

HIGH PERFORMANCE BUILDING INITIATIVES IN MARYLAND PUBLIC SCHOOLS

ENERGY CONSERVATION, ALTERNATIVE ENERGY SOURCES, AND HIGH PERFORMANCE BUILDING PRACTICES

SUBMITTED TO THE BOARD OF PUBLIC WORKS

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Evergreen Elementary School, St. Mary's County
LEED Gold School

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HIGH PERFORMANCE BUILDING INITIATIVES IN MARYLAND PUBLIC SCHOOLS

Executive Summary

Maryland's High Performance Schools

Across Maryland, a culture of innovation in the design and construction of school facilities has taken root under a variety of names: "high performance schools," "green architecture," "sustainable design." This fourth annual report describes a variety of high performance initiatives, from energy conservation resulting from behavior changes, through use of alternative sources of energy, to enhanced daylighting. The majority of school systems are actively promoting a culture of conservation and energy awareness among teachers, staff, and the students themselves. Design innovations that have an impact on the environment include the use of materials with recycled content or made from renewable sources, materials that have low levels of "embedded" energy (the energy expended in the production, transportation, and installation of the material), and geothermal ground source heating and cooling systems (see Appendix 2, "Maryland Schools with Geothermal Mechanical Systems," page 47. In the construction phase, increasing attention is being paid to protecting soils, recycling waste materials, mitigation of downstream and downwind site impacts from stormwater run-off, and sequencing the work to improve the indoor air quality of the building when it is occupied. Thirteen school systems have a total of 43 LEED (Leadership in Energy and Environmental Design) certification school facilities in various stages of planning, design, construction and occupancy, and as a result of the High Performance Building Act of 2008, all new schools are required to achieve a certification of LEED Silver or equivalent (see "Maryland Certified High Performance Schools," page 46).¹

These innovations reflect a growing national and international recognition of the importance that facilities of all types play in energy consumption and environmental quality. Approximately 40% of the world's total energy consumption is generated through the construction and operation of buildings, and buildings are heavily implicated as well in the production of greenhouse gases and other forms of pollution.² With approximately 125,000,000 square feet of building space in Maryland being used for schools, any significant improvement in the energy and environmental characteristics of school buildings, including their location and how they are sited, will make contributions in these areas. As public buildings that are prominent in the life of communities, schools can serve as models of good environmental stewardship, not only for the adults who visit them, but especially for the young people whose attitudes are being formed through education and through exposure to the actions of their elders. Moreover, there is increased recognition of the relation between the quality of a school facility and learning: while the teacher is always the most important factor in a child's education, good schools can support the teacher's difficult mission by providing facilities that are healthy and inspiring, and in some cases they can serve as teaching tools related to the science, math, environmental, and social studies curricula. Maryland's most recent Gold Certified LEED school, the Evergreen Elementary in St. Mary's County, was specifically designed from the outset with this pedagogical goal in mind.

High performance schools are becoming increasingly attractive to local governments because they are more efficient and cost effective than conventional school facilities over the life span of the building. In 2003, it was reported that a premium of between 1.6 and 2.4 percent above conventional costs was required to achieve LEED Silver certification.³ It is anticipated that as high performance expectations and expertise permeate the world of developers, architects, and constructors, the cost for high performance facilities will converge with the cost of conventional construction. Concurrently, as

¹ The requirement applies only to new schools for which the request for proposal for architectural/engineering services was released after July 1, 2009; however, a number of school districts took the initiative to move forward with LEED certification before the requirement became effective. Several others have designed and built new schools to "LEED-like" standards without undertaking the additional administrative efforts that are involved in certification.

² National Council of Architectural Registration Boards, *Sustainable Design* (Washington, DC: NCARB, 2001) p 3

³ Kats, Gregory *et al.* "The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force." Report developed for the California Sustainable Building Task Force, October 2003 1-134. 06., available at <http://www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf>.

energy costs rise, the pay-back period for the energy-related first costs in a LEED school becomes increasingly shortened. For example, while it is now estimated that the pay-back period for a geothermal ground source heat pump system is approximately seven years, first costs for geothermal systems have dropped so rapidly in the lower Eastern Shore since 2006 that savings are reported to accrue as soon as the systems are put into operation. This striking reduction of costs is thought to be entirely attributable to the contractors' increasing familiarity with the system rather than to changes in the technology. Many high performance technologies, including geothermal systems, have become more reliable in the last decade. High performance buildings also achieve significant reductions in water usage, an issue of heightened concern as water supply becomes the major factor that limits new development in some parts of Maryland. Sustainable sites, defined as school sites that reduce vehicle miles traveled (VMT), support neighborhood connectivity, and promote the health of communities and the environment, also reduce both energy consumption and the carbon footprint of the building over their life cycles.⁴ Other types of benefits that result from these innovations, including health improvements for building occupants, enhancement of educational achievement for students, and increased productivity and retention of staff, are real but are difficult to translate into financial terms.

The State Role: Policies and Practices

Through the policies and practices of the Interagency Committee on School Construction (IAC) and other agencies, the State of Maryland supports local efforts to achieve high performance schools:

- *The High Performance Buildings Act of 2008* (Chapter 124, Maryland Laws of 2008; Senate Bill 208 / House Bill 376). Passed in the 2008 session of the General Assembly, this legislation requires that all new schools for which the architectural/engineering proposal is issued after July 1, 2009 must achieve a rating of LEED Silver or equivalent from a nationally recognized accreditation entity. The State will pay for 50% of the additional local costs for fiscal years 2010 through 2014; the IAC has determined that the additional local costs will be calculated at 2% of the combined building and site costs of the project. There are currently a total of 43 schools, including three renovation projects, that have attained or are seeking LEED certification: 27 are in various phases of planning, nine are under construction, and seven are completed or occupied.
- *Smart Growth Policies*. Through the high performance certification points that can be achieved for the location of a school and its accessibility by pedestrians and mass transit, the High Performance Buildings Act of 2008 aligns with policy objectives under development by the Governor's Smart Growth Sub-Cabinet and by the Maryland Department of Planning. Since increased energy usage is associated with high levels of vehicle miles traveled by bus fleets and by parents who drive children to and from schools, the location of schools and the accessibility of school facilities to neighborhoods for walking, bicycling and transit are factors that affect energy usage over the life cycle of school facilities. Nationwide, the cost of bus transportation is a large element of the operating budget of school districts. Siting schools so that walking, bicycling, and public transit are viable travel options will support active communities, reduce energy consumption levels, lower operational costs for school systems, and improve student health.
 - *Smart Sites*. Three public schools have been included in the first round of Smart Site candidates approved by the Smart Growth Sub-Cabinet in the summer of 2009. As Smart Sites, these schools will be targeted to receive coordinated technical assistance from a set of State agencies in order to provide visible evidence of the advantages of smart growth planning. The Hyattsville Elementary School project in Prince George's County is linked with downtown revitalization and neighborhood conservation efforts in the Hyattsville Route One corridor, and will support the locally adopted "Gateway Arts District" Sector Plan of the Maryland-National Capital Park and Planning Commission. The Calvert Middle School project will provide on-site environmental education resources and will link into a larger plan to develop a compact, pedestrian oriented town center in Prince Frederick. The Germantown Elementary project in Anne Arundel County will address site

⁴ Maryland Department of Planning, *Models and Guidelines Document Number 27 "Smart Growth, Community Planning and Public School Construction"* (Baltimore: Maryland Department of Planning, 2008)

beautification and improving the walkability of the school site through sidewalks and other infrastructure improvements. All three projects are at early stages of conceptualization.

- *Task Force on the Future for Growth and Development.* Because of their influence on urban growth patterns, school location and sites have been an important topic of discussion for the Task Force on the Future for Growth and Development, commonly referred to as the 773 Task Force, established in 2007. In the summer and fall of 2009, the Task Force examined, among other issues concerning schools, the potential to build compact schools on small sites in order to support built-up areas within and reduce housing development outside of Priority Funding Areas (PFAs), and whether and how schools should be subject to PFA review in a manner similar to State funding for highways, sewer systems, and other types of infrastructure. Recommendations regarding these issues will be presented to the Governor in early 2010.
- *Models and Guidelines Document.* “Smart Growth, Community Planning and Public School Construction.” Issued in July 2008 as publication Number 27 of the Maryland Department of Planning series *Managing Maryland’s Growth*, this document provides guidance and a model process to assist local jurisdictions in the selection, development, and design of school sites that will concurrently support the educational program while enhancing the quality of community life and protecting the natural environment. The document describes methods for integrating school planning, funding and design with community planning, public health, walkability, energy efficiency, co-location, and transportation choices and costs. The document includes an extensive bibliography of research and reports that demonstrate the linkages between good school planning and environmental, transportation, and health benefits.
- *Maryland Green Building Council.* The Interagency Committee on School Construction has been represented since 2007 on the Maryland Green Building Council through two of its members, the Secretary of the Department of General Services and the Deputy Secretary of the Maryland Department of Planning, and through its Executive Director. In the annual report, found on the Department of General Services website at www.dgs.maryland.gov, the Council details its efforts to promote the practice of green building in the state. Evergreen Elementary School, Maryland’s most recent LEED Gold school, is featured on the cover of the 2009 MGBC annual report.
- *Department of General Services Energy Performance Standards.* The regulations of the Public School Construction Program (PSCP), which implements the policies of the Interagency Committee, require that all State-funded school construction projects must follow the Department of General Services *Procedure Manual for Professional Services* standards for energy conservation, life cycle cost analysis, and roofing.
- *Conserving and Enhancing the Natural Environment on School Sites.* Since 1999, every major new school construction project must include site features that will conserve or enhance the natural environment and contribute to the environmental education program. Such features include bio-retention areas, stormwater management ponds, gardens, wetlands, forest trails, and meadows. These site enhancements are usually connected to the educational program, particularly in the areas of environmental science, biology, social studies, mathematics, and the arts.
- *Communication.* The PSCP encourages high performance design initiatives through the promulgation of best practices at tri-annual facility planners meetings, publication of this annual report on high performance initiatives in Maryland schools, and its work on legislation to address the financing of sustainable improvements. Through the Designee for the State Superintendent of Schools, the PSCP is linked to the Maryland Association for Environmental and Outdoor Education (MAEOE) Maryland Green Schools Program of the Maryland State Department of Education.

The Report

The information in this report was collected in January 2010. Each local educational agency (LEA) has reported on their own initiatives; the Public School Construction Program has organized this material into larger categories that will be useful to decision makers and school facility planners throughout the region. The ten categories follow an approximate gradient from least to most costly, and from those that are most easily implemented with existing resources to those that are most difficult to implement. Within each category, the school districts are listed in alphabetical order. Efforts have been made to reduce redundancy and repetition; however, in a field as complex as high performance facilities, overlap and multiple references are inevitable. The principle topics are:

- I Innovations in Policies, Programs, Regulations and Guidelines
- II The Human Element: Behavior Modification, Public Education and Personnel Training
- III Conserving Natural Resources
 - A Energy Conservation
 - B Water Conservation
- IV Improved Practices
- V Energy Procurement Strategies
- VI Preventive Maintenance Programs
- VII Alternative Energy Sources
- VIII Capital Improvements
- IX Preservation and Enhancement of the Natural Environment
- X The Comprehensive Approach: High Performance Initiatives

HIGH PERFORMANCE BUILDING INITIATIVES IN MARYLAND PUBLIC SCHOOLS

I Innovations in Policies, Programs, Regulations and Guidelines

Allegany

- Adopted an Energy Management, Conservation Policy in 2003. Specific Energy Conservation Guidelines were developed and have been implemented.

Anne Arundel

- Promotes sound design and construction practices in energy consumption and conservation through the educational and design specifications, bolstered by Department of General Services (DGS) guidelines.
- 10% of the scoring used in the evaluation criteria in requests for proposals for architectural and engineering services concerns the firm's experience with high performance school design.

Calvert Adopted a new energy conservation policy in December 2008.

Caroline Has developed and adopted an energy conservation policy with the assistance of Energy Education, Inc. An Energy Educator/Manager is responsible for implementing the policy.

Cecil

- The Board took action on an energy conservation policy and regulation in February 2008.
- Has developed design standards that specify energy efficient and environmentally friendly features.

Dorchester

- Adopted an Energy Conservation Policy and Procedures.
- Emphasis is placed on re-use of existing facilities rather than replacement schools wherever possible.
- Starting with the New North Dorchester Middle School replacement, special emphasis is applied to carefully defining the teaching technology needs of the end-users in the classroom.

Harford

- The Board of Education approved a comprehensive energy management plan in June 2008 to reduce resource and energy consumption while creating a more environmentally sustainable organization. The plan included hiring a resource conservation manager and formation of a central committee to steer the direction of the program. The committee has developed a new energy policy and energy conservation guidelines.
- Current design standards call for specific energy efficient features such as low-E glass, mechanical systems, centralized energy management systems, insulation values, and light sensors.
- Developed and approved an Energy and Resource Conservation Policy as well as procedures.
- Established an Energy and Resource Committee to identify short and long-term opportunities, and respond to the needs of the schools. Subcommittees have been formed for Recycling, Green Cleaning, Curriculum, and Incentives Programs. These committees advise the main committee.
- Current design guidelines require that all new County buildings and public schools be designed in accordance with the Leadership in Energy and Environmental Design (LEED) Silver Rating or an equivalent rating under a comparable green building performance measure.

Howard

- Promotes a Green School strategy which integrates educational and facility related efforts, including LEED standards in future new construction.
- To provide guidance, a Resource Conservation Plan has been developed to concisely communicate energy and environmental initiatives within HCPSS. Temperature guidelines

are incorporated into this plan to evenly regulate space temperatures as well as to reduce waste.

Kent Has implemented an energy management program with the adoption of policy and guidelines. The policy and guidelines were disseminated to all KCPS employees.

Montgomery

- Approved an energy conservation policy in 1973 and amended it in 1997.
- The board reviews an annual MCPS Resource Conservation Plan including extensive electricity and water conservation guidelines and procedures.
- At the start of each school year, all schools are required to file a SERT plan, identifying team members and planned activities.

Prince George's

- In October 2007 the County Executive formally established the “Go Green Program”, establishing a “Go Green Program” Executive Steering Committee to reach the five goals listed below. The Executive Order further required that an Energy Manager be hired and an Energy Efficiency Council be established with representation from County agencies to lead the energy conservation program and to engage all County employees in the process. The Board has adopted the Prince George’s County’s Go Green Initiative Executive Order. An Energy Manager has been hired. The five goals are:
 - Reduce energy consumption per square foot in all existing County buildings by 20% by year 2015;
 - Design and construct all new County buildings and public schools in accordance with the Leadership in Energy and Environmental Design (LEED) Silver Rating or an equivalent rating under a comparable green building performance measure;
 - Establish incentives for both new and existing private commercial buildings to achieve a LEED Silver Rating or an equivalent rating under a comparable green building performance measure;
 - Establish green building education and outreach programs; and
 - Ensure that a sufficient number of development and permit review staff possess LEED accreditation to assist commercial developers or large-scale property owners in meeting performance measures.
- Requires a LEED Accredited Professional on every project.

Queen Anne's Developed energy guidelines (as policy) and disseminated them to all schools.

St. Mary's The Board of Education has endorsed an energy conservation plan:

- An energy committee will develop a program, identify short and long-term opportunities, and respond to the needs of the schools.
- Site teams at each school will determine and target specific conservation measures.
- An energy manager will develop and implement the energy conservation program, working closely with the committee and site teams and providing training and education to the students, faculty and staff.
- Green School coordinators at each school will work under the energy manager to increase energy conservation awareness, environmental awareness, support training, and provide on-going guidance.
- Signed a joint resolution with county government to implement sustainability and energy efficiency measures.

Somerset Has developed an energy conservation policy to complement the guidelines proposed by Energy Education, Inc.

Talbot Has developed energy conservation guidelines that were disseminated to all schools.

Washington Created a Superintendent’s Energy Advisory Committee to share ideas between Instruction and Facilities, Maintenance, and Operations regarding energy conservation practices. The committee meets on a monthly basis during the school year.

Wicomico Energy conservation policy guidelines have been developed to encourage reductions in energy use and resource conservation measures for all of its buildings.

Worcester All designs utilize the DGS manuals “Procedures for the Implementation of Energy Conservation” and “Procedures for the Implementation of Life Cycle Cost Analysis and Energy Conservation.”

II The Human Element: Behavior Modification, Public Education and Personnel Training

Allegany

- Has continued a partnership with Energy Education Inc. that was implemented in 2003. The energy conservation program stresses behavioral changes and has provided substantial reductions in energy usage.
- All schools receive periodic reports on energy usage and are encouraged to develop plans to reduce usage.
- Has established an Outdoor Education Program for all fifth grade students. The students attend a one week residential environmental education program at the Western Maryland 4-H Center in nearby Garrett County. Students learn about the natural world, explore the forest and lake ecosystems, and work cooperatively through hands-on lessons designed to extend and enhance classroom learning.

Anne Arundel

- Utilizes energy education and various other environmental themed lesson plans within the K-12 classroom as part of the AACPS instructional program.
- Going “green” is promoted throughout all levels of the workforce and in the instructional arena.
- The Superintendent’s FY2009 Operating Budget funded a program to solicit a contractual energy educator/trainer and to establish a demand-side behavioral modification program in an effort to improve the human element of the equation. The energy educator program has been delayed due to fiscal concerns.
- Seventeen elementary, one middle, and three high schools participate in the Maryland Green Schools program. Other schools are actively engaged in obtaining similar accreditation status.
- Environmentally themed co-curricular clubs and outdoor educational opportunities are supported.

Baltimore

- Energy Conservation guidelines were developed and disseminated to all schools and a “Turn Off” campaign is continuously being encouraged, concurrent with the development of a user participation program for conservation of energy by behavior modification of occupants
- Initiated an Environmental Action Team (EAT) - The team meets once every two weeks for discussion and corrective action on energy conservation and environmental issues
- Conducted demonstrations and training with the building operational and maintenance staff to improve communication and awareness on energy conservation issues
- Distributed energy conservation posters to every school in the system
- The Energy Management and the Office of Science partnered in an effort to focus on sustainability issues inside the school building
- All fourth grade students are required to complete an Eco-Scouts science unit which includes completion of a schoolyard habitat restoration project
- Thirty-six schools have been certified as green schools under the Maryland Green School program

Calvert

- The Supervisor of Energy Management has established a training program that is administered annually at each school site to inform and educate students and staff on proven ways to conserve energy. This program is responsible for a major portion of the reduction in energy consumption.
- The Division of Instruction has initiated a Green School Program to educate and promote recycling and energy conservation.
- Is working to create a link between the instructional program and the Calvert community with the green design features at the new Calvert Middle School. This capital project has been designated as a "Smart Site" (see Executive Summary). The school facility will serve as a model and as a catalyst for increasing public understanding of the connections between the natural and the built environments.

Caroline

- Is in the second year of a five year contract with Energy Education, Inc. to change 'energy behaviors'. Positive impacts have already been realized.
- The first ten months of an energy conservation program have resulted in nearly \$200,000 of energy savings, representing 15% of budgeted energy costs.

Carroll Has instituted sustainable energy and environmental education/communication training for operations and maintenance personnel:

- In the fall of 2008, instituted a system-wide effort to reduce electricity consumption through behavior modifications such as darkening spaces when not in use for more than five minutes, powering down computers and monitors at the end of each day, and turning off any other electrical devices when not in use.
- The superintendent challenged all students and staff members to develop energy reduction strategies at each school and administrative building.
- Distributed recycling containers systemwide to encourage conservation efforts.

Cecil

- Appointed an Energy Education Coordinator in spring 2008 to develop and implement a system-wide energy education program with the goal of educating all stakeholders on how their habits and actions have a direct impact on the use of natural resources. By communicating savings data, conservation efforts, and best practices, CCPS hopes to instill a "green" ethic throughout the school system and beyond. FY 2009 marked the first full year of implementing energy and natural resources conservation practices. In the first year, CCPS saved 2.5 million kWh of electricity; combined conservation efforts allowed the system to save approximately \$1.2 million.
- Offers incentives and rewards for schools demonstrating top conservation efforts, conducts energy audits of each of its buildings, and regularly distributes resources and savings data to each building to help energy users to become accountable for their energy consumption.
- Has forged a partnership with NorthBay Outdoor Adventures and works with several student groups providing hands-on natural resource conservation learning and activities.
- Key achievements of the program to date:
 - A ban on personal small appliances (coffee pots, mini-refrigerators, and microwaves)
 - A single stream recycling program
 - All office and non-instructional computers and monitors, as well as other electronic equipment (printers, copiers, scanners, laminators, etc.) are turned off at the end of each day
 - Lights are to be turned off when rooms or work areas are unused for more than 15 minutes.
 - Lighting up an entire building or floor for cleaning is to be discontinued.
 - All outside lights, including marquis and signs, are to be turned off as appropriate.
 - Athletic and sporting activities are scheduled so as to reduce the need for field and stadium lighting.
- Publishes annually a Best Practices For Energy & Resource Conservation handbook to serve as a tool and reference regarding current conservation measures and expectations.

- Implemented a Peak Load Capacity Protocol to notify building occupants via e-mail when there is a high probability of a Peak Load Capacity (“red” day) for the electrical transmission system during summer months
- Established an Energy Champion program. Volunteers are solicited at each building site to serve as their building’s Energy Champion and serve as liaisons for the energy education program.
- Employees are reminded to dress appropriately depending on the season.
- Secured a grant of \$18,500 through MSDE and MEA to further the efforts of the conservation program. The funds will be used in the coming year to: supplement a voluntary task lamp and power strip program; pilot Vending Miser® and Snack Miser® technology; purchase light meters and Kill-A-Watt devices; produce approximately five short educational videos to be streamed in all schools; host the Energy Hog Traveling Road Show at all 17 elementary schools; hire guest speakers/trainers; and supplement printed material costs.

Charles

- Is developing instructional materials to promote student energy conservation awareness, as well as ideas and concepts that students can share with their families at home. The curriculum includes age-appropriate discussions on the nature and extent of energy and its resources, energy conservation and efficiency, the economic and environmental effects of energy use, and alternative energy technologies. The division is also developing a curriculum for promoting enhancement of the “green” environment.
- There is a system-wide policy prohibiting the opening of windows and exterior doors during the heating and cooling seasons.
- Temperature ranges can vary for other areas in the school—gyms, for example, need not be heated to the same temperature as classrooms when physical activity is scheduled. Auditoriums, hallways, storage rooms, and other little used rooms are not heated and cooled to the same temperature as occupied rooms.
- Many rooms and areas that have windows in direct sunlight are equipped with operational blinds that can help control temperature by being closed in the cooling months and opened in the heating months.
- Optimum comfort levels for relative humidity are maintained between 35–60 percent during the cooling season, and above 50 percent during the heating season.
- Maximum use of natural lighting is encouraged throughout the system. Partial lighting and dimmer switches are used where appropriate. All lights, including outside lights, not necessary for safety are turned off when rooms are not in use.
- Encourage turning off televisions and VCRs when not in use, and computers and copiers at the end of the day.
- Increase energy savings and equipment life by educating equipment users on how to properly operate energy consuming devices

Dorchester Is in the fourth year of a contract with Energy Education, Inc. to alter employees “energy behaviors” in order to change energy consumption. Positive impacts are already being realized.

- Provides energy rewards for schools/buildings.
- Communicates Energy Policy and Procedures and expectations to staff.
- Has instituted mandatory monthly training and professional development for all building head custodians to instill “ownership” in their facilities and establish expectations that go beyond cleaning and satisfying regulatory requirements; has led to an increased sense of professionalism and a desire to address as many facility problems at the building level as possible.

Frederick Carried forward with “Be An Energy Saver” campaign in all schools and central office buildings:

- Awards are given to students and staff in recognition of outstanding energy conservation.
- Energy emissaries have been appointed at all schools.
- Reporting of energy use on a school-by-school basis occurs quarterly.
- The program encourages personnel to:
 - Turn off lights, computers and other appliances when not in use;
 - Dress appropriately for the building climate, and;

- Promptly report any heating, cooling or other building issues.

Harford

- Has 20 schools in the Maryland Green Schools program, with other schools actively engaged in obtaining accreditation status.
- Energy and Resource Conservation Policy and Procedures were developed concurrent with development of the Harford Environmental Leadership Program (HELP). The goal of the Program is to conserve energy and other resources through, among other features, behavior modification of the school community.
- Provides ongoing training workshops for Leadership in Energy and Environmental Design (LEED) for the Facilities and Planning and Construction departments.
- The Resource Conservation Committee works in tandem with the Earth and Environmental Science programs to focus on sustainability issues inside the school buildings and provide real-world problem solving opportunities for students.
- Conducts demonstrations and training with the Building Engineers and Chief Custodians to improve communication on energy and resource conservation issues.
- Secured a grant of \$18,500 through MSDE and MEA to fund a student centered energy reduction competition. The funds were used to purchase occupancy sensors for lighting in student designated areas of the school building. Students were provided with the energy reduction data for their schools.
- Awarded a \$5,000 grant by the Maryland Energy Administration to install a supplemental solar hot water heater at Norrisville Elementary School. The unit is located so that it can be used as an educational tool.

Howard

- The Superintendent of Schools is a panel member of Maryland's Partnership for Children in Nature, and other staff members are actively involved in the Environmental Literacy Working Group and the School Yard Habitat subcommittee.
- A system-wide energy awareness program, funded through the school system's Energy Management Department's budget, provides tools, training and workshops to involve students in a hands-on approach to learning about energy and energy conservation. Tools that measure and analyze energy consumption in the school buildings are provided as real-life science projects. Presentations to students, staff and administrators provide practical solutions to energy dilemmas in the school environment and encourage students to actively change energy consumption behaviors and to take the message home to their own families.
- All schools receive periodic feedback on energy usage and have the opportunity to work with energy management personnel to train staff and students on energy and energy awareness. A web based database of utility information is shared with administrators and teachers for inclusion in projects or teaching assignments.
- All schools are eligible to receive a portion of their school's energy savings through an energy rebate program. Cost savings are shared with schools in order to reward behavior modification and conservation activities.
- By 2009, 18 schools had received certification or recertification in the Maryland Green Schools Program. An additional 30 elementary, middle and high schools are working towards the certification. Through the Elementary Science Office, a vast resource database is provided on the intranet to support these schools in their two-year program.
- A voluntary program providing task lamps and power strips has assisted staff in the "turn off and unplug" campaign to change staff behavior and has been successful in reducing energy consumption as well as phantom load consumption.
- An energy manager will develop and implement the energy conservation program, working closely with the committee and site teams and providing training and education to the students, faculty and staff.
- Resource Conservation Administrators at each school will work with the Resource Conservation Manager to increase conservation awareness, support training, and provide on-going guidance.
- Working to integrate educational curriculum and environmental stewardship.

Kent Contracted with Energy Education Inc in 2007 to develop and implement an energy program that incorporates personnel training and school system behavior education. From April 2008 to October 2009 the school district achieved a 36.94% cost avoidance.

Montgomery

Since 1995, MCPS has operated a School Energy and Recycling Team (SERT) program, providing support and resources for in-school teams to adopt a culture of energy conservation and active recycling. A variety of tools, resources, and trainings are available through numerous media channels to create awareness and inspire participation in the mandatory program.

- School administrators are required to submit an annual action plan that designates staff to lead and participate in the energy conservation and recycling programs, states expectations, and provides strategies and opportunities for improvement in both energy conservation and recycling.
- Energy conscientious behavior and successful recycling are rewarded and recognized through monetary incentives granted to high performing schools. School performance is evaluated based on quarterly energy and recycling data, school observation data, and active school artifacts submitted by schools to the SERT office. Schools can access historical quarterly energy data and monthly recycling rates through an interactive SERT website. Additional awards are available to schools actively participating in the SERT program, as evidenced from quarterly site visits made by SERT energy facilitators and activities completed and submitted by schools for credit. Energy and recycling efforts are celebrated, recognized, and featured through various centralized communication channels including the MCPS Bulletin, MCPS website, SERT Flash, and SERT website. Staff who demonstrate significant contributions towards a culture of conservation are nominated to the Superintendent for an "Above and Beyond the Call of Duty" Award (ABCD).
- The SERT program integrates education related to energy conservation and recycling into the support provided to school-based energy/recycling teams:
 - Students are encouraged to conduct in-depth, topic-specific science explorations, and participating teachers can utilize energy and recycling activities provided through the SERT staff and website. Energy analysis tools are available to all schools through the "Lend-a-Tool" program.
 - SERT coordinates and partners with community groups to increase awareness, enhance energy and recycling program participation, and adopt environmentally responsible practices.
 - System-wide contests are developed for students at different grade levels to create awareness campaigns relating to energy conservation and recycling. Contestants are recognized and rewarded through certificates, ceremonies, and monetary incentives.
 - Centralized training is available for staff, students, and SERT members to assist in the development of a sustainable energy conservation and recycling team. Students and staff learn about the structure of the program, eligibility requirements for awards and incentives, activities and tools used, recommended recycling infrastructure, expectations of the program, and additional programs and initiatives in which their schools can participate. Staff can request private training and assessments at their school site from SERT staff. Training for SERT is centralized and participants are awarded professional development credit for successful completion.
- SERT provides training components to supporting divisions within MCPS to encourage participation and increase awareness of the importance of energy conservation and recycling. Building service staff receives training through their leadership training program. Training also is provided to trade mechanics at maintenance depots who are participating in energy-efficient technology upgrades.

Prince George's Suitland Elementary School was designed with the partial objective of using the building as a teaching tool by making "green" building features as visible as possible. Features include a demonstration photovoltaic (PV) array on the gym roof and photovoltaic shingles on the south roofs, an outdoor teaching classroom adjacent to the science classroom, an outside courtyard with a "Bay Saver" landscape, and "School Yard Habitat" planting.

Queen Anne's Contracted with Energy Education Inc. (EEI) in 2005 and has hired a coordinator to audit energy consumption, educate employees in energy savings, and introduce and monitor energy savings strategies. This program addresses personnel training and behavioral changes.

St. Mary's Has taken a leadership role in promoting environmental and resource stewardship in the local community. Among its educational programs are the following:

- Green School Coordinators and teachers work with students at each school to reduce their energy use and capture the coveted "Energy Flag." The Board of Education encourages schools to become Green Schools, integrating environmental instruction, professional development, conservation practices, and community partnerships.
- Utilizes a mobile classroom at outreach community events and schools to promote sustainability through hands-on activities.
- Provides performance-based incentives to the school-based energy conservation teams.
- Created an environmentally-friendly terrapin mascot named "Wattson" to be the green school ambassador. Wattson works with students to identify conservation measures and develop positive environmental habits.
- Evergreen Elementary School, a LEED gold school, is a learning laboratory for energy efficiency, alternative energy, and sustainable living:
 - Students are able to see energy consumption and comparisons in real time at an energy and information kiosk.
 - The system's energy data is tracked with web-based software (UtilityDirect by SchoolDude) allowing all locations on-line access to their energy consumption and expenditure data. This data is used as a learning tool for students and allows site administrators to stay updated on their energy conservation efforts.
- Formed a partnership with the local electric cooperative to provide energy saving kits to families, with a return incentive of \$25/kit donated to the school.
- Training of staff in the LEED program is on-going.

Somerset

- Is in the second year of an energy management contract with Energy Education, Inc., working with staff and students to change energy practices.
- Has hired an energy manager to audit schools to identify wasteful or promising practices.
- Estimates that in the first 15 months savings due to behavior changes exceeded \$400,000.

Talbot

- Has implemented an energy education and management program with EEI Inc. of Wichita Falls, Texas. The school system's year to date, degree day adjusted usage is 22% below the base year, and is 19.5% lower overall.
- A "turn off" campaign is continuously being encouraged, concurrent with development of a user participation program for conservation of energy by behavior modification of occupants.

Washington

- Is seeking grants to install a small (1 KV) photovoltaic solar generator and a small wind mill generator to be used as demonstration models for students.
- Is designing a green modular/portable demonstration classroom as part of a building project for Washington County Technical High School students
- Washington County Technical High School has been awarded an InvenTeams grant from the Massachusetts Institute of Technology to participate in a research team that is developing a roof system that will change color according to the outside temperature. The roof would be dark on heating days and light on cooling days, and would collect solar radiant heat in the winter and reflect it in the summer.
- Has established an energy conservation/green schools committee to review current energy practices and determine methods to increase student and staff participation in the effort to conserve energy and protect the environment.

III Conserving Natural Resources

A. Energy Conservation

Allegany

- A pilot project to retrofit existing temperature control equipment in two older elementary schools has proven successful in reducing energy usage. The internet-based system will be expanded to include two additional schools in 2010.
- Installed motion sensors for lighting in restrooms at one facility and motion sensor room thermostats at one elementary school. This program will be expanded to other facilities in the future.
- Reduced the summer work week to four 10-hour days.

Anne Arundel

- Has a centralized Energy Management Office within the Facilities Division with a staff of four. Over 90% of AACPS schools have automated Energy Management Systems (EMS) that generate efficiencies through centralized scheduling, monitoring, operating, and trouble-checking of buildings and energy systems. The majority of the Energy Management Systems were initially installed as part of a multi-phase energy performance contract (EPC), one of the first major public sector EPCs in the State. These systems, and the electro-mechanical equipment that they control, continue to be aggressively updated or replaced as funding permits with more modern and energy efficient strategies.
- Issued an executive order to lower/raise the heating/cooling criteria set-point system-wide in 2008 in order to reduce fuel, oil, gas and electricity consumption.
- Consolidates after-hour, weekend and summer building usage patterns by aggregating more users into fewer structures.
- Performed a lighting retrofit in the early 1990s to most schools to install T-8 fluorescent tubes and electronic ballasts

Baltimore City

- Entered into an agreement with four Energy Service Companies (ESCOs) with the goal of producing guaranteed savings through reduced energy consumption to carry out necessary improvements to aging buildings and systems.
- Participates in the Baltimore Gas and Electric Company (BGE) rebate program for energy efficiency and management of energy costs through the installation of eligible new equipment.

Baltimore

- Created a database to identify an energy efficiency index for all schools.
- Conducted an energy audit for eighty-seven energy inefficient schools to develop low cost/no cost energy conservation measures and major projects for inclusion in the capital and other major maintenance programs.
- Developed and implemented a Peak Load Capacity (PLC) protocol for selected buildings resulting in demand control savings.
- Completed random inspections for compliance with energy guidelines at twenty schools.
- Continued a program of installing programmable electronic controls in portable classrooms.
- Converted building automation single zone scheduling to multiple zone scheduling.
- Increased the number of support staff focusing on building automation controls.
- Installed motion sensors for lighting in several schools.
- Initiated a program to closely monitor scheduling of equipment based on weather conditions and building usage.

Calvert

- Adjusted all heating and cooling setbacks by 4 degrees in order to reduce fuel, gas or electrical usage.
- All new buildings and new HVAC systems are monitored and controlled through an Energy Management System to reduce energy usage when buildings are in unoccupied mode.

- Classroom trailers have been retrofitted with an energy management system (Envirotrol CS2000) which is programmed for occupancy and environment set points. Energy savings have been achieved in classroom trailers, a major source of energy consumption.
- The Supervisor of Energy Management has retrofitted schools with energy saving devices such as energy efficient lighting fixtures, lamps (T-8), LED exit fixtures, occupancy sensors and zoned lighting in classrooms to utilize daylight as funding allows.
- Achieved a 10% reduction in energy use from the previous year.

Caroline

- All schools are on a centralized Energy Management System which has recently received an extensive software upgrade.
- Utilizes a four day work week during the summer, and closed for two weeks during the winter holiday, to conserve energy.
- Installed microprocessors on several boilers to compute a percentage of the last off-cycle and an economy factor to reduce the total amount of burn time and ignitions.

Carroll

- Utilizes an Energy Management System to monitor and control the building environment.
- Installed Vending Misers on all vending machines.
- Instituted a program to replace oil fired boilers with high efficiency gas fired systems.
- Utilize energy and utility data to identify areas for improvement.

Cecil

- In April 2008, partnered with Energy Star to optimize conservation efforts.
- Has benchmarked the electrical usage for all 33 of its buildings and maintains a database to monitor the monthly electrical consumption.
- Conducts regular energy audits to identify energy and cost savings opportunities and determine compliance with current CCPS best practices.
- Operates all buildings using a Building Automated System (Metasys).
- Completed Phase II of a capacitor installation project, and conducts inspections at various schools to identify equipment that would benefit from capacitors, which will be installed as the budget allows.
- In the coming year, intends to purchase and implement computer power management software (Power Save ®) that will power down computers during periods of inactivity.
- Reduces leaking energy (“phantom loads”) from a variety of electronic equipment by unplugging units or utilizing a surge protector/power strip that is turned off at the end of every day.
- Whenever possible uses daylighting strategies and task lighting, preferably outfitted with a compact fluorescent light bulb (CFL)..
- Heating & Cooling:
 - All doors, including vestibule doors and doors to corridors and hallways, and windows are kept closed while HVAC systems are operating.
 - During the heating season, window coverings are kept open for passive heat gains and natural daylight, and are closed at the end of the day to keep heat in.
 - During the cooling season, window coverings are kept closed to block direct sunlight.
 - All windows and doors are monitored to ensure they have appropriate weatherstripping.
 - Plans to conduct a utility bill audit of water and electrical bills (and possibly telecom) using a third party service provider. No upfront costs are incurred as fees are contingency based. An RFP for this service is being drafted.

Charles

- Energy Management Systems are programmed to accomplish control strategies such as optimal start/stop, air- and water-side economizing, chilled and heating water resets, night setback and setup, night purge, morning warm-up, hot and cold deck optimization, and lighting sweeps
- Established energy-efficient operation as a specific goal for the facilities department
- Replacing old equipment and systems with new, efficient technologies

- Provide principals with the ability to benchmark and compare energy use among similar buildings. A building with an unusually high annual energy use intensity or energy use index (EUI, or energy consumption per square foot per year) compared to buildings of the same type and use, often indicates energy waste and opportunities for savings.
- Employs a skilled staff member whose primary focus is developing and implementing the system's energy management plan with an equal emphasis on efficient building operation
- Since the mid-1980s has used Computerized Energy Management Systems in all facilities, including all new construction.
- Achieves sizeable savings through the use of energy monitors in portable classrooms that provide for temperature variance within pre-set ranges based upon occupancy.
- Has a partnership with the local electrical cooperative, which provides for the periodic joint review of electrical usage, load analysis, energy conservation measures, and sharing of ideas to promote efficient energy usage.
- Has a certified energy manager on staff.
- Utilizes software solutions to analyze consumption on a daily basis.
- Installs energy-efficient replacement equipment
- In classrooms and offices that can be individually controlled, temperature control systems are set at 68°F in the day during the heating season and 78°F during the cooling season and set back at night for optimum efficiency. Programmable thermostats, with access limited to authorized personnel, are used where appropriate.
- Limits water storage temperatures to 130°–140°F, and installs booster water heaters where higher temperatures are needed, such as kitchens
- Replaces oversized fans and their motors
- Plants shade-type landscaping on west side of buildings
- Equipment is only "on" when actually necessary to meet occupant needs or fulfill its intended function

Dorchester

- Has invested in building controls with remote access and central/global management capabilities.
- Initiated an energy conservation program that has saved approximately 23.5% in energy consumption and \$1.2 million in less than three years.
- Developed energy shutdown protocols for lighting and HVAC schedules on nights, weekends, holidays, and summer breaks to save energy when buildings are not in use.
- Conducts energy audits internally and with outside consultants.
- Uses data loggers to monitor HVAC equipment and lights.
- Has removed lights from vending machines.
- Using only CFL bulbs in bulb type fixtures.
- Consolidates educational programs during school breaks to use as few buildings as possible, and to set back the HVAC systems in buildings not in use.
- Replaces T-12 lamps with T-8 lamps as resources permit.

Frederick

- Has installed software that automatically powers down all computers within the system beyond the normal business day.
- Has reduced the work week for FCPS employees to four 10-hour days during the summer to reduce building energy use.
- Employs a Certified Energy Manager/Energy Procurer whose duties include monitoring billing, facility use, and promoting energy conservation.
- Initiated annual energy audits of all schools, including grading and follow-up.
- Limits summer school activities to those schools that have multiple zoning capacity.
- Reduced thermostat settings during heating season at all schools.
- Piloted HVAC control systems for portable classrooms.
- Initiated a program to install occupancy sensors that automatically shut off lights in older schools as funding permits.
- Initiated a program to replace all high bay lighting with energy efficient T-8 lighting throughout the system as funding permits.

- Piloted the use of energy efficient chillers that are oilless in operation, using magnetic bearings to compensate for the lack of oil. The units are highly efficient and, since no oil is used to lubricate bearings, environmentally friendly.

Garrett

- Buildings with newer controls are placed in set-back mode during night-time operations where possible.
- In 1993 installed T-8 fluorescent tubes and electronic ballasts at most schools.
- The renovated Northern Middle School, completed in the fall of 2009, incorporates daylighting through a clerestory installed in the hallways that surround the center classrooms.
- Performed a five year energy audit 1999-2002, and has solicited a proposal for a new energy audit.

Harford

- Forty-nine of fifty-three schools have centralized energy management systems of varying levels, from control of individual units and spaces to some mechanical equipment in the boiler room (start/stop only).
- Expanded the capabilities of computerized energy management at Bel Air High School and Wakefield Elementary School and added Joppatowne Elementary School to the list of buildings centrally controlled by the energy management system.
- Awarded a \$264,000 grant by the Maryland Department of the Environment to retrofit the latest emission control technology onto older diesel engines in an effort to reduce diesel emissions, and to purchase a filter cleaning machine for diesel buses.
- Utilizes internal software to automatically shut down classroom computers when not in use.
- Installed HVAC occupancy sensors throughout many areas of Aberdeen High School, C. Milton Wright High School and Joppatowne Elementary School.
- Installed occupancy sensors for corridor lighting at four high schools, with plans to continue sensor installation at additional schools throughout the year. Utilizes high efficiency LED lighting on the exterior entrance canopy of Edgewood Middle School.

Howard

- Has 83% (64 schools and offices) of its buildings on a comprehensive and centralized Energy Management System whereby major heating and cooling equipment can be centrally scheduled and temperatures controlled. The remainder of the schools are planned to be upgraded over the course of several years as budgets allow.
- Installed additional controls in close to 200 portable classroom units to control the HVAC usage during non-occupied periods.
- With lighting upgrades over the past three years, installed additional controls on the outside lighting at seven schools to turn off the lighting when it is not needed.
- Has installed or proposes to install occupancy sensors in the following schools: Northfield and Waterloo Elementary Schools, and Mount Hebron and Long Reach High School. The sensors will control interior lighting in corridors, classrooms, storage areas and toilet rooms.
- Continues to specify the most efficient and innovative HVAC equipment for construction and renovation projects including a significant amount of added variable frequency drives which decrease energy consumption as well as increase the mechanical life of equipment.
- Routinely tunes boilers to maximize efficiency.
- Reduced domestic water loop temperature by ten to fifteen degrees.

Kent

- Initiated a system-wide energy contract with Energy Education, Inc to develop and implement an energy conservation program in December, 2007. The program includes adopted guidelines for electric, fuel oil and propane usage, and deficiencies found during energy audits are reported to the facilities department.
- Reduced the work week for employees to four 10 hour days during the summer to reduce energy use.
- Consolidated summer school for students to two schools to contribute to energy savings.
- All of its eight school buildings are controlled by energy software that provides control of temperatures and set-backs.

Montgomery

- Employs a variety of energy data tools to improve energy efficiency and reduce utility costs. A utility billing database and a large number of interval meters (15-minute interval electricity consumption data for large buildings) provides energy performance information. This data is used to:
 - Provide performance-based incentives to the school-based energy conservation teams.
 - Evaluate new construction projects and efficiency improvements compared with baseline performance.
 - Manage peak electricity use during periods when electricity cost and capacity charges are highest.
- Since the 1980's, has developed and upgraded a network of Energy Management Systems.
- Synchronizes the HVAC schedules and thermostat set points at all portable classrooms through an internet interface, with a high level of savings, allowing portable classrooms to be shut down on evenings, weekends, and during school breaks. The payback time for the equipment installation has been under one year.
- In FY 2005, instituted the system-wide shutdown of all 40,000 computers at the end of the evening via network controls, and deactivation of monitors after 30 minutes of idle time.
- Used low interest energy conservation loans from the Maryland Energy Administration to finance several energy conservation projects.
- Replaced all existing T-8 lamps in FY 2007 with a higher-efficiency, longer life (30,000 hours) model, reducing energy used for lighting by an additional 25 percent.
- Uses standardized Energy Star 4.0 computer replacements, including flat panel LCD monitors and high-efficiency power supplies. Has a program to actively control the peak load contribution of each facility during critical summer weekday hours. Peak loads have been reduced 40%, resulting in savings of \$1.6 million in the next fiscal year.

Prince George's

- Installed Verdiem's Surveyor Personal Computer Power Management software, which measures, manages, and reduces electrical energy consumption on PC networks, saving approximately \$300,000 per year in electrical cost, and concurrently reducing CO₂ greenhouse gas emissions.
- Plans to install a state-of-the-art centralized multi-protocol Energy Management System (EMS) console within the Maintenance Department utilizing Metasys[®] and Tridium[®] (Niagara) application servers so that the majority of PGCPs facilities will be automatically monitored and controlled. This work is still in progress and is about 15% completed.
- Completed lighting conservation retrofit for 104 schools.

Queen Anne's

- Has installed Vending Misers on all soda machines to reduce the amount of energy consumed.
- Installed microprocessors on all boilers to compute a percentage of the last off-cycle and then compute an economy factor to reduce the total amount of burn time and ignitions.
- All portable classrooms will have Proliphex Network Thermostats, which are web browser interfaced and can be controlled from one central location.
- Is tightening energy management system programming and system checks for scheduled use and/or unoccupied times, and implementing better facility usage over the summer to consolidate use and to manage and reduce HVAC costs.
- Conducts energy audits of all schools to develop a list of low cost/no cost energy conservation measures and major projects for inclusion in the capital and other major maintenance programs.

St. Mary's

- Is expanding the use of programmable thermostats in portable classrooms.
- Has de-lamped lighting in common areas to conserve energy; classrooms will also be de-lamped where appropriate.
- During the past three winter breaks, shut down all plants in order to conserve energy.
- All schools are on a computerized Energy Management System allowing for central control of heating. Exterior lighting is controlled at two schools under the Energy Management System.
- Replaced outdated T-12 fluorescent lamps with new T-8 lamps.

Somerset

- Has installed microprocessors at two schools in an attempt to reduce energy consumption by increasing the amount of time that boilers cycle off between start ups.
- Is monitoring setback times for nights, weekends and holidays to maximize energy savings.
- The recommendations of Energy Education, Inc. include building temperature settings as well as night, weekend and holiday setbacks.

Talbot

- All schools have automated Energy Management Systems.
- Is retrofitting all of the portable classrooms with energy smart T-stat controls.

Washington

- Has employed an Energy Management Specialist whose duties include reviewing school-by-school energy use and expenditures, and determining best practices to improve energy use throughout the system.
- Is re-lamping inefficient fluorescent (HID) fixtures with decreased energy consumption fixtures (T-8 fluorescent) while maintaining appropriate light levels.
- Exercises centralized control of each facility's Energy Management System to allow efficient scheduling, troubleshooting and monitoring, as well as to maximize energy efficiency.
- Performs physical audits of the schools to assure that lighting on/off times as well as heating set points and scheduling are in conjunction with school activities.

Wicomico

- Most systemic renovation projects have included an upgrade and/or expansion of the Energy Management System.
- Has installed energy controls on vending machines.
- Completed installation/retrofit of energy smart T-stat controls in most portable classrooms.
- Is retrofitting the remaining fluorescent lights in schools to electronic ballasts.
- Temperature settings have been adjusted for both the cooling and heating seasons.
- Unapproved electrical appliances have been removed from all facilities.

Worcester

- Formed the WCBOE Energy Committee in 2008 in response to increased energy costs. The Committee, comprised of Board of Education Maintenance and Finance personnel as well as representatives from several energy providers, evaluated current practices and identified areas of potential savings by improving efficiency and reducing energy consumption. An energy assessment of lighting, heating and cooling at all 14 schools was completed. The Committee reports to the board of education and will provide regular energy performance updates to the board.
- The Maintenance Department received an Energy Audit Report from PEPCO Energy Services for Buckingham Elementary School and Berlin Intermediate School. The report included a discussion of existing conditions at each school and a detailed listing of proposed Energy Conservation Measures (ECMs) to reduce energy consumption, energy demand and water consumption, resulting in substantial operational maintenance savings.
- Upgraded the existing automatic temperature control Energy Management Systems at 10 of the 14 schools.
- The Maintenance Supervisor and his staff monitor each school for energy saving practices, including turning off lights and computer equipment in rooms not in use, ensuring exterior

doors and windows are closed when heating/cooling systems are operational, and coordinating heating/cooling requirements for after-school activities.

- Reduced exterior and interior lighting at all schools where possible through the use of the Energy Management System.
- Implemented a T-8 high efficiency fluorescent lighting fixture replacement policy for all school buildings.
- Reviewed and revised school building heating and cooling temperature set points.
- Installed and evaluated the energy efficiency of stand alone energy management thermostats in all county portable and temporary classrooms.
- The maintenance department is tracking monthly and annual school fuel consumption to verify fuel and cost savings.
- Architects and mechanical/electrical consulting designers are charged with employing energy conservation procedures on all WCBOE projects.

B. Water Conservation (see also Section IX, Preserving and Enhancing the Natural Environment)

Allegany Standardized the installation of low flow fixtures for both new and replacement applications.

Anne Arundel

- Is replacing all high school stadium fields with synthetic turf, eliminating the need for watering. The effort is approximately half completed.
- Is converting water tower cooled air conditioning chiller systems to environmentally friendly air cooled chiller systems.

Baltimore City Utilized an ESCO program to install water-efficient equipment in the bathrooms and kitchens to conserve/reduce annual water, energy and sewer charges

Caroline Two recently renovated schools have been equipped with waterless urinals. Waterless urinals are also being retrofitted to all elementary schools as funds are available.

Carroll

- Installed water saving devices in kitchens and/or cafeterias, and has begun installing low flush or waterless urinals and low flush water closets in new construction and renovations.
- Installing native landscape plantings reducing need for irrigation.
- Utilizes stadium irrigation systems that sense rain events to reduce water applications.

Cecil

- Has designed water saving measures, including waterless urinals, into the Calvert Elementary and new Cecil Technical High School projects.
- In Summer 2008, Kenmore Elementary installed, thanks to a community service project funded by Johnson Controls, Inc., a rain barrel to help offset the outdoor watering demand placed on their well system during summer months. This project provides an educational opportunity for the science students.
- During holidays and extended breaks, all dishwasher water boosters are turned off.
- Employees are reminded to immediately report any leaky water fixtures.

Charles County Public Schools

- Has remote computerized control of automatic sprinkler systems
- Uses lower water usage replacement fixtures
- Added rain sensors to irrigation systems
- Properly aims nozzles in irrigation systems

- Uses low-water usage landscape plants where appropriate
- Uses mulch to reduce water quantities required

Dorchester

- Uses water saving devices in the boy's restrooms at North Dorchester Middle School to reduce the amount of effluent that is discharged to the treatment facility in Hurlock, MD.
- Plantings are being limited to indigenous species that are drought tolerant.
- Audit process continues to look for plumbing leaks and promptly requests repairs where necessary.

Frederick

- Utilizes low flow water saving fixtures in the design of new and replacement schools. Lincoln ES renovation fixtures are designed to reduce water consumption by 40%.
- Artificial turf fields have been installed at three high schools eliminating need for irrigation.
- Uses drought tolerant native plant species.
- Lincoln ES renovation is designed to recycle rainwater and gray water.

Harford

- Current maintenance procedures utilize low flow water saving devices for new and replacement fixtures, and current building design standards require low flush and/or waterless urinals and low flush water closets in new construction and renovations.
- Installed peddle valves and a 1.5 gpm aerator in nine kitchen facilities to reduce water consumption.
- Two (2) high school stadium fields have synthetic turf, eliminating the need for watering.
- Installed water saving devices in kitchens and cafeterias.
- One audit criteria within the Building Sustainability Audit process items requires inspecting buildings for plumbing leaks and promptly requesting repairs where necessary.
- An artificial turf field has been installed at North Harford High School and Harford Technical High School, eliminating the need for a field irrigation system.

Howard

- Utilizes low flow water saving devices in the design of new and replacement fixtures.
- Has completed upgrades of stadium and Bermuda practice field irrigation systems by converting the irrigation equipment from basic mechanical controllers to modern centralized computer software. A weather station with auditing data was incorporated into the control programs, capturing data based on many weather and plant factors such as solar radiation, wind, air temperature, humidity and rainfall. The improvement has resulted in a significant reduction in water consumption, with an estimated annual savings of \$10,000.

Kent As part of the Energy Education program, water usage is monitored weekly during scheduled energy audits.

Montgomery

- Waterless urinals have been installed at Great Seneca Creek, Little Bennett, and Wm. T. Gibbs elementary schools, and Martin Luther King, Loiederman, and Francis Scott Key middle schools.
- Artificial turf for the stadium field was installed at Richard Montgomery High School in 2007 and installations are underway for Walter Johnson and Paint Branch high schools, eliminating the need for a field irrigation system.

Prince George's

- Completed water conservation retrofit projects for 97 schools.
- The principles of water conservation listed below are incorporated into current projects in design and were used in two completed projects:
 - Collected rainwater from an adjacent room to irrigate an outside courtyard.
 - Used drought tolerant, low maintenance native and adaptive plant species on the entire school ground to eliminate landscape irrigation.

- With low-flow plumbing fixtures listed below on new projects, anticipates providing over 40 percent savings:
 - Waterless urinals
 - Dual-flush water closets in all restrooms and toilets
 - Low-flow lavatories in all restrooms and toilets
 - Low-flow sinks in the classrooms
 - Low-flow shower heads
 - PGPCS standard sinks in the kitchen

St. Mary's

- Evergreen Elementary School is projected to use 90% less domestic water through the use of rainwater cisterns that collect water from the roof. The water is utilized to flush the toilets, which are dual-flush.
- Waterless urinal technology is utilized at Evergreen Elementary School and is being integrated into other facilities throughout the system. Where existing systems are already in place, low flow systems are being utilized.
- Plantings are being limited to indigenous species that are drought tolerant.

Somerset

- Utilized reduced flow toilets and urinals in the new Somerset Intermediate School. Will use those same type of low flow units in the current renovation of Washington High School.

Washington

- Athletic field irrigation controls are being upgraded to use satellite transmitted weather data to accurately implement watering program. Individual meters are used for irrigation system to monitor water usage and receive reduction in sewer rates.

Wicomico

- Waterless urinals have been installed at the County Stadium athletic building, including locker rooms and public restrooms.
- All toilet, urinal or faucet fixture replacements use ultra-low flow fixtures.

IV Improved Practices

Allegany

- Utility usage is recorded daily by school based personnel. Any anomaly is reported immediately for evaluation and repair. Monthly usage is compiled and evaluated by the Energy Manager.
- Implemented the use of Green cleaning products in July 2007.
- Maintains a county wide recycling program for cardboard, plastic bottles and fluorescent lights.

Baltimore City

- Collected utility data for the past few years and established a base line in order to verify the effects of building improvements and review the accuracy of utility bills.
- Sought out alternative and new technology used in playground surface material. By utilizing a single-pour setup instead of a two-pour system, surfacing costs have been reduced 50%.

Baltimore Collaborated with the county government in developing a ten year School Waste Management Plan with a goal to reduce the county's carbon footprint by 10 percent

Calvert

- Implemented the use of Green cleaning products.
- Electronic communication and dissemination of school system publications has reduced paper consumption.

Carroll Uses a utility bill payment and management application to establish annual utility usage and cost data in order to compare annual consumption and costs, confirm the effects of building/equipment renovations and improvements, and confirm the accuracy of all utility bills.

Cecil Printing and copying is maximized by using both sides of the paper.

Charles

- Service contracts with Honeywell® and Johnson Controls® require activities that address efficient building operation and include methods to track operating changes, improvements, and deficiencies over time
- Promotes continuity of information in order to reduce training time for new staff and ensure that efficient operating strategies are maintained during staff turnovers or absences by having a clear, written set of sequences of operation and building control strategies
- Staff can use portable electronic dataloggers to optimize equipment operation
- Encourages students/staff to use greener methods of transport – cycling, walking
- Has been recycling since 1990, and went to a single stream recycling program in 2009 recycling all acceptable materials. The system recycles electronics, chemicals, waste oil, books and furniture.

Dorchester

- Requires that all design consulting teams be conversant with modern energy and water saving strategies, as well as geothermal and other alternative technologies, in order to qualify.
- Conducts regular professional development training for Operations and Maintenance staff. Significant areas include energy conservation, team cleaning to reduce lighting costs, and use of low VOC cleaning chemicals and products wherever possible.
- Deployed a VOIP phone system at 3 schools, and is currently in the planning process to implement a VOIP system at the largest high school. Goals include sharing PRI-ISDN lines located in one location in order to cut down on costly individual phone lines located at each site, reducing local calling rates by utilizing network infrastructure to place calls between sites, and maintaining the system with district staff rather than expensive service contracts with third party vendors.
- Conducts inventories of surplus technology components, furniture and equipment to reintegrate them into both instructional and business operations in lieu of new replacements.

Harford

- Developed a centralized data base to track and evaluate all utility bills.
- Developed a green cleaning program with guidelines and training for custodial staff.
- Developed a sustainability review process for new construction programs to insure that new facilities are critically analyzed during the design and construction phase.
- Developed and implemented a full scale single stream recycling program and centralized data base to track and evaluate all waste disposal bills.
- Proposed a green roof system at a future elementary school. This green roof will serve as an educational tool and will reduce storm water runoff.
- Green Cleaning Program will centralize and automate MSDS process.

Howard

- Recycling policies encourage reduction of natural resources. The system was recognized by Waste Management in 2008 for being first in recycling volume among all school systems in the Baltimore area, with over 1000 tons recycled.
- Has partnered with the County government to consolidate trash and recycling contracts to decrease costs across the board.
- Emphasizes procuring cleaning products which have reduced environmental impact.

- All floor products purchased by the system are Green Seal certified and the estimated source reduction in non biodegradable products is greater than 30 tons annually.
- A combination of native plantings and an environmentally responsible Integrated Pest Management program helps to maintain a healthier environment.
- Employs third party commissioning agents for all major construction and renovation projects. Retro commissioning of HVAC systems is being done on an expanding basis. HCPSS plans to utilize current BGE Rebates to help fund this continued effort.

Kent Is planning to go "green" July 1st with cleaning supplies and one motorized floor cleaner

Montgomery Developed a Green housekeeping and operations plan that incorporates green cleaning, integrated pest management, recycling and energy management. Building service staff receives training, support, and monitoring to ensure the plan is fully implemented at all schools.

Somerset

- Constructed a new school and renovated another with pulp extractor systems to reduce the amount of solid waste being placed in landfills.
- Requires contractors to recycle all recyclable building materials demolished in our renovation of Washington High School.

St. Mary's

- Utilizes a utility bill management application that tracks annual utility usage and cost data in order to compare annual consumption and costs, confirm the effects of building/equipment renovations and improvements, confirm the accuracy of all utility bills and assist with behavior management changes in the schools.
- Conducts regular professional development training for Operations, Maintenance and school based staff.
- Utilizes a comprehensive program that focuses on energy conservation, team cleaning to reduce lighting costs, and use of low VOC cleaning chemicals and products wherever possible.
- Employs a Green School Manager whose duties include monitoring billing, identifying energy reduction opportunities, and promoting energy conservation and the Green School Program.
- Utilizes Green Seal certified products for operational supplies and maintenance projects, when feasible.
- Evaluates new construction projects and efficiency improvements compared with baseline performance.
- Developed an integrated pest management, recycling and energy management program in which building service staff receives training, support, and monitoring to ensure the plan is fully implemented at all schools.
- Specifies school furniture that has a high recycled content and is low VOC.
- Specifies school playground equipment that has a high recycled content and is PVC free.
- At Evergreen Elementary School, a green roof demonstrates the value of reducing storm water runoff. The green roof is located on an outdoor science classroom as well as on the front canopy.
- Working with schools to develop rain garden and rain barrel projects.

Washington Is reviewing information and visiting other LEAs' projects that have have implemented "green" designs.

Wicomico

- Secured professional assistance to collect real time data, audit existing mechanical operations for performance and efficiency, make recommendations, and re-commission systems for maximum performance.
- Has collected utility data for the past few years and established a base line in order to verify the effects of building improvements and review the accuracy of utility bills.

V Energy Procurement Strategies

Allegany

- Continues to purchase electricity through a multi-county consortium.
- Purchases natural gas on the futures market.
- Multi-fuel boilers have been installed at many schools. The schools are able to convert from natural gas to fuel oil as costs fluctuate.

Anne Arundel Belongs to numerous buying consortiums/cooperatives in order to leverage economies of scale, and uses various bidding strategies in order to reduce per unit consumption costs.

Baltimore City Since electricity deregulation, has been coordinating the purchase of electricity with surrounding counties to achieve the best available rates.

Baltimore Reduced energy cost by utilizing joint procurement efforts with other school systems under the umbrella of Baltimore Regional Cooperative Purchasing Committee (BRCP)

Calvert

- Utilizes a bidding process for gas, fuel oil and propane to reduce purchase costs.
- Participates in the Smart Savers Energy Program established by BGE and SMECO to receive rebates against the purchase of energy-efficient mechanical equipment.
- Plans to participate in the EmPOWER Clean Energy Communities program which is funded by the EECBG, in order to possibly secure funds for the installation of renewable energy systems.

Caroline, Cecil, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico and Worcester Are members of the Eastern Shore of Maryland Educational Consortium Energy Trust (ESMEC-ET), which saves costs by purchasing electricity on the open commodities market or at rates less than the default rate. The consortium also serves as a conduit for the purchase of fuel oil, and utilizes volume purchasing. Since 2001, the ESMEC Energy Trust Electric Procurement Program has been a vital instrument in continued efforts to achieve lower electric supply costs and more flexible price risk management. Participation has increased from the nine founding members to twenty-two current members, including school systems, municipalities, county governments and community colleges. Total savings of over \$6.4 million to Trust members has been achieved through fiscal year 2008.

Carroll Participates in several consortia in order to obtain electricity, fuel oil, and natural gas at the lowest possible price, and uses various bidding strategies to reduce the per unit price of the commodities.

Charles County Public Schools

- Purchases electricity from a customer-owned electric cooperative which provides electricity to over 147,000 services in southern Prince George's County, Charles County, St. Mary's County, and all but the northeast portion of Calvert County
- Participates in a gasoline and fuel oil procurement cooperative with other local school districts and county governments

Dorchester

- Actively monitors heating fuel costs at facilities with dual fuel systems to ensure best value.
- Actively monitors and manages heating oil storage capacities, inventories and buy decisions to capitalize on market price fluctuations and bulk deliveries. Has a positive, long standing working relationship with fuel suppliers who know market intricacies.
- Works with energy vendors to plan bulk purchases at optimal market conditions

Frederick

- Participates in an electricity procurement cooperative with other school districts, county governments and municipalities in western Maryland on the Alleghany Power grid.
- Engages in fast track approval of natural gas supplies in response to favorable market changes.
- Installs dual fuel heating systems in the schools, allowing either fuel oil or natural gas to be purchased and used depending on the current price of the commodity

Harford

- Participates in a purchasing consortium, the Baltimore Regional Purchasing Cooperative, in which school districts and municipalities jointly procure natural gas and electricity to maximize savings.
- Currently utilizes the Harford County Government propane gas contract to reduce the per gallon cost of product.

Howard

- Has examined several energy purchasing consortiums and has successfully bid electricity and natural gas contracts with adjoining school systems through FY 2009. HCPSS currently utilizes the natural gas portion of the contract with the Baltimore Regional Cooperative Purchasing Committee, in which districts and municipalities jointly procure utilities in futures markets at the lowest cost. HCPSS will join the Cooperative for electricity purchases after the completion of the existing contract in Fall 2010.
- Has also participated in the voluntary Emergency Load Response Program in order to reduce the peak load stress on the PJM Electric grid. The school system successfully achieved a nearly 4 MW contribution to the program in 2009. Revenue for FY 2010 is expected to exceed \$100,000.

Montgomery Manages utility costs through block purchases of electric and natural gas futures on the deregulated energy markets. Blocks of electricity are purchased through a dedicated PJM (Pennsylvania, New Jersey, and Maryland) system wholesale account, building an electricity supply portfolio for up to five years into the future. Natural gas is also purchased on the futures market up to three years in advance. MCPS has an electric cost management plan that documents the risk management strategies with percentages and timelines to minimize the volatility and cost of electricity consumed by MCPS. The price point efficiencies of the wholesale market have allowed MCPS to avoid approximately \$4 million over the utility default rate in the first four years of operation.

Prince George's Since electricity deregulation, has contracted with Washington Gas Energy Services for electricity savings of \$1.4 M over the past five years.

St. Mary's Participates in a consortium in order to obtain fuel oil at the lowest possible price.

Washington Continues to participate in a multi-LEA consortium for electricity procurement to maximize savings. In addition, procures heating oil cooperatively with other local government entities, and takes advantage of cooperative arrangements with other agencies for the purchase of natural gas.

Worcester Is one of the founding members of the Eastern Shore of Maryland Educational Consortium Energy Trust (ESMEC-ET).

VI Preventive Maintenance (PM) Programs
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General All school systems utilize both maintenance and operations personnel to perform preventative maintenance checks and repairs in order to maintain equipment in operating order, with the goals of reducing energy consumption, reducing waste by extending the useful life of equipment, and improving the indoor air environment for building occupants. One system defines preventive maintenance as “the proactive application of proper inspection and servicing techniques to plant and equipment systems on a continuous selective cyclical and routine basis, consistent with essential requirements, available staffing and fiscal resources” (Harford County Public Schools). See also

“Guidelines for Maintenance of Public School Facilities in Maryland” (Public School Construction Program, May 2008). The items below provide greater detail on specific actions and items.

Baltimore City Four Energy Service Contractors (ESCOs) engaged to perform capital improvements also perform preventive maintenance on selective elements of the mechanical systems of the schools.

Calvert

- Utilizes the Automatic Temperature Control system to trend HVAC equipment use and performance, which can indicate the need for maintenance.
- Utilizes the work order tracking system to disclose frequent repair and/or maintenance calls on equipment.

Carroll

- Instituted a computerized PM schedule and reporting process for each building supervisor to maintain records on building and equipment conditions.
- Performs annual training to support preventive maintenance program and introduce new practices and procedures.

Charles

- Performs an annual review of Preventative Maintenance Program to improve HVAC efficiencies
- Uses a computerized preventive maintenance work order component of the TMA Enterprise® software package for all repair, maintenance and preventive maintenance work orders to insure that inspecting, adjusting, lubricating, testing, and replacing takes place on a regular, ongoing basis and that records are maintained electronically
- Conducts periodic inspections of building conditions and maintains an inventory of buildings components and equipment
- Includes preventive maintenance along with other maintenance projects in long- and short-term maintenance plans that are tied to capital improvement programs, capital budgets, and operating budgets
- Ongoing training is available to improve employees’ technical skills and meet their individual training needs
- Has a plan for each facility that formally includes PM procedures for periodically reviewing and monitoring the operating sequences, strategies, and schedules

Dorchester

- Performs annual summer cleanings of boilers by in-house staff.
- Heating plants are under a yearly preventive maintenance contract with certified licensed contractor.
- HVAC control systems in older facilities are “re-commissioned” to optimize energy savings pending major capital projects.
- Old, antiquated control systems in existing facilities are replaced as funding allows (about one per year).
- All major chiller systems are on contracted, manufacturer recommended, preventive maintenance schedules.
- Runs a web-based work order request/management system to track preventive maintenance.

Frederick The preventive maintenance program of all existing equipment has been so successful that energy performance contractors have not been able to identify any new initiatives that would guarantee additional savings.

Harford

- Conducts Essential Equipment Preventive Maintenance Rolling Field Audits of the entire school system, including projections for new school facilities and schools undergoing major renovation/reconstruction, with prompt replacement of projection data with actual data upon completion construction.

- Formulates and periodically updates equipment maintenance criteria for over 30 major and sub-equipment categories, serving as a basis for planning, organizing, analyzing and processing a high volume of data.
- Utilizes and continuously revises a Preventive Maintenance Subtotals Equipment Task Network that includes per-unit annual coverage capabilities in order to manage the frequency and specifics of PM service intervals within five major school sub-zones.
- Identifies selective essential rates of coverage of the school system based on the available staffing, the system size, and the criticality of service.
- Applies and continuously updates labels on the thousands of items of equipment audited, including innovative classroom ceiling grid labeling for equipment installations above ceiling level.
- Annually replaces obsolete electrical distribution equipment, retrofits solid state technology circuit breaker phase and ground over current trip devices, and has implemented a MABE-funded thermographic imaging/infrared testing study of electrical distribution equipment.
- Rides a procurement contract with the Baltimore and/or Howard County Public School Systems for HVAC PM, as well as the development & implementation of very functional, efficient pricing request/order procedures.
- Has distributed a preventive maintenance communication newsletter to the school system distributed on average 4.67 times per year over a 12 year span providing pertinent information, soliciting, encouraging and reinforcing mutual team work and cooperation.

Howard

- Performs quarterly equipment maintenance including filter changes, belt replacements and lubrication of bearings as needed, which along with the annual cleaning and tuning of boilers and maintenance of cooling towers is estimated to save approximately 5% annually in energy costs.
- Provides regular training on HVAC and energy management systems.

Kent Preventive maintenance contract provides a work order management system that monitors and schedules all life safety and standard Preventive Maintenance work.

Montgomery Indoor Air Quality teams develop building maintenance plans for schools, which include initial and follow-up preventive maintenance services. An Automated Energy Management Team provides periodic calibration and testing of thermostats in schools to ensure proper operation. The Division of School Plant Operations staff follows a documented process for periodic filter changes and bearing lubrication.

Prince George's Two Energy Service Contractors (ESCOs) that were engaged to perform capital improvements also perform essential performance assurance and preventative maintenance on the mechanical systems.

St. Mary's Annually reviews and updates the comprehensive preventative maintenance program:

- To program the next six years of required maintenance projects and to integrate these projects with the Capital Improvements Program.
- To analysis and document the efficiencies of the preventive maintenance program.
- To define work flows, work order priority classifications, types of maintenance practices to be utilized, and budget development methodology.

Talbot

- All buildings have fully automated computerized HVAC control systems that provide "alarms" when equipment is not properly functioning.
- Has a continuing preventive maintenance program to perform monthly, quarterly and annual maintenance including filter changes, belt replacements and lubrication of bearings.
- Performs annual cleaning and tuning of boilers and maintenance of cooling towers.

Wicomico Has established standard procedures involving three areas of responsibility, with required actions ranging from daily to annually.

VII Alternative Energy Sources

General 21 school systems have implemented geothermal ground source heating and cooling systems at 74 schools, including at this writing 38 in operation, 16 in construction, and 20 in design.



Mechanical Room, Geothermal Ground Source Heating and Cooling System
Great Seneca Creek Elementary,
Montgomery County



Mechanical Room, Geothermal Ground Source Heating and Cooling System
St. Michael's Elementary and High,
St. Michael's, Talbot County

Allegany Fort Hill High School received grants to install a 1 kw photovoltaic solar generator. The system has been integrated into the school's environmental science curriculum

Anne Arundel

- Piney Orchard Elementary was constructed in 2000 utilizing a geothermal heat pump system. There is an ongoing comparison of this school to a sister school with a standard 2-pipe, boiler heating system.
- Installation of 1 KW of solar energy panels is currently underway for an outdoor education center as part of the Maryland Energy Administration's MDV Solar Schools grant project.

Baltimore City Is currently discussing the feasibility of installing solar panels at identified school sites with a solar panel company.

Calvert

- The geothermal system at Mill Creek Middle School realizes a savings of approximately \$44,000 per year compared to another school of comparable size and construction.
- Windy Hill Middle School has received a 1kw solar panel for educational purposes through the Maryland Energy Administration MDV Solar Schools Grant.

- Beach Elementary School has received a wind turbine through the Wind Swept Grant provided by the Maryland Energy Authority. The data provided by these systems is shared with the other Calvert County schools.
- Is investigating adding a solar panel array of significant size to provide energy to one of our schools through the use of grants from the EmPower program.

Caroline All future projects will utilize geothermal systems.

Carroll

- A hybrid central-geothermal HVAC system is planned for the HVAC systemic replacement project at Westminster High School.
- Investigation is underway to develop an “Energy Park” to introduce students to alternative energy generation methods.

Cecil

- Through a grant from the Maryland Energy Administration, has installed a small, demonstration-sized (approximately 1 kWh) solar array at the Bohemia Manor Middle/High School to meet a modest portion of the building’s energy load.
- Through partnerships with North Bay Adventures and a grant from the EPA, renewable power in the form of wind and solar will be installed as a part of environmental education extension activities with the Cecil Alternative Program at Providence School.
- The entire fleet of school-owned student buses use B5 grade biofuel.

Charles Is designing a geothermal heat pump system among other energy efficient considerations for a new high school design, as well as solar panels to assist in heating the school’s domestic hot water system.

Dorchester

- Choptank Elementary School, built over ten years ago, was the first geothermal school facility in Maryland.
- All future projects in Dorchester County will utilize geothermal HVAC systems.
- Warwick Elementary School is piloting the use of bio-diesel for heating via an MEA grant.

Frederick

- Earth Space Science Lab, completed in the summer of 2009, the FCPS is piloting a geothermal heating/cooling system and solar panel installation and operations.
- Solar panels have been installed at Oakdale ES to provide electric power for a portable classroom.
- At the FCPS bus garage, used bus motor oil is re-used to heat the garage.

Harford

- A solar hot water collection system has been installed at Norrisville Elementary School.
- A prototype photovoltaic electric generation station has been installed at the Harford Glenn Environmental Center, and a grant has been received to construct a prototype wind turbine for electricity generation at the Center.

Howard Is currently in negotiations to construct a large solar project at a local land fill to provide power to the adjacent Worthington Elementary School.

Kent Is working with the Maryland Energy Administration to pilot one school using biodiesel fuel for heating.

Montgomery

- Purchases 15 percent of its system-wide electricity requirements from wind-generated electric producers.

- Hosts large production-sized solar photovoltaic systems (PV) at eight schools. These systems are capable of providing between 20 and 40 percent of the electric requirements of the school during peak summer daytime periods. Costs of installation and maintenance are born by the renewable energy development corporation working under power purchase agreements with MCPS.



Lakelands Park MS roof in Montgomery County, part of a 133 KW solar PV system, 770 panels; installed under a power purchase agreement in 2008



Quince Orchard High School, located in Gaithersburg, MD - hosting a 319 KW photovoltaic system, 1799 PV panels; installed under a purchased power agreement in 2009

St. Mary's

- At Evergreen Elementary School, a geothermal system is being used for one classroom wing and an energy consumption study is being conducted to compare it to a traditional system in an adjoining wing. The building also incorporates photovoltaic technology (6KW) and a wind turbine. Overall the building is projected to use 30% less energy than a school designed with conventional systems.
- The Chesapeake Public Charter School utilizes a geothermal heating and cooling system.
- A grant from the Maryland Energy Administration was used to install a 1KW photovoltaic system at Leonardtown Elementary School.
- Design of a small solar thermal system for hot water at Evergreen Elementary School has been completed.
- The use of an integrated solar photovoltaic system for the new metal roof at the Benjamin Banneker Early Childhood Center is being investigated.
- Solar thermal applications for the HVAC system renovation at Greenview Knolls Elementary School will be studied as part of the design for that project.

Somerset

- Will consider geothermal technology when planning for future HVAC renovations.
- At Crisfield High, is working with the Governor's Office on a small wind energy program. This program will provide a modest energy savings and an environmental education enhancement for students.
- Is working with a private industry vendor to establish a combined system of renewable energy, incorporating wind energy, solar photovoltaic cells and battery storage for excess energy storage and possible sale back to the grid. The Board of Education has approved the investors to carry out a feasibility study, and is now seeking additional investors to begin the project.

Talbot The geothermal system installed at St. Michaels High and Elementary Schools in conjunction with the renovation of the facility has reduced the kilowatt usage by approximately 50 percent.

Worcester The geothermal heating/cooling system at the new Ocean City Elementary School generated \$49,000 in energy savings during the first 12 months of operation.

Wicomico Typically designs all new schools to include geothermal systems.

VIII Capital Improvements

General The majority of systemic renovation upgrades and large projects are carried out utilizing energy efficient and high performance systems, including those described below. Additional items are shown under the LEA headings and in other sections of this report.

Building Envelope:

- Insulated/low-E window systems
- Reflective roof surfaces to minimize solar gain and reduce cooling loads
- Roof replacements with extra roof insulation
- High performance skylights to take advantage of daylight opportunities

HVAC:

- High efficiency, Energy Star equipment
- Airside economizers for "free cooling"
- Air-to-air heat exchangers
- Heat pumps employing variable refrigerant flow zoning technology
- High efficiency boilers, hot water heaters and chillers
- Dual fuel heating systems
- Conversion of water tower cooled air conditioning chiller systems to environmentally friendly air cooled chiller systems

- Geothermal systems where applicable (see Section VII, Alternative Energy Sources)
- Carbon dioxide (CO₂) sensors for outside air ventilation control
- Three-stage domestic water heating system using solar, geothermal and propane energy sources
- Displacement ventilation
- Carbon dioxide (CO₂) sensors for outside air ventilation control
- Variable Frequency Drives (VFDs) on air-handling units (AHUs) and pumps
- Building Management System/Direct Digital Control (DDC)
- High Efficiency Motors
- Room sensors for AC systems in portables
- Green Refrigerants
- Commissioning of the HVAC systems
- Water saving devices to reduce pump energy requirements

Electrical / Lighting:

- Energy efficient light fixtures
- Retrofitting t-12 fluorescent bulbs with energy efficient T-8 bulbs
- Replace incandescent lights with compact fluorescent lights
- Occupancy sensors
- Control of various lights with energy management system.(i.e. parking lot lights)
- Install prototype high efficiency hand dryers
- Install prototype LED lighting
- Replacing mercury vapor fixtures with lower wattage metal halide fixtures (with improved light output)
- Replacement of unreliable mechanical time clocks for exterior lighting with modern, programmable, accurate digital clocks

Baltimore City Engaged four energy service contractors (ESCOs) in energy performance contracts to perform energy conservation projects at about 160 schools. Items of work include lighting upgrades, HVAC equipment, automatic temperature controls, windows, and water conservation. Funding combined guaranteed energy savings with capital improvement program allocations. Expected annual savings are \$4.8 million.

Caroline Initiated a system-wide energy performance contract in 2002 with Custom Energy, Inc. and the Maryland Energy Administration. The total cost of the contract was slightly over \$1 million, and included lighting, conversion of kitchen appliances to propane, selected re-zoning of air conditioning units, and an overall upgrade to an electronic Energy Management System.

Carroll

- Is currently in the second year of an energy performance contract guaranteed to provide \$10.8 million cost avoidance over the 15 year project term. The project includes retrofits at 41 schools, with a total project value of \$9.4 million including lighting system upgrades and facility management system enhancements at all schools, control system upgrades at Carroll Springs, Spring Garden, and Piney Ridge elementary schools, and new HVAC and window systems for William Winchester, Charles Carroll and Freedom elementary schools. Over \$1.6 million in cost avoidance has been realized since inception.
- As part of the normal maintenance replacement schedule, equipment is being upgraded to achieve greater energy efficiency.

Cecil Initiated a system-wide energy performance contract in FY06 with Johnson Controls, Inc., including upgraded lighting fixtures, hot water heaters, boilers and window glazing to reduce energy consumption. Consolidation of telecommunications systems provides additional operational savings.

Harford

- All renovated and/or new facilities utilize four (4) mini boilers and two (2) air-cooled centrifugal chillers with dual compressors that operate only as needed.

- Performance based contracting has been utilized since 1996; there are 22 schools currently under performance contracts.

Howard

- A multi-year energy performance contract has funded large capital projects such as chiller and boiler replacements. Two phases have successfully been completed, producing annual savings of \$600,000. An additional phase to include twelve schools is planned.
- All capital replacement projects of MEP equipment are internally reviewed to ensure that energy efficient designs are specified.

Montgomery Has a program to upgrade all Energy Management Systems to be Direct Digital Control and web-based.

Prince George's

- Has commissioned two Energy Service Contractors (ESCOs) to perform energy audits and implement energy conservation measures at 208 facilities. Items of work include lighting upgrades (T-8, T-5, electronic ballasts, LED exit signs, compact fluorescent light bulbs, occupancy sensors, photocells), HVAC equipment, automatic temperature controls, air barrier upgrades, high efficiency motors, and water conservation. Funding combined guaranteed energy savings with State and local capital improvement program allocations. Expected combined average energy savings are in excess of \$8M annually. Projects are currently in progress and is about 60% completed.
- Has accomplished the last fifty-five roof replacement projects with improved insulation with an R-value of 13, and has used specialty reflective coating on the metal to reflect solar heat and Energy Star coated built up roof systems where feasible.

St. Mary's

- Over the past 14 years, SMCPS has renovated and modernized 65% of its buildings, bringing them to contemporary energy standards and incorporating a number of sustainable design features.
- Has utilized three Energy Performance Contracts over the last 13 years.
- Major entrances are designed with vestibules to reduce the cooling or heat load.
- All projects are reviewed to see where sustainable design elements can be incorporated such as water and electrical efficiency.

Somerset

- Has utilized compactor/extractor systems in two kitchen operations.
- Is exploring the option of performance contracting to include building envelop systems after the HVAC systems have already been replaced. These include windows, roofs and doors.

Wicomico

- Is exploring a Performance Based Contract lighting retrofit project for Beaver Run Elementary School.
- Is exploring a Performance Based Contract / Alternative Financing option for some of the HVAC systemic renovation projects that have been deferred for several years.

Worcester Maintenance Department is exploring grant funding through the Delmarva Power Commercial and Industrial Energy and Efficiency Incentive Program to upgrade mechanical and lighting systems in all schools.

IX Preservation and Enhancement of the Natural Environment

Allegany Partnered with local agencies in the Urban Canopy program. Native hardwood trees have been planted at four schools.

Anne Arundel Working with the county public works department, several bio-retention facilities, including two multi-acre bogs, have been constructed. The bogs were developed in conjunction with the outdoor education center and are used for various programs.

Baltimore City

- Concentrated efforts in removing and replacing underground storage tanks.
- Partnering with Parks and People Foundation to create green space, eliminate erosion, and plant street trees on schoolyard lots as part of the TreeBaltimore Initiative. The goal is to double the tree canopy by year 2037.
- Oversees the Schoolyard Greening Plan consisting of non-profit organizations and public agencies that conduct schoolyard/environmental education programs and projects.
- Removal of small areas of unused asphalt to create new green space (must be one acre or more to be eligible).

Baltimore

- 31 high schools and four middle schools with a total of 1,350 students participated in a Forest Buffer Restoration project, planting 675 native trees in school yards and local parks

Calvert

- The new Calvert Middle School and Barstow Elementary School have reforestation set-aside areas platted to insure the preservation of forested areas. Barstow Elementary will have a major sloped area reforested through an agreement with a local developer; the intention is to do the same on the new Calvert Middle School site.
- Development plans for the new Calvert High School require that the site be brought up to current regulations with respect to reforestation and pre-development water quality conditions.



Reforestation
Barstow Elementary School, Prince Frederick, Calvert County

Carroll

- 12 schools created rain gardens in the spring of 2009, and two more in the fall of 2009. There are plans to create six more rain gardens in the spring of 2010. The average garden is roughly 600 square feet, with some in excess of 1000 square feet.
- Storm water systems are designed to maximize water recharge and improve quality.
- Site designs take advantage of the use of pervious concrete to reduce impervious surfaces.

Cecil Three schools have earned the Maryland Green Schools status: Conowingo Elementary, Elk Neck Elementary, and Bohemia Manor Middle School. These schools have acted to preserve and/or enhance their outdoor school environments through projects such as outdoor classrooms, gardens, rain barrels, native vegetation and plantings, trails, clean-ups, etc. Both Perryville and Rising Sun Middle Schools anticipate submitting their applications in the coming year.

Charles

- Many schools now have environmental projects such as wetlands, storm water collection systems, rain water gardens and grassland projects. These programs are carried out in cooperation with state and federal agencies and supported by local non profit programs.
- For the new high school:
 - Will harvest rain from the roof for irrigation.
 - Will use existing excess storm water management capacity of an adjacent owner by agreement.
 - Will maximize use of pervious concrete for walkways.



Stormwater pond
North Point High School, Waldorf, Charles County

Dorchester

- The Storm Water Management system at North Dorchester Middle School includes two subterranean storm water infiltration systems to contain storm water on site, as well as minimizing pond use and area.
- The Dorchester Career and Technology Center, now under construction, incorporates similar technologies and storm water management system designs.

Frederick County

- Trees are sited to reduce heat islands.
- Piloted use of pervious pavement at the Linganore High School replacement project.
- School yard habitats have been planted at several schools.
- Participates in a tree canopy program in cooperation with the Potomac Conservancy, with goal of achieving 20% tree canopy coverage.
- Existing wetlands were protected on the site of the new Oakdale HS and are maintained as outdoor classroom.
- Cooperates with the County Government in the enhancement of storm water management systems on school sites and the Forest Resource Ordinance Program.
- Partnered with Frederick County Department of Public Works in the design and construction of several upgraded storm water management facilities designed to enhance the quality of storm water runoff.



Pervious Pavement
Linganore High School,
Frederick County

Howard Partnered with Howard County Department of Public Works in upgraded bioretention facilities to enhance the quality of storm water runoff.



Prior to Construction



Burleigh Manor Middle School, Howard County
7th Graders Planting a Bioretention Area



Immediately after Planning



Two years after construction

Garrett The environmental area at Route Forty Elementary School is used to enhance the science curriculum. Students explore, identify, draw and label various plants and animals found in the habitat area. Tadpoles are released in the pond while completing lifecycle studies on frogs. Younger students are able to cultivate pumpkins and sunflowers; they plant the seeds gained from the experience to continue the cycle while observing the signs of the changing seasons. The environmental area also serves as an outdoor reading classroom, providing a nice backdrop for story time and building prior knowledge for various texts, and providing lessons about responsibility and respect for nature.

Montgomery

- Since the adoption of the State's new environmental regulations which promote the use of Environmental Site Design (ESD) techniques, MCPS is collaborating with the Maryland Department of the Environment (MDE) and the Montgomery County Department of Environmental Protection to implement ESD technology in all current and upcoming major capital projects to the maximum extent practicable.
- MCPS has been piloting green roof technologies and other Low Impact Design (LID) techniques, such as permeable pavement, since 2005. Since then, the green roof technology has been implemented at William B. Gibbs Elementary School completed in summer 2009, and is currently planned for Paint Branch High School and Farmland, Garrett Park, Cannon Road, Jackson Road, and Downcounty Consortium #28 (McKenney Hills) elementary schools.
- The Facility Design Guideline has been updated to utilize various techniques to minimize impervious areas in efforts to maximize green spaces, protect natural habitats, and minimize site impacts for storm water management.



Demonstration green roof
Northwood High School, Silver Spring, Montgomery County

Prince George's The following strategies are incorporated in the design of most new school projects where applicable:

- Minimize the building footprint on the site by building two or more stories.
- Use available natural woodlands on site for environmental classrooms or outdoor studies (Dr. Henry Wise, Jr. HS; Mary Harris 'Mother' Jones ES)
- Locate the buildings on site to maximize the open space for athletic play fields.
- Use vegetated landscape on 50% or more of the open space

St. Mary's

- Evergreen Elementary School preserves approximately 75% of the school site as protected woodlands and wetlands. Working with the Department of Natural Resources in the development of a nature trail on the school site. Educational signage has been installed around the site and at the bioretention areas. The site is a compact design.
- The master planning of a new elementary school has identified opportunities for an outdoor environmental education classroom and nature trails that will utilize the existing features of the site as an educational tool.
- Work with schools to create nature trails, rain barrel projects, native plant and butterfly gardens, and projects that mitigate soil erosion.

Talbot

- Has created an environmental meadow and rain garden at Easton Elementary School.
- Has created an environmental butterfly and rain garden in the courtyard of St. Michaels Elementary School.

Washington

- Two Schools currently under construction include Forest Conservation Easements granted to enhance the natural habitat of the site.
- New Storm water control techniques/mitigation techniques are being utilized to minimize the space required for Storm Water retention ponds (sand filters, swales, etc.)

X The Comprehensive Approach: High Performance Initiatives
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General – See Appendix “Maryland Certified High Performance Schools” for list of schools currently in planning, construction, or occupancy that have or will achieve LEED certification. LEED strategies applicable to school buildings include, among others, the following:

Basic Strategies:

- Choose sites that maximize walking and use of mass transit, minimize vehicular dependence
- Maximize energy conservation
- Provide excellent indoor air quality (IAQ)
- Provide both fundamental and enhanced commissioning
- Maximize use of natural day lighting in teaching areas
- Select environmentally preferred building materials
- Recycle construction and demolition waste
- Give regional priority by utilizing materials from within 500 miles from the site

Project Planning and Design:

- Review of potential sustainable design initiatives to be incorporated
- Develop “Greening” Initiatives Matrix & Guidelines specifically for the project
- Energy modeling to yield the best performance and lowest energy costs, with an energy analysis and alternatives report
- Coordinate alternatives with Project Design Team, incorporating “green” information into the specifications and construction documents
- Interface with Maryland State Department of Education (MSDE) for support in integrating green strategies

- Provide a room in each facility for storage and collection of recyclables
- Airlocks at entrances that will see heavy pedestrian traffic to reduce energy gain and loss

“Green” features:

- Clerestory windows and a classroom natural ventilation strategy
- Natural daylight in the entry hall
- Sun tubes to the first floor classrooms
- One inch of added insulation to the exterior walls
- Architectural shade overhangs on west and south windows
- Entrance canopy shades on the administration window;
- Healthy, non-polluting, non-toxic interior finishes and construction materials
- GREEN Guard certified furniture for the classrooms

High Performance Initiatives:

- Preferred parking provided for low-emitting and fuel efficient hybrid vehicles
- Construction, demolition and land clearing debris diverted from disposal in landfills and incinerators
- Recyclable recovered resources redirected back to the manufacturing process
- Reusable materials redirected to appropriate sites
- Certain materials must have recycled content, e.g. "green" finishes, fly ash in concrete, etc.
- A minimum indoor air quality performance will be established
- Minimum exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke
- Outdoor air delivery monitoring of CO₂
- Rain water recovery for irrigation
- Green housekeeping
- Green building curriculum

Energy Conservation Initiatives:

- Enhanced commissioning of the building energy systems, including heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls
- Lighting and day lighting controls
- Light shelves to increase the effectiveness of daylight
- Vegetated (green) roof surfaces
- Renewable energy systems (wind, solar, photovoltaics, etc.)
- Compliance with both the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) and the prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1- latest edition with amendments)
- Whole Building Energy Simulation
- Advanced, energy conservative mechanical system
- Provision for the ongoing accountability of building energy consumption over time
- Reducing Heat Island Effect at the roof level and at the site grade level
- Enhanced Refrigerant Management, requiring zero use of CFC-based refrigerants in new base building HVAC&R systems (reducing ozone depletion and supporting early compliance with the Montreal Protocol; R134a refrigerant will be used.)

Allegany

- Have included “LEED-like” design requirements in all architectural and engineering contracts.
- LEED requirements are considered in all building improvements and retrofits.

Anne Arundel Without seeking LEED certification, the system has employed most of the LEED strategies since 2004.

Baltimore City Is developing new building design and construction standards requiring all new or major renovation projects to obtain LEED Silver certification, and for all projects to incorporate LEED design concepts, standards and recommendations wherever possible.

Baltimore Conducts continued LEED training programs for technical and professional employees.

Calvert LEED initiatives have been implemented into most new school construction projects. Projects will attain the LEED Silver rating when possible.

Carroll Without seeking LEED certification, the system employs most of the LEED strategies including:

- Building orientation to take advantage of natural light and reduce heat load
- Geothermal HVAC systems with heat recovery for fresh air
- Building automation systems for operation and monitoring
- Water conservation measures such as waterless urinals, low flush water closets, faucets with motion sensors
- Storm water initiatives to improve water recharge and improve quality
- Use of high velocity hand dryers to reduce paper waste
- Energy efficient lighting and controls
- Roofing practices to reduce heat gain

Charles

- Designs as many LEED recommendations into schools as the project budgets permit, without going through the LEED application process.
- Pursuing LEED Silver certification for all new schools.
- In addition to many features described in other sections, high performance considerations for a new high school design include:
 - Heat recovery and water recovery systems for swimming pool
 - Rain water harvesting for irrigation use and possible gray water system
 - Energy efficient light fixtures using T-5 lamps
 - Daylighting and daylighting controls
 - Switching to provide multiple lighting levels

Dorchester Has applied the techniques and technologies of LEED without seeking certification for the past decade.

Frederick Considers multiple heating/ventilation systems with cost/benefit analysis of each, uses as many "green" design standards as possible, and locates new schools in densely developed areas to reduce the number of bus trips. Pursuing silver LEED certification for all new schools.

Harford

- Major projects have used “LEED-like” practices regardless of whether the buildings were scheduled to be LEED certified.
- The Joppatowne Elementary School Modernization project will be the system’s second LEED certified building (the first was a new central office building).
- Sustainability review process has been developed for all new construction to insure that sustainable practices, materials, and products are utilized.

Kent Has partially incorporated integrated LEED strategies such as geothermal system, automatic lighting shutoff controls (sensors), increased ventilation, and controllability of systems.

Montgomery

- Initiated a LEED pilot project in 2003. Great Seneca Creek Elementary School, opened in 2006, is the first public school in Maryland to be certified LEED Gold.
- Francis Scott Key Middle School, completed in 2009, is the first certified LEED Gold middle school in Maryland.
- The Board of Education has committed to certify all new buildings with a minimum Silver rating under the USGBC LEED program.
- Facility Design Guidelines were updated to incorporate sustainable design practices based on LEED for all major capital projects.



Francis Scott Key Middle School – Certified LEED Gold
Montgomery County Public Schools



William B. Gibbs Elementary School - LEED certification pending
Montgomery County Public Schools

Prince George's

- Under the LEED 2009 for Schools New Construction and Major Renovation, Gold LEED certification is sought for all new schools.
- Schools Completed:
 - *Suitland Elementary School* (LEED Gold)
 - Reduction of energy use by 20% over ASHRAE 90.1, 1999 Standards:
 - Total annual energy costs reduced from \$62,750 to \$53,600 (approximately 16%);
 - Annual Energy Intensity reduced from 44,045 BTU/sq.ft. to 36,450 BTU/sq.ft. (approximately 21%).
 - Pollution prevention savings annually will be 808,500 lbs CO₂, 1 ton SO₂, 1,460 lbs NOX.
 - \$60,000 additional costs in enhanced commissioning and long-term monitoring to insure peak performance;
 - Projected savings of approximately \$9,150 in annual direct energy operational costs, not including savings from reduced lighting loads, water saving features, etc.;
 - Construction savings of approximately \$50,000 were achieved by not installing fuel storage tank, and by downsizing equipment.
 - *Vansville Elementary School* (LEED Gold)
 - 38.8% energy savings as compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004.

Saint Mary's

- The Evergreen Elementary School was designed to achieve at least a LEED Silver rating, however based on construction efforts it achieved a LEED Gold rating. Overall the building is projected to use 30% less energy than a school designed with conventional systems.
- Construction project designs are approached to include energy efficient design and as many LEED recommendations as the project budgets permit, however not all projects will go through the LEED application process.
- Pursuing LEED silver certification for all new schools.

Washington Is pursuing LEED strategies at two schools currently under construction. Commissioning of major electric and HVAC systems is to be utilized in the two schools.

Worcester The renovation/addition or replacement school project for Showell Elementary School will be designed to achieve at least a LEED Silver rating.

APPENDIX 1

THE MARYLAND HIGH PERFORMANCE BUILDINGS ACT

CHAPTER 124, MARYLAND LAWS OF 2008 (SENATE BILL 208 / HOUSE BILL 376)

PASSED AND ENACTED: Maryland Legislative Session of 2008

Summary: This legislation was developed by the Maryland Green Building Council and proposed by the Administration in the recent session of the General Assembly. The legislation addresses both facilities owned and entirely funded by the State, and new school facilities, which are owned by the local school districts and, in most cases, receive construction funding from both the State and the local county governments. All State buildings larger than 7,500 square feet, and with exceptions for utility buildings such as storage facilities, will be required to achieve a LEED Silver rating or equivalent; a 2% increase of budget is provided to defray additional expenses. All new school buildings after a specified date will be required to be LEED Silver, with a waiver process established through the Interagency Committee. The State will provide additional funding for 50% of the extra local costs for five fiscal years.

Terms:

Board of Public Works (BPW), consisting of the Governor, the State Treasurer, and the State Comptroller, is generally responsible for the approval of contracts for public works and other aspects of State procurement. The BPW approves the annual Capital Improvement Program as recommended by the IAC, as well as the regulations that govern public school construction in the state.

Interagency Committee means the Interagency Committee on School Construction (IAC), established by the Board of Public Works in 1971 to administer Maryland's Public School Construction Program. The IAC consists of the State Superintendent of Schools (chair), the Secretary of the Maryland Department of Planning, the Secretary of the Department of General Services, and two members of the public appointed by the General Assembly.

Public School Construction Program is the State agency, reporting to the Board of Public Works, that implements the policy decisions of the IAC. Staff of the PSCP administer the funds approved by the State for school construction, and provide technical assistance to school districts in the procurement, design, and construction of their public school construction projects.

The Act:

Amendment to Education Article, section 3-602.1.

(A) (1) In this Section the following words have the meanings indicated.

(2) "High Performance Building" means a building that:

- (i) Meets or exceeds the current version of the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) green building rating system Silver rating; or
- (ii) Achieves at least a comparable numeric rating according to a nationally recognized, accepted, and appropriate numeric sustainable development rating system, guideline, or standard approved by the Secretaries of Budget and Management and General Services.

(B) This Section applies to the construction of new schools that have not initiated a request for proposal for the selection of an architectural and engineering consultant on or before July 1, 2009.

(C) Except as provided in Subsection (D) of this Section, a new school that receives state public school construction funds shall be constructed to be a high performance building.

- (D) (1) The Board of Public Works shall establish a process to allow a school system to obtain a waiver from complying with Subsection (C) of this section.
- (2) The waiver process shall:
 - (i) Include a review by the Interagency Committee to determine if the construction of a high performance building is not practicable; and
 - (ii) Require the approval of a waiver by the Interagency Committee.
- (E) For fiscal years 2010 through 2014 only, the State shall pay 50% of the local share of the extra costs, identified and approved by the Interagency Committee, that are incurred in constructing a new school to meet the High Performance Building requirements of this Section.
- (F) The Board of Public Works shall adopt regulations to implement the requirements of this Section.

Section 3. And be it further enacted, that Section 1 of this Act shall apply to capital projects that have not initiated a request for proposal for the selection of an architectural and engineering consultant on or before the effective date of this Act.

Section 4. And be it further enacted, that this Act shall take effect July 1, 2008.

APPENDIX 2

MARYLAND CERTIFIED HIGH PERFORMANCE SCHOOLS

HIGH PERFORMANCE SCHOOLS IN MARYLAND								
SURVEY OF LEED CERTIFIED SCHOOLS								
Public School Construction Program								
21-Jan-10								
LEA	NAME OF SCHOOL	CURRENT STATUS:			LEED CERTIFICATION LEVEL THAT WILL BE/HAS BEEN:		OTHER CERTIFICATION SOUGHT?	ADDITIONAL ESTIMATED COST TO ACHIEVE HIGH PERFORMANCE CERTIFICATION?
		"O" - Occupied	"C" - Construction	"P" - Planning/Design	Sought	Achieved		
		O	C	P				
Baltimore City	Waverly PreK-8			1	Silver			Estimated 1,500,000 Construction + 400K A/E
Baltimore County	West Towson ES (New School)		1		Silver			Estimated \$450,000 (Construction) + \$328,299 (A/E, CM and Comm. Agent)
	George Washington Carver School for Arts and Technology (Replacement High School)		1		Silver			Estimated \$2,300,000 (Construction) + \$529,492 (A/E and CM) + Comm. Agent cost to be added
	Dundalk/Sollers Point HS (Replacement High Schools)			1	Silver			
Carroll	Mt. Airy MS (renov/add)			1	Silver			\$75,000 (Additional A/E Fee if we choose to pursue LEED Silver Certification)
Cecil	New Cecil Technical HS (new)			1	Silver			
Charles	High School 2013 (new)			1	Silver or Gold			\$1,098,000
Frederick	Lincoln ES (renov/add)			1	Silver			
Harford	Joppatowne ES (replacement)	1			Certified			\$66,000.00 (Commissioning Agent)
Howard	Northfield ES (renov/add)		1		Silver			\$1,650,000
	Thunder Hill ES (renov/add)			1	Certified			\$650,000
	Stevens Forest ES			1	Certified			\$500,000
Montgomery	Great Seneca Creek ES (new)	1			Gold	Gold		6% of total project
	Francis Scott Key MS (replacement)	1			Gold	Gold		5% of total project
	Wm. B. Gibbs ES	1			Gold			5% of total project
	Cashell ES (replacement)	1			Gold			5% of total project
	Carderock Springs ES (replacement)		1		Gold			5% of total project
	Cresthaven ES (replacement)		1		Gold			5% of total project
	Cabin John MS (replacement)		1		Gold			5% of total project
	Farmland ES (replacement/renov)		1		Gold			5% of total project
	Paint Branch HS (replacement)		1		Gold			5% of total project
	Garrett Park ES (replacement)			1	Gold			5% of total project
	Cannon Road ES (replacement)			1	Silver			5% of total project
	Seven Locks ES (replacement)			1	Silver			5% of total project
	Gaithersburg HS (replacement/renov)			1	Not determined			5% of total project
	Hoover MS (replacement)			1	Not determined			5% of total project
	Beverly Farms ES (replacement/renov)			1	Not determined			5% of total project
	Weller Road ES (renov/add)			1	Not determined			5% of total project
	Glenallen ES (replacement)			1	Not determined			5% of total project
	McKenney Hills ES (replacement)			1	Not determined			5% of total project
Prince George's	Vansville ES (new)	1			Gold	Gold		\$185,462.00
	Barack Obama ES (Formerly Planning SR VI) (new)		1		Gold			\$193,447.00
	Avalon ES (Replacement)			1	Gold			\$166,444.00
	Henry G. Ferguson ES (Replacement)			1	Gold			\$53,557.00
	New Clinton Area ES (new)			1	Gold			\$79,028.00
	New Hyattsville Area ES (new)			1	Gold			\$75,439.00
	Fairwood ES (new)			1	Gold			\$253,693.00
	Greenbelt MS (replacement)			1	Gold			\$124,200.00
	Oxon Hill HS (replacement)			1	Gold			\$447,591.00
	Fairmont Heights HS (replacement)			1	Gold			\$408,468.00
Queen Anne's	Sudlersville MS (replacement)			1	Silver or Gold			Estimated at 3% of the total project cost. This includes the cost of A/E services.
St. Mary's	Evergreen ES (new)	1				Gold		\$1,200,000
Wicomico	Bennett MS (replacement)			1	Silver			\$138,000 for design phase only
SUBTOTALS		7	9	27				
TOTAL				43				

APPENDIX 3

MARYLAND SCHOOLS WITH GEOTHERMAL MECHANICAL SYSTEMS

(survey 8/5/09, updated 1/10)

LEA	Occupied	In Construction	In Planning/Design
Anne Arundel	1 <i>Piney Orchard ES</i>	0	0
Baltimore	1 <i>Vincent Farm ES</i>	1 <i>Geo. Wash. Carver Center</i>	2 <i>Dundalk HS/ Sollers Point Tech HS</i>
Calvert	2 <i>Mill Creek MS</i> <i>Barstow ES</i>	1 <i>Calvert MS</i>	0
Caroline	1 <i>Col. Richardson MS</i>	1 <i>Col. Richardson HS</i>	1 <i>Preston ES</i>
Carroll	1 <i>Ebb Valley ES</i>	2 <i>Westminster HS</i> <i>Manchester Valley HS</i>	0
Cecil	2 <i>Holly Hall ES</i> <i>Northeast ES</i>	1 <i>Calvert ES</i>	1 <i>Cecil Technical HS</i>
Charles	0	0	1 <i>New High School</i>
Dorchester	4 <i>Judy Hoyer Center</i> <i>Choptank ES</i> <i>Mace's Lane MS</i> <i>North Dorchester MS</i>	1 <i>School of Tech.</i>	0
Frederick	1 <i>Earth Space Science Lab</i>	0	1 <i>Lincoln ES</i>
Harford	1 <i>North Harford HS</i>	0	0
Howard	0	1 <i>Northfield ES</i>	0
Kent	1 <i>Rock Hall ES</i>	0	0
Montgomery	8 <i>Spark M. Matsunaga ES</i> <i>Richard Montgomery HS</i> <i>Great Seneca Creek ES</i> <i>Little Bennett ES</i>	1 <i>Cabin John MS</i>	4 <i>Cannon Road ES</i> <i>Garrett Park ES</i> <i>Seven Locks ES</i> <i>Paint Branch HS</i>

LEA	Occupied	In Construction	In Planning/Design
Montgomery cont'd			
	<i>William B. Gibbs, Jr. ES</i>		
	<i>Bells Mill ES</i>		
	<i>Francis Scott Key MS</i>		
	<i>Cashell ES</i>		
Prince George's	1	1	4
	<i>Vansville ES</i>	<i>Barack Obama ES</i>	<i>Greenbelt MS</i>
			<i>Oxon Hill HS</i>
			<i>Fairmont Heights HS</i>
			<i>Fairwood ES</i>
			<i>Avalon ES</i>
			<i>Henry G. Ferguson ES</i>
			<i>Hyattsville Area ES</i>
			<i>Clinton Area ES</i>
Queen Anne's	3	0	1
	<i>Matapeake ES</i>		<i>Sudlersville MS</i>
	<i>Matapeake MS</i>		
	<i>Kent Island ES</i>		
St. Mary's*	1	0	0
	<i>Evergreen ES</i>		
Somerset*	3	1	0
	<i>Somerset Interm.S</i>	<i>Washington HS</i>	
	<i>Woodson ES</i>		
	<i>Deal Island ES</i>		
Talbot	0	2	0
		<i>St. Michael's ES</i>	
		<i>St. Michael's MS/HS</i>	
Washington	0	1	1
		<i>Antietam Academy</i>	<i>Eastern Primary</i>
Wicomico	5	1	3
	<i>North Salisbury ES</i>	<i>James M. Bennett HS</i>	<i>Bennett Middle</i>
	<i>Prince Street ES</i>		<i>Northwestern ES</i>
	<i>Westside Primary</i>		<i>Parkside HS</i>
	<i>Westside Int.</i>		
	<i>Willards ES</i>		
Worcester	2	1	1
	<i>Ocean City ES</i>	<i>Pocomoke HS</i>	<i>Snow Hill HS</i>
	<i>Worcester Tech. HS</i>		
Total	38	16	20

APPENDIX 4

GLOSSARY OF TERMS

air handling unit (AHU) - A device used to condition and circulate air as part of a heating, ventilating, and air-conditioning system (see *HVAC*). Usually, an air handler is a large metal box containing a blower, heating and/or cooling elements, and filters.

air-side economizers - Air-side economizers utilize automatically controlled dampers to mix return air and outside air to obtain mixed air cool enough (about 55°F–60°F) to meet the building's cooling requirements. They can reduce energy costs in cold and temperate climates while also potentially improving indoor air quality, but are most often not appropriate in hot and humid climates.

air-to-air heat exchanger - This device mechanically ventilates and dehumidifies buildings in colder climates. During the winter it transfers heat from the air being exhausted, to the fresh, outside air entering the building. Fifty to eighty percent of the heat normally lost in exhausted air is returned to the building.

Alliance to Save Energy [www.ase.org] - Founded in 1977, the Alliance is a non-profit coalition of business, government, environmental and consumer leaders. It supports energy efficiency as a cost-effective energy resource and advocates energy-efficiency policies that minimize costs to society and the global climate. The Alliance undertakes research and educational programs, designs and implements energy-efficiency projects, promotes technology development, and builds public-private partnerships worldwide.

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) – A professional association that promotes training, certification, and standards for engineers in these disciplines. ASHRAE develops standards for both its members and others, for the purpose of establishing consensus for methods of test for use in commerce and performance criteria for use to guide the industry. ASHRAE publishes three types of voluntary consensus standards: Method of Measurement or Test, Standard Design, and Standard Practice. ASHRAE does not write rating standards unless a suitable rating standard will not otherwise be available. Consensus standards define minimum values or acceptable performance, whereas other documents, such as design guides, may be developed to encourage enhanced performance. ASHRAE is accredited by the American National Standards Institute (ANSI) and follows ANSI's requirements for due process and standards development.

ASHRAE/IESNA Standard 90.1-2004 (“Energy Standard for Buildings Except Low-Rise Residential Buildings”) – An ASHRAE standard that provides minimum standards for the energy efficient design of buildings (except low-rise residential buildings). The standards apply to the building envelope and to these building systems: HVAC, service (domestic) hot water, electric power distribution, electric motors and drives, and lighting.

biodiesel - Unlike common petroleum-based diesel, increasingly called *petrodiesel*, biodiesel is a fuel usually derived from vegetable sources, such as soybean oil. It can be used in unmodified diesel-engine vehicles. This distinguishes it from *straight* or *waste vegetable oil* fuels which can only be used in modified vehicles.

building commissioning - “Commissioning implements a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria. The defined objectives and criteria are often referred to as the owner's project requirements (OPR), which involve achieving, verifying, and documenting the performance of each assembly or system to meet the building's operational needs. The commissioning process uses the owner's project requirements as the reference to determine acceptance of the design. Commissioning includes verifying and documenting that the project operational and maintenance documentation and training of operation and maintenance personnel occur. The result should be fully functional systems that can be properly operated and maintained throughout the life of the building.” ASHRAE Technical Committee 7.9 webpage.

built-up roof - A roof consisting of multiple plies of roofing felts laminated together with bitumen. The material can consist of bitumen-saturated felt, coated felt, polyester felt or other fabrics. A surfacing is generally applied and can be asphalt, aggregate (gravel or slag), emulsion or a granule-surfaced cap sheet.

carbon dioxide (CO₂) sensors - CO₂ is a byproduct of human respiration and is known to cause health effects when concentrations exceed a certain limit. Sensors can be installed in areas that have infrequent or irregular occupancy patterns, such as auditoriums and classrooms. The sensors allow the ventilation system to be controlled by the concentration of CO₂ present in the space, thereby reducing the amount of ventilation required during unoccupied times. As the space becomes occupied, the sensors will detect an increase of CO₂ and adjust the amount of outside air needed.

carbon footprint - Is "the total set of greenhouse gas (GHG) emissions caused by an organization, event or product."⁵ Carbon footprint is frequently expressed in terms of the total emission amount of carbon dioxide, or its equivalent of other GHGs.

CFC-based refrigerants - Chlorofluorocarbons are compounds used in refrigerants, including automobile and building air conditioning systems. They deplete the earth's ozone layer and manufacturers are no longer allowed to produce them. Non-ozone depleting alternatives have been developed (see *R134a*).

COMAR – Code of Maryland Regulations

daylighting - Is the practice of placing windows, or other transparent media, and reflective surfaces so that, during the day, diffused natural light provides effective internal illumination. Daylighting is distinguished from sunlighting, the direct lighting of surfaces with sunlight. Within the overall architectural design of a building, particular attention is given to daylighting when the aim is to maximize visual comfort, productivity, or to reduce energy use. Energy savings from daylighting are achieved either from the reduced use of electric lighting, or from passive solar heating or cooling.

DGS - Maryland Department of General Services. The Department supports State and local government agencies by providing a variety of functions, including planning, design, and construction management, facilities maintenance, procurement of goods and services, receipt and distribution of excess property, and provision of real estate services. The Secretary of DGS is a member of the Interagency Committee on School Construction.

direct digital control (DDC) - Technology used to control HVAC (see *HVAC*) devices via microprocessors containing software performing the control logic. DDC receives input data from the sensors installed in the HVAC system and, in turn, sends output data to control the HVAC system devices. These systems may have graphics software that allows operators to monitor, control, alarm and diagnose building equipment remotely.

displacement ventilation - Displacement ventilation uses the natural buoyancy of warm air to provide improved ventilation. Supply air is introduced to the space at or near the floor level, at a low velocity, at a temperature only slightly below the desired room temperature. The cooler supply air "displaces" the warmer room air, creating a zone of fresh cool air at the occupied level. Such systems are typically more energy efficient than conventional overhead systems, as only air in the zone of human occupancy is conditioned.

dual fuel heating system - A dual fuel system allows alternative fuels to be used, for example oil and natural gas. This approach allows the building owner to purchase fuels at the lowest cost without a capital conversion project, or to switch between energy sources to optimize environmental conditions. One system consisting of an electric heat pump and a gas, oil or propane furnace, will automatically switch to increase efficiency depending on the outside temperature. In the spring and fall, the heat

⁵ ["What is a carbon footprint?". UK Carbon Trust.](http://www.carbontrust.co.uk/solutions/CarbonFootprinting/what_is_a_carbon_footprint.htm)
http://www.carbontrust.co.uk/solutions/CarbonFootprinting/what_is_a_carbon_footprint.htm.

pump extracts heat from the outside air and pumps it indoors, warming the building more efficiently than with electric resistance heat. On cold winter days and nights (below 30 or 40 degrees Fahrenheit) back-up heat from the fossil fuel furnace is used. In the summer, the heat pump reverses its cycle and acts as a central air conditioner, extracting heat from indoors and pumping it outside.

earth-coupled heat exchanger - Also known as ground-coupled heat exchangers or earth cooling/warming tubes, these systems utilize the earth's near constant subterranean temperature to warm or cool air. They are often a viable alternative to conventional systems since there are no compressors, chemicals or burners, and only blowers are required to move the air. They are regularly used in Europe and slowly being adopted into North America.

energy management system (EMS) - A system to automatically control, monitor, and optimize the generation and flow of energy. An EMS conserves energy by adjusting operating hours and/or cycling equipment, and generates efficiencies through centralized remote scheduling, trending, monitoring, operating, and trouble-checking of buildings and energy systems. Centralized EMS systems also allow for the preservation of equipment in cold temperatures. EMS devices range from simple on/off time clocks controlling a single system, to sophisticated computerized controls that manage all the energy-consuming systems in a building or in multiple buildings.

energy performance contracting - A financing technique that uses cost savings from reduced energy consumption to repay the capital cost of installing energy conservation measures. Normally offered by Energy Service Companies (ESCOs), this technique allows building users to achieve energy savings without up-front capital expenses. The costs of the energy improvements are borne by the performance contractor and paid back out of the energy savings, which are guaranteed by the ESCO based on an audit of the building.

energy service company (ESCO) - A business that develops, installs, and arranges financing for projects designed to improve the energy efficiency and maintenance costs for facilities over a seven to twenty year time period. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project.

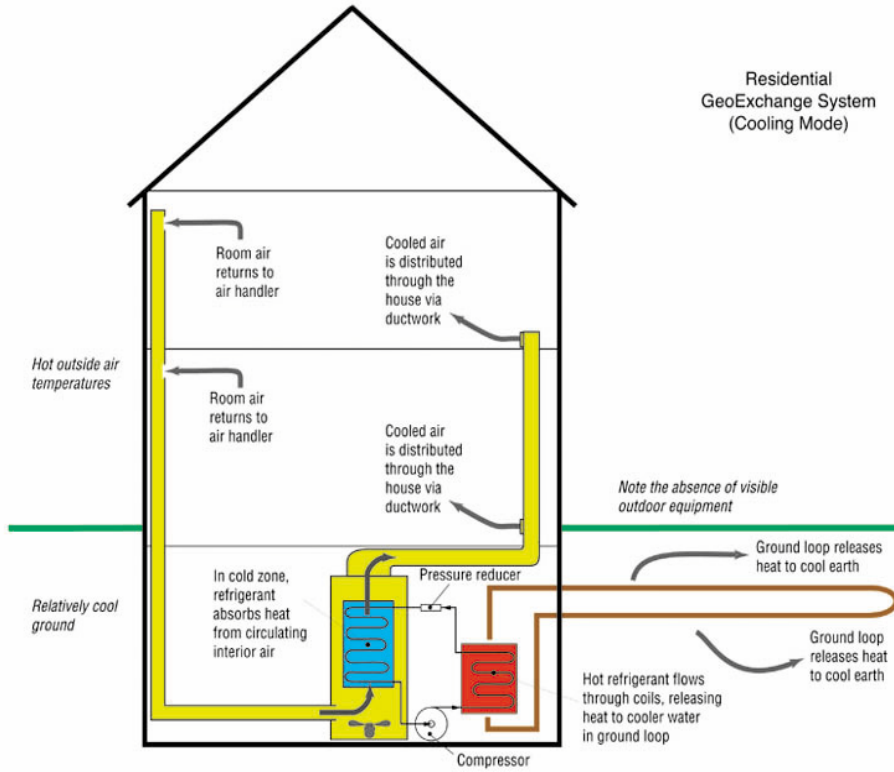
Energy Star - Was introduced in 1992 by the EPA as a voluntary labeling program designed to identify and promote energy-efficient products in order to reduce greenhouse gas emissions. Computers and monitors were the first labeled products. In 1996, EPA partnered with the U.S. Department of Energy for particular product categories. Today the label covers many categories, including new homes and commercial and industrial buildings.

Energy use index (EUI) – A measure of energy consumption per square foot per year. Comparison of EUI among buildings of similar type and use can identify waste and opportunities for savings.

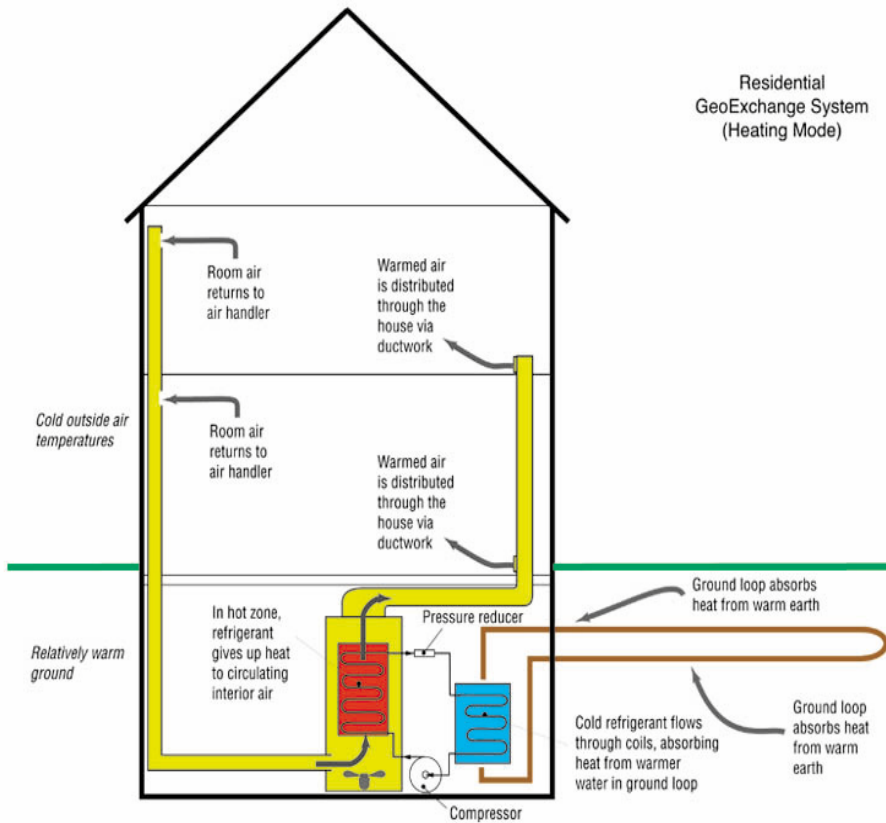
geothermal ground source heating and cooling system - Also known as "geo-exchange" systems or geothermal heat pumps, these heating and cooling systems operate based on the stability of underground temperatures; ground a few feet below surface has a very stable temperature throughout the year. These systems use the earth as a heat source in winter and a heat sink in summer, and are estimated to have a payback period of less than eight years. See diagram, p. 52.

geothermal heat pump - See *geothermal ground source heating and cooling system*

Residential
GeoExchange System
(Cooling Mode)



Residential
GeoExchange System
(Heating Mode)



The Geothermal Ground Source Heating and Cooling Concept

gray/grey water system - Also known as *sullage*, is non-industrial wastewater generated from domestic processes such as washing dishes, laundry and bathing. Gray water comprises 50-80% of residential wastewater. It is distinct from *black water* (water from sewage systems) in the amount and composition of its chemical and biological contaminants from feces or toxic chemicals. Gray water may possibly be reused for other purposes, especially landscape irrigation, but there are public health considerations.

greenhouse gas emissions (GHG) - Are atmospheric gases that absorb and emit radiation within the thermal infrared range. The main greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone. The process of absorption and emission is the fundamental cause of the greenhouse effect.⁶

HID - High intensity discharge. These lamps produce light by passing an electric arc through a metal vapor, such as mercury or sodium.

HVAC - Heating, ventilating and air conditioning; sometimes referred to as *climate control*.

HVAC occupancy sensors - Are infrared and/or ultrasonic devices that determine the presence of people by detecting changes in room temperature or motion (via sound). They can activate lighting and/or climate control.

Leadership in Energy and Environmental Design (LEED) - The LEED Green Building Rating System was begun in 1998 by the U.S. Green Building Council, a non-profit organization committed to expanding sustainable building practices. The Council is composed of more than 13,500 organizations from across the building industry. LEED encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. In the LEED green building scoring system there are 69 possible points and buildings can qualify for four levels of certification: Certified 26–32 points, Silver 33–38 points, Gold 39–51 points, and Platinum 52–69 points.

LED - Light-emitting diode, often used as small indicator lights on electronic devices and increasingly in higher power applications such as flashlights and area lighting.

light shelf - An architectural element that allows daylight to penetrate deep into a building. This horizontal light-reflecting overhang is placed above eye-level and has a high-reflectance upper surface. This surface is then used to reflect daylight onto the ceiling and deeper into a space.

low-E - Low-emittance coatings are microscopically thin metal or metallic oxide layers deposited on a window or skylight glazing surface. They block a significant amount of radiant heat transfer, thus lowering the total heat flow through the window. Low-E coatings are transparent to visible light.

low-flow - In 1995, the National Energy Policy Act mandated the use of toilets that use no more than 1.6 gallons of water per flush. Since then, low-flow plumbing fixtures including toilets, faucet aerators and showerheads have been developed that save substantial amounts of water compared to conventional fixtures while providing the same utility.

Maryland Energy Administration (MEA) - Created in 1991, the Administration works to maximize energy efficiency in Maryland, reduce reliance on foreign fuel, and improve the environment. The Administration coordinates and directs energy planning for State agencies, and helps local governments implement programs to reduce energy consumption. It is the lead agency for implementing alternative fuel policy (National Energy Policy Act of 1992).

Metasys - A building management system manufactured by Johnson Controls, Inc., to automate, integrate and control such systems as HVAC equipment, security and lighting.

⁶ International Panel on Climate Control ([IPCC AR4 SYR Appendix Glossary](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_appendix.pdf)" (PDF). http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_appendix.pdf. Retrieved 2008-12-14.

Montreal Protocol on Substances That Deplete the Ozone Layer - An international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The treaty was entered into on January 1, 1989 and has since undergone seven revisions. It is believed that if the international agreement is adhered to, the ozone layer is expected to recover by 2050.

Niagara - A software framework manufactured by Tridium used to normalize the data and behavior of diverse devices, such as those used in building automation systems, regardless of manufacturer.

NO - Nitrogen oxide, a term used to signify any of several compounds of nitrogen and oxygen.

performance-based contracting - Also called performance-based acquisition, is a technique for structuring all aspects of a work contract around the purpose and outcome desired as opposed to the process by which the work is to be performed. Such contracts clearly spell out the desired end result expected of the contractor. The manner in which the work is to be performed is left up to the contractor. This encourages contractors to be innovative and to find cost-effective ways of delivering services. By shifting the focus from process to results, this technique also promises better outcomes. In facility management, PBC is most often associated with energy performance contracts.

phantom loads - The [electric power](#) that is consumed by appliances while they are switched off or in a [standby mode](#). Also called standby power, vampire power, vampire draw, phantom load, or leaking [electricity](#).

photocell - An electronic device, specifically a resistor, whose electrical properties are modified by the action of light. When light strikes the cell, it allows current to flow more freely. When dark, its resistance increases dramatically. They can be used to detect large or small fluctuations in light levels.

photovoltaic (PV) - A technology that converts light directly into electricity. This occurs when light particles (photons) fall on the boundary between dissimilar semiconductors, usually made of silicon.

photovoltaic shingles - (see *photovoltaic*) Roofing shingles which can be installed in the same way as conventional shingles. About 500 square feet of shingles produce three kilowatts during peak sunlight, enough for most residences.

photovoltaic solar generator - An electricity generator using photovoltaic technology (see *photovoltaic*).

PJM - PJM Interconnection is a regional transmission organization that coordinates the movement of wholesale electricity in several eastern states, including Maryland. The company operates the world's largest competitive wholesale electricity market and ensures the reliability of the largest centrally dispatched grid in the world.

Pulp Extractor – A waste disposal device that acts similar to a disposer by breaking food waste down into small pieces. The result is then transferred to an extractor where all of the water is pressed out. Finally, the waste is drained and dumped into the trash. A machine can convert as much as 100 pounds of waste to about 20-25 pounds of disposable waste.

Qualified Zone Academy Bond (QZAB) - This program was established under the Taxpayer Relief Act of 1997. It provides a source of funding that may be used for renovating school buildings, purchasing equipment, developing curricula, and/or training school personnel, but not for new construction. This is a tax credit bonds program, not a grant program. The federal government covers all of the interest on these bonds. Maryland's QZAB program is administered by the Public School Construction Program.

R134a - Is a commercially available hydrofluorocarbon (HFC) refrigerant for use as a long-term replacement for CFC-based refrigerants in new equipment and for retrofitting older CFC systems.

rainwater harvesting - the gathering, accumulating and storing, and re-use of rainwater for non-potable applications, e.g. irrigation of playing fields or flushing of toilet fixtures.

R value - The measure of the resistance of building materials and structures to the flow of heat; the higher the R-value the better the substance is as thermal insulation.

sun tubes - *Light tubes* or *light pipes* are used for distributing natural or artificial light. In their application to daylighting, they are also called solar pipes, daylight pipes, or solar light pipes. The oldest and most widespread type of light tube used for daylighting is the "tubular skylight." It consists of a round tube lined with highly reflective material that conducts light rays through a building, starting from an entrance-point located on its roof or one of its outer walls.

sustainable design - Also referred to as "green design", "eco-design", or "design for environment", is the art of designing physical objects and the built environment to comply with the principles of economic, social and ecological sustainability. The aim is to produce places, products and services in a way that reduces use of non-renewable resources, minimizes environmental impact, and relates people with the natural environment.

systemic renovation project - Renovation or replacement of a specific building system in a school facility which extends the useful life of the facility for a minimum of fifteen (15) years (COMAR 23.03.02.15).

T-5, T-8, T-12 - Fluorescent lamps are designated with a code, the "T" indicating tubular shape, the number representing the diameter in eighths of an inch. T-12s have old magnetic ballasts, T-8s have energy-saving electronic ballasts, and T-5s are quite small and may be battery-operated.

Tridium - See *Niagara*.

variable frequency drive (VFD) - A variable-frequency drive controls the operating speed of an AC motor by controlling the frequency and voltage of the power supplied to the motor.

vegetated (green) roof surface - A roof of a building that is partially or completely covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane. Among many other benefits, green roofs reduce heating and cooling loads, reduce the urban heat effect, increase roof life span, and reduce stormwater runoff.

volatile organic compounds (VOC) - Organic chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize and enter the atmosphere. A wide range of carbon-based molecules, such as aldehydes, ketones, and other light hydrocarbons are VOCs. The term often is used in a legal or regulatory context and in such cases the precise definition is a matter of law. The United States Environmental Protection Agency(EPA) defines a VOC as any organic compound that participates in a photoreaction. The term may refer both to well characterized organic compounds and to mixtures of variable composition. The most common VOC is methane.

VSD - Variable Speed Drive. See *Variable Frequency Drive*.

wind turbine - A device that converts the kinetic energy in wind into mechanical energy. If the mechanical energy is used directly by machinery, such as a pump or grinding stone, the machine is usually called a windmill. If the mechanical energy is then converted to electricity, the machine is called a wind generator, wind turbine, wind power unit or wind energy converter.