changes. This must include monitoring occupants for test scores and attendance rates.

Documentation

Copy of School Board policy committing the school to monitor health and productivity, along with test scores and attendance rates.

7.2 PURCHASING STANDARDS

7.2.1 CREDIT: ENERGY STAR® NEW EQUIPMENT

1 point	The school district must adopt a formal policy to require ENERGY STAR® equipment and appliances for all new purchases for the school, and to prohibit the purchase of low efficiency products.

The U.S. Environmental Protection Agency's ENERGY STAR program maintains a database of compliant manufacturers and products. To earn this credit, the school district must pass a resolution requiring that all new equipment or appliances for the school be ENERGY STAR - compliant. Products not currently covered under the ENERGY STAR program are excluded from the scope of this credit. A partial list of equipment covered by ENERGY STAR includes computers, monitors, copy machines, water coolers, printers, scanners, refrigerators, and washing machines. In addition, the resolution must state that the school district cannot purchase halogen torchieres and portable electrical resistance heaters for the school nor allow their use by staff.

Documentation

Copy of formal School Board policy.

Resources

ENERGY STAR: http://www.energystar.gov/

7.2.2 Credit: Prohibition of Personal Electrical Devices

1 point	School district must adopt a formal policy to prohibit staff at the school from bringing personal electrical devices such as portable electrical resistance heaters, microwaves, coffee pots, hot plates, and refrigerators.

Significant energy is consumed by multiple cooking and heating appliances typically found in schools. The school district must provide a suitable central location such as the teachers' lounge or staff cafeteria for suitable electrical devices.

Documentation

Copy of formal School Board policy.

7.2.3 Credit: Purchase Low-Mercury Lighting

1 point	Purchase low-mercury fluorescent lamps for all new fluorescent light fixtures.

Fluorescent and HID lamps contain mercury; when broken, incinerated, or buried in a landfill, they release mercury into the air, water and soil and endanger human health and the environment. Low-mercury, or "green end cap," lamps do not eliminate the hazardous waste stream but do reduce it considerably.

7.3 Clean Energy

7.3.1 Credit: Clean Energy

1 point	Commit for a minimum period of two years to purchasing Renewable Energy Certificates (RECs) or clean renewable electricity for the equivalent of at least 25% of the school's projected annual electricity needs.

Purchase electricity for the school from a provider of clean renewable electricity or Renewable Energy Certificates (RECs) such that the equivalent of 25% of the school's projected annual electricity needs will be provided by renewable sources.

A renewable energy facility sells two things, electricity and Renewable Energy Certificates (RECs). A REC is a credit generated for each megawatt-hour of power produced by certain renewable energy technologies. Though not always, RECs can often be sold separately from the electricity and are purchased by utilities, which must meet legal requirements to "produce" renewable power. Electricity suppliers are often required to purchase ***new*** RECs (from renewable energy facilities built since 1997) to match an increasing percentage of a customer's demand. Choosing to pay a premium for renewable energy from a newer facility (as opposed to older renewable energy sources built before 1997) is most likely to succeed in developing additional renewable energy facilities.

Sample Resolution

WHEREAS, the cost of conventional fuels, such as oil and natural gas is increasing; and
WHEREAS, in the last five years, New York has become increasingly dependent on natural gas; and
WHEREAS, fuel diversity is important for energy security reasons; and
WHEREAS, fossil fuels are limited in supply and will someday be exhausted; and
WHEREAS, fossil fuels generate pollutants when combusted, including greenhouse gases that can lead to global climate change; and
WHEREAS, renewable power is from clean, abundant energy sources, such as the sun and wind; and
WHEREAS, renewable power generates few, if any, pollutants.
NOW THEREFORE BE IT RESOLVED that the ________________ [insert name of school district, city or town] will make arrangements to purchase clean renewable electricity or Renewable Energy Certificates (RECs) for a period of two years covering at least 25% of the ___________________ [insert name of school] projected annual electricity needs. The __________[insert name of school] projected annual electricity needs are _____kwh [insert number of kwh].

Documentation

A copy of formal School Board resolution. The resolution must show the number of kilowatt-hours (kWh) for which clean renewable electricity or RECs will be purchased on an annual basis.

AND

Appropriate documentation from the clean power or REC supplier indicating the number of kilowatt-hours (kWh) for which clean power or RECs are being purchased (if such documentation is available at the time the school project is applying for NY-CHPS recognition).

AND

From the "*Energy Prerequisite: Minimum Energy Pe*" provide data from energy modeling report showing projected annual electricity needs for school.

Resources

For information on the Clean Energy Choice program, see http://www.cleanenergychoice.org/

7.4 TRANSPORTATION

7.4.1 CREDIT: ALTERNATIVE FUELS BUSES

1 point	At least 20% of the buses serving the school must use an alternative fuel such as compressed natural gas or utilize clean technology buses with hybrid electric-diesel engines. This credit may also be achieved by committing to use B-20 diesel fuel in all the buses serving the school for a period of two years.

The purpose of this credit is to encourage fuel diversity in school bus fleets and to promote clean alternatives to diesel fuel. The school district must carefully consider the pros and cons of each type of fuel. B-20 bio-diesel is a mixture of 20% agriculturally derived oils and fossil fuel. It burns more cleanly than 100% diesel fuel, although it is known to exhaust elevated levels of nitrogen oxides. Compressed natural gas (CNG) is an efficient and clean fuel. However, CNG refueling stations can be quite expensive to construct, so this option would be more attractive to communities with existing CNG fuel stations. Diesel-fueled, hybrid-electric buses employ a mixture of battery power and diesel fuel power. The technology is available for city transit buses and is currently being studied for its applicability to school buses. Early results indicate that "plug-in" hybrid electric school buses, which charge at night, exhaust few emissions and can reduce fuel costs over the life cycle of the bus.

Documentation

A letter from the school district describing the type of alternative fueled buses that will be used to serve the new or renovated school. Provide a count of the number of buses to serve the school. Twenty percent of the buses serving the school must run on alternative fuel.

If the bus or buses have not yet been purchased, provide product literature on the type of bus to be purchased and a letter from the school district certifying that money has been dedicated for the purchase. For contracted school bus services, provide a copy of the contract with the transportation company indicating that 20% of the buses serving the school will use alternative fuel.

If 20% of the buses serving a school is not a whole number, then round down to the next highest whole number.

To document that B-20 diesel fuel will be used in <u>all</u> the buses serving the school, provide a copy of a two year contract with a fuel supply company or transportation company (or a one year contract, with the option to renew for another year) stating that fuel supply for buses used on the daily route for collecting students will be B-20 bio-diesel. If entering into a contract at the time of submission for NY-CHPS recognition is not possible, develop a memorandum of understanding with the fuel supply or transportation company that clearly outlines the intention to use B-20 diesel in the buses that will serve the completed school.

7.4.2 Credit: Alternative Fuels Maintenance Vehicles & Equipment

1 point	Specify alternative-fuel maintenance vehicles and equipment, using electricity, propane, or natural gas. This credit addresses lawnmowers, tractors, and maintenance trucks, but does not include life safety equipment. To achieve the credit, 50% of the cost for the above maintenance vehicles and equipment must go toward the purchase of alternative fuels items.

Alternative-fuel vehicles and equipment promote clean air on and around the school campus.

Documentation

Bid specifications and cost estimates for all lawnmowers, tractors, and maintenance trucks to be purchased for the school. This credit is achieved when 50% of the combined purchase cost goes toward purchasing alternative fuels maintenance vehicles and equipment.

7.4.3 Credit: Anti-Idling Measures

1 point	Adopt a no idling policy that applies to all school buses operating in the school district and all vehicles operating in the school zone. The policy must include the following provisions: • School bus drivers must shut off bus engines upon reaching destination, and buses will not idle for more than three minutes while waiting for passengers. This rule applies to all bus use, including daily route travel, field trips, and transportation to and from athletic events. School buses must not be restarted until they are ready to depart and there is a clear path to exit the pick-up area. • Prohibit idling of all vehicles for more than three minutes (including all passenger vehicles and delivery trucks) in the school zone AND post appropriate signage. • School bus companies and drivers must limit idling time during early morning warm-up to manufacturers' recommendations — generally five minutes in all but the coldest weather and for pre-trip safety inspections. • The school district must provide an indoor waiting space for drivers who arrive early and need to keep warm. • Transportation operations staff must evaluate and shorten bus routes whenever possible, particularly for older buses with the least effective emissions control. • All school district bus drivers must complete a "no idling" training session at least once. All bus drivers will receive a copy of the school district's "No Idling Policy" or equivalent educational materials at the beginning of every school year. Exceptions to this policy are appropriate only when running an engine is necessary to operate required safety equipment or to perform other functions that require engine-assisted power (e.g., waste hauling vehicles, handicap accessible vehicles, etc.).

Exposure to diesel exhaust, even at low levels, is a serious health hazard and can cause respiratory problems such as asthma and bronchitis. Diesel emissions are well-documented asthma triggers and may increase the severity of asthma attacks. Asthma is currently the number one cause of missed school days for American children. *Source:* Asthma Regional Council website:
http://www.asthmaregionalcouncil.org/about/documents/SchoolBusNoIdlingPolicy7.29.04.doc

The Asthma Regional Council's website also offers a number of tools for the school district to use for its anti-idling program. See:
http://www.asthmaregionalcouncil.org/about/BusToolkit.htm

Documentation

Copy of signed resolution or signed school district policy including, at a minimum, the provisions outlined in this credit.

Resources

Additional provisions may apply — see sample policy on Asthma Regional Council website for guidance: http://www.asthmaregionalcouncil.org/about/BusToolkit.htm

7.4.4 Credit: Install Diesel Oxidation Catalysts On All Buses

1 point	Retrofit all buses associated with the school and manufactured before 2007 with oxidation catalysts.

EPA's emissions standards will lead to significantly less pollution from buses manufactured after 2007, but significant reductions are easily attained from retrofitting existing buses. Oxidation catalysts reduce particulate matter by 10 to 40 percent. They cost approximately $1,000 to $2,000 per bus and require no maintenance.

Resources

http://www.epa.gov/otaq/retrofit

7.5 Design for Flexible Use

7.5.1 Credit: Design to Use components of the Building as Laboratory

1 point	Design the building so it can be directly used by the teaching staff as a laboratory (such as an accessible photovoltaic system and associated teaching components); OR the school must adopt a policy to follow a national program, such as the National Energy Education Development (NEED) Project, the Alliance to Save Energy's Green Schools program, or other appropriate program.

7.5.2 Credit: Design to Use as Red Cross/ Community Shelter

1 point	Design appropriate entrances and arrange with authorities to use the school as a Red Cross or emergency community shelter in the event of emergency. Enter into a contract with the Red Cross or appropriate emergency shelter provider to utilize the facility in emergencies.

Note: This design change could increase the Building Importance Factor used in structural requirements.

Documentation

Copy of executed emergency shelter agreement.

7.6 Innovations

7.6.1 Credit: Innovation Credits

1–3 points	Innovation Credits offer an opportunity to earn credits that follow in the spirit of the NY-CHPS requirements. These points can also be garnered to reward efforts that greatly exceed the existing credit parameters. To achieve innovation points: 1) Define the credit and its purpose; 2) Describe the proposed criteria for compliance including any applicable standards; 3) Identify and maintain documentation that verifies compliance with the proposed credit; and 4) Develop a narrative describing how the credit reflects sustainable or environmental health and safety practices. OR If the Innovation Credit is for exceptional performance in an existing credit area, then create a narrative of the design approach, which explains how credit was exceeded by a significant amount. Only one Innovation Credit may be applied to each criterion.

NY-CHPS is designed to be a comprehensive guide to high performance green design, but as new clean technologies and creative thinking evolve, there is a need to support and encourage them. These Innovation Credits are offered for communities that go beyond what is required by NY-CHPS and push on to achieve superior performance, educational and environmental benefits, and innovative policies.

Examples:

- Provide a "Green Roof" on the school. While Green Roofs are not common in the United States, they offer some significant benefits: capture of rainwater that reduces runoff; lower roof temperatures in the summer for less space cooling; added insulation for less space heating; and opportunities for students to learn about types of plants.
- Before renovation of a building and after construction is completed, test for lead and other contaminants in the water supply.
- Provide vented janitorial closets on each floor to facilitate ease of maintenance.
- For other examples of Innovation Credits, see the LEED-NC *Reference Guide Version 2.2*. As Innovation credits are achieved in NY-CHPS projects, they will be made publicly available.

Documentation

For each new credit attempted: 1) Define the credit and its purpose; 2) Describe the proposed criteria for compliance including any applicable standards; 3) Identify documentation requirements that verify compliance with the proposed credit; 4) Develop a narrative describing how the credit reflects sustainable or environmental health and safety practices; and 5) Maintain the documentation identified in #3.

OR

If the Innovation Credit is for exceptional performance in an existing credit area, then develop a narrative of the design approach, including an explanation of how the original credit was exceeded by a significant amount.

Appendix A: Glossary

ASHRAE — American Society for Heating, Refrigeration, and Air Conditioning Engineers

ASTM — American Society for Testing and Materials. www.astm.org

B-20 — B-20 is the term for a blend of 20% renewable bio-derived diesel fuel with 80% petroleum-based diesel fuel.

Biodiesel — Biodiesel is a domestic, renewable fuel for diesel engines derived from natural oils like soybean oil, and which meets the specifications of American Society for Testing and Materials D 6751. Biodiesel is not the same thing as raw vegetable oil. It is produced by a chemical process which removes the glycerin from the oil.

Bio-gas — Gas, rich in methane, which is produced by the fermentation of animal dung, human sewage or crop residues in an air-tight container. It is used as a fuel to heat stoves, lamps, run small machines and to generate electricity. The residues of biogas production can be used as a low-grade organic fertilizer.

Bio-oil — A liquid known as bio-oil can be created from biomass found in forestry and agricultural residues. The biomass is thermo-chemically converted to bio-oil by using processes called direct liquefaction or fast pyrolysis. The high water and oxygen content of bio-oils reduces their heating value to less than half the value of petroleum. However, bio-oils are low in viscosity and have been successfully burned in boilers, kilns, turbines and diesel engines.

Biomass — Biomass is any biological material that can be used as fuel. Biomass fuel is burned or converted in systems that produce heat, electricity, or both heat and power. In this document, biomass fired systems refer to systems that are fueled by clean wood chips from forestry or saw mill operations.

CSI — Construction Specifications Institute

CHPS — Collaborative for High Performance Schools

ComCheck — This is software developed by the U.S. DOE to help commercial projects demonstrate compliance with all commercial energy code requirements for envelope, lighting, and mechanical systems. For more information, see http://www.energycodes.gov/comcheck/

DOE-2 — Software that was developed by the U.S. DOE to predict the fuel consumption (both electric and fossil fuel) of a building based on its design. Later iterations include DOE 2.2, a more advanced form of the original software.

DOE-2.1E — This is an updated version of DOE-2 software.

E-Quest — (Energy QUick ESTimator) — eQUEST is sophisticated software that allows for detailed energy analysis of a designed building. It also allows users to build 2-D and 3-D displays of the building geometry.

NPDES — National Pollution Discharge Elimination System, a program administered by the U.S. Environmental Protection Agency.

PowerDOE — PowerDOE is another version of software that allows users to detail the predicted energy consumption of a building. Like e-QUEST, it is very graphical in its presentation of both the building description and the display of results. It includes 2-D and 3-D display of the building geometry.

VisualDOE — Energy modeling software that is based on DOE-2 and allows users to evaluate energy and demand impacts of design alternatives.

VOC — Volatile Organic Compound

Appendix B: Equipment Efficiencies

CEE High-Efficiency Commercial Air Conditioning and Heat Pumps High-Efficiency Specifications

Revised 12/21/04

Unitary Air Conditioners and Condensing Units, Electrically Operated

Equipment Type	Size Category	Sub-Category	Tier 2* Efficiency
Air Conditioners, Air Cooled (Cooling Mode)	<65,000 Btu/hr	Split System	13.0 SEER 11.6 EER**
		Single Package	13.0 SEER 11.0 EER**
	□65,000 Btu/hr and <135,000 Btu/hr	Split System and Single Package	11.0 EER 11.4 IPLV
	□135,000 Btu/hr and <240,000 Btu/hr	Split System and Single Package	10.8 EER 11.2 IPLV
	□240,000 Btu/hr	Split System and Single Package	10.0 EER 10.4 IPLV
Air Conditioners, Water and Evaporatively Cooled	All Sizes	Split System and Single Package	14.0 EER
		Split System and Single Package	14.0 EER
		Split System and Single Package	14.0 EER

SEER—Seasonal Energy Efficiency Ratio   EER—Energy Efficiency Ratio   IPLV—Integrated Part Load Value

**CEE Tier 1 was eliminated as of December 31, 2002 in response to increasing federal minimum standards.*

***CEE recognizes that SEER alone does not address demand savings, and encourages members to include measures that do. Use of this specification, while encouraged to promote continued improvement in demand performance, is at the discretion of participating utilities until such time as meaningful EER information is available for most potentially qualifying models.*

CEE High-Efficiency Commercial Air Conditioning And Heat Pumps High-Efficiency Specifications

Revised 12/21/04

Unitary and Applied Heat Pumps, Electrically Operated

Equipment Type	Size Category	Sub-Category	Tier 2* Efficiency
Air Cooled (Cooling Mode)	<65,000 Btu/hr	Split System	13.0 SEER 11.6 EER**
		Single Package	13.0 SEER 11.0 EER**
	□65,000 Btu/hr and<135,000 Btu/hr	Split System and Single Package	11.0 EER 11.4 IPLV
	□135,000 Btu/hr and <240,000 Btu/hr	Split System and Single Package	10.8 EER 11.2 IPLV
	□240,000 Btu/hr	Split System and Single Package	10.0 EER 10.4 IPLV
Air Cooled (Heating Mode)	<65,000 Btu/h	Split System	8.0 HSPF
		Single Package	7.5 HSPF
	□65,000 Btu/hr and <135,000 Btu/hr	47˚F db/43˚F wb Outdoor Air	3.4 COP
		17˚F db/15˚F wb Outdoor Air	2.4 COP
	□135,000 Btu/hr	47˚F db/43˚F wb Outdoor Air	3.3 COP
		17˚F db/15˚F wb Outdoor Air	2.2 COP
Water Source (Cooling Mode)	<135,000 Btu/hr	85˚ Entering Water	14.0 EER
Water Source (Heating Mode)	<135,000 Btu/hr	70˚ Entering Water	4.6 COP

SEER—Seasonal Energy Efficiency Ratio

EER—Energy Efficiency Ratio

HSPF—Heating Seasonal Performance Factor

IPLV—Integrated Part Load Value

COP—Coefficient of Performance

**CEE Tier 1 was eliminated as of December 31, 2002 in response to increasing federal minimum standards.*

***CEE recognizes that SEER alone does not address demand savings, and encourages members to include measures that do. Use of this specification, while encouraged to promote continued improvement in demand performance, is at the discretion of participating utilities until such time as meaningful EER information is available for most potentially qualifying models.*

MECHANICAL EQUIPMENT EFFICIENCIES REQUIREMENTS *ADVANCED BUILDINGS—BENCHMARK* *V1.1*

By New Buildings Institute

PACKAGE TERMINAL AIR CONDITIONERS AND HEAT PUMPS, ELECTRICALLY OPERATED

Equipment Type	Size Category	Required Efficiency
Air Conditioners & Heat Pumps (Cooling Mode)	<7000 Btu/hr	11.9 EER
	□7000 Btu/hr and <10,000 Btu/hr	11.3 EER
	□10,000 Btu/hr and <13,000 Btu/hr	10.7 EER
	□13,000 Btu/hr	9.5 EER

Source: Advanced Buildings—Benchmark Version 1.1

http://www.poweryourdesign.com/ABbenchmark.pdf -See Mechanical Equipment Efficiency Requirements—pp. 68-71.

ABSORPTION CHILLERS

Equipment Type	Required Efficiency Full Load COP (IPLV)
Air Cooled, single effect	0.60, but only allowed in heat recovery applications
Water Cooled, single effect	0.70, but only allowed in heat recovery applications
Double effect—direct fired	1.0(1.05)
Double effect—indirect fired	1.20

Source: Advanced Buildings—Benchmark Version 1.1

http://www.poweryourdesign.com/ABbenchmark.pdf -See Mechanical Equipment Efficiency Requirements—pp. 68-71.

MECHANICAL EQUIPMENT EFFICIENCIES REQUIREMENTS *ADVANCED BUILDINGS—BENCHMARK* V1.1

By New Buildings Institute

		Required Efficiency—chillers with ASDs or without ASDs		Required Efficiency—chillers with ASDs optional compliance path	
Equipment Type	Size Category	Full Load (kW/ton)	IPLV (kW/ton)	Full Load (kW/ton)	IPLV (kW/ton)
Air Cooled w/ Condenser	All	1.2	1.0	N/A	N/A
Air Cooled w/o Condenser	All	1.08	1.08	N/A	N/A
Water-cooled Reciprocating	All	0.840	0.630	N/A	N/A
Water Cooled, Rotary Screw and Scroll	<100 tons	0.780	0.600	N/A	N/A
	□100 tons and <150 tons	0.730	0.550	N/A	N/A
	□150 tons and ≤300 tons	0.610	0.510	N/A	N/A
	>300 tons	0.600	0.490	N/A	N/A
Water Cooled, Centrifugal	<150 tons	0.610	0.620	0.630	0.400
	150 tons and ≤300 tons	0.590	0.560	0.600	0.400
	>300 tons and ≤600 tons	0.570	0.510	0.580	0.400
	>600 tons	0.550	0.510	0.550	0.400

Compliance with full load efficiency numbers and IPLV numbers are both required.

Systems with single chillers that operate on 460/480V require ASDs. ASDs are optional in multiple chiller systems.

Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI Standard 550/590 test conditions (and thus cannot be tested to meet the requirements of this table) of 44ºF leaving chilled water temperature and 85ºF entering condenser water temperature must meet the applicable full load and IPLV/NPLV requirements in Appendix B, Tables 1-6 of Advanced Buildings, E-Benchmark version 1.1.

Source: Advanced Buildings—Benchmark Version 1.1

http://www.poweryourdesign.com/ABbenchmark.pdf -See Mechanical Equipment Efficiency Requirements—pp. 68–71.

Appendix C: Insulation Requirements

MINIMUM INSULATION REQUIREMENT R-VALUES AND MAXIMUM INSULATION U-FACTORS

Minimum Insulation Requirement R-Values and Maximum Insulation U-factors

For Climate Zone 5		
	R-Value	**U-Factor**
Roofs		
Insulation Entirely Above Deck	R-25 ci	U-0.039
Metal Buildings (with R-5 thermal blocks)[1]	R-19 □ + R-13	U-0.047
Attic and Other[2,3]	R-38	U-0.027
Walls Above Grade		
Mass, exterior insulation	R-11.5 ci	U-0.078
Mass, interior insulation	R-13	U-0.085
Metal Building	R-10 + R-13	U-0.061
Metal Framed	R-13 + R-5 ci	U-0.077
Wood Framed and Other	R-13 + R-3.8 ci	U-0.064

ci - continuous insulation
Source: Advanced Buildings – Benchmark v1.1 2005 pp. 54-55

[1] Thermal blocks are an R-5 of rigid insulation, which extends 1" beyond the width of the purlin on each side, perpendicular to the purlin.

[2] Where vapor permeable insulation is used, the temperature of any condensation plane should be kept above the dew point of the internal air.

[3] In any attic-type space, where insulation is blown or sprayed into the cavity, an additional R-11 of insulation is required.

Appendix D:

Materials Protection

PROTECTION OF BUILDING MATERIALS FROM WATER DAMAGE

SAMPLE SPECIFICATIONS FOR IEQ

A. General: The General Contractor must be responsible for protecting the Work from moisture, in order to prevent growth of fungus, bacteria and other biological contaminants.

B. Existing and New Building Construction:
   1. Refer to Division I for materials and installation of weatherproof enclosures.
   2. Remove and replace construction which becomes wet and has been wet for 24 hours or more, or which shows evidence of biological growth due to the presence of moisture.

C. Stored Construction Materials:
   1. Take precautions to prevent porous materials such as gypsum board, insulation, ceiling tile, wood and similar products from becoming wet.
   2. Discard construction material which becomes wet, or which shows evidence of biological growth due to the presence of moisture.

D. Humidity Control: After the building is enclosed, control humidity within construction areas using dehumidification equipment and desiccant drying techniques. Relative humidity within the building enclosure must be maintained at no greater than 35% RH while drying out the building and 60% RH thereafter.

E. Procedures for drying out construction materials that have become wet:
   1. In the case that an unanticipated event permits the entry of water into new or existing construction, the Contractor must perform procedures to dry out construction within 24 hours, to a degree that will not support biological growth using restoration drying techniques.

2. Identify wet materials and remediate in accordance with the following publication: United States Environmental Protection Agency, 2001, "Mold Remediation in Schools and Commercial Buildings". See: http://www.epa.gov/mold/mold_remediation.html or http://www.epa.gov/mold/images/moldremediation.pdf.
3. Construction that is not adequately dried out, or which shows evidence of biological growth, must be removed immediately from the construction area and disposed of legally.
4. Wetting by contaminated water and subsequent cleaning and decontamination must be supervised by a qualified company as approved by the Owner.