

# **HIGH PERFORMANCE BUILDING INITIATIVES IN MARYLAND SCHOOL CONSTRUCTION**

**ENERGY CONSERVATION, ALTERNATIVE ENERGY SOURCES, AND HIGH  
PERFORMANCE BUILDING PRACTICES IN MARYLAND PUBLIC SCHOOL  
CONSTRUCTION**

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April 22, 2008

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Special thanks to James Blackburn, special consultant to the Public School Construction Program, for his contributions to this report.

## Introduction

Across Maryland, a culture of innovation in the design and construction of school facilities is growing under a variety of names: “high performance schools,” “green architecture,” “sustainable design.” This report shows the variety of issues that the movement covers, from energy conservation through use of geothermal ground source heat pump systems to enhanced daylighting. Design innovations include the use of recycled materials, materials from renewable sources, and materials that have low levels of “embedded” energy (the energy expended in the production, transportation, and installation of the material). A number of school systems are actively promoting a culture of conservation and energy awareness among teachers, staff, and the students themselves. In the construction phase, increasing attention is being paid to the mitigation of downstream/ downwind site impacts due to stormwater runoff, disturbance of soils and recycling of waste materials. At least three school systems have LEED (Leadership in Environmental and Energy Design) certification school facilities in various stages of planning, design, construction, or occupancy, attesting to their commitment to this progressive movement in facility design. Several other systems report that they currently design and build their schools to “LEED-like” standards without undertaking the additional administrative efforts that are involved in certification.

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. Consequently, any significant improvement in the energy and environmental characteristics of school buildings will make a contribution to this pressing set of issues. 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 actually serve as teaching tools related to the science, math, environmental, and social studies curricula.

High performance schools are becoming increasingly attractive to local governments because they are more efficient and cost effective than conventional school facilities. As energy costs rise, the pay-back period for energy-related first costs becomes increasingly shortened. Currently, it is estimated that the pay-back period for a geothermal ground source heat pump system is seven years, although first costs have dropped so rapidly in the lower Eastern Shore that savings accrue in these areas as soon as the system is put into operation. This reduction of costs has occurred in the last three years, and is thought to be entirely attributable to increasing familiarity with the system by contractors rather than to changes in the technology. This technology has become more reliable in the last seven to ten years. High performance buildings also achieve significant reductions in water usage, an issue of heightened concern as water supply becomes the factor limiting new development in some parts of Maryland.

Other types of benefits that result from these innovations, including reduction of greenhouse gas emissions, 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. Since location and access by transit are factors considered in achieving LEED and other high performance certifications, legislation passed in the recent session of the General Assembly (Senate Bill 208/House Bill 376) aligns with policy objectives being developed by the Smart Growth Sub-Cabinet established under the Lieutenant Governor.

The information in this report was collected in January 2008. Each local educational agency (LEA) has reported their own information; the effort of the Public School Construction Program has been to organize this material into larger categories that will be useful to decision makers and school facility planners throughout the region.

## **I. The Human Element: Behavior Modification, Public Education and Personnel Training**

**Allegany** Has contracted with Energy Education Inc. in 2003 to develop and implement an energy conservation program; the system-wide cumulative cost avoidance has now exceeded \$2,900,000 based on the actual reduction in usage. Rather than investing in capital projects, the program addressed personnel training and behavioral changes.

### **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 Request contains a proposed program to solicit a contractual energy educator/trainer and to establish a demand-side behavioral modification specialist program in an effort to improve upon the human element of the equation.

**Baltimore City** Is involved with conservation educational efforts, evaluation of applicable new technology, and monitoring future improvements in schools for conservation.

### **Baltimore**

- Energy conservation guidelines were developed and disseminated to all schools and 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.
- Has ongoing training programs for Leadership in Energy and Environmental Design (LEED) designs for several employees.

**Calvert** Has added a new Supervisor of Energy Management position for FY08, with responsibility to inform and educate students and staff on proven ways to conserve energy.

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

**Cecil** Pending policy approval, has appointed an Energy Education Coordinator to develop and implement a system-wide energy education program to modify stakeholders’ energy consumption behavior.

**Charles** The instructional division is developing materials to promote student energy conservation awareness, as well as ideas and concepts that can be shared with their families at home.

**Dorchester** Is in the second 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.

**Frederick** Initiated a “Save 5% Program” in all schools and central office buildings. Awards are given to students and staff in recognition of outstanding energy conservation. The Program encourages personnel to:

1. Turn off lights, computers and other appliances when not in use;
2. Dress appropriately for the building climate, and;
3. Promptly report any heating, cooling or other building issues.

### **Howard**

- Is actively involved in a Green Schools program funded by a grant from the Maryland Energy Administration. Ten middle schools, two high schools, and one elementary/middle school participate. HCPS has partnered with the Alliance to Save Energy to create school programs that involve students in a hands-on approach to learning about energy and energy conservation, with some programs including environmental issues as well as economic impacts. The programs are age-appropriate and challenge the students to come up with ideas on their own.
- The schools are actively trying to change staff behaviors to reduce energy consumption, and students are encouraged to take this message home to their own families to reduce personal utility costs.

**Montgomery** Operates a Green Schools Focus program with a staff of nine, providing regular visits to each school to monitor energy use, educate staff and students on how to save energy, modify behavior, facilitate hands-on student research on school energy and environmental impacts, and reward schools for good energy performance.

**Prince George's** Suitland Elementary School is one of the first elementary schools that PGCPSS designed and completed with "green" and energy conservation initiatives, with the partial objective of using the building as a teaching tool by making "green" building features as visible as possible (e.g. a demonstration photovoltaic (PV) array on the gym roof and photovoltaic shingles on the south roofs). Other features include:

1. An outdoor teaching classroom adjacent to the science classroom;
2. An outside courtyard with a "Bay Saver" landscape;
3. A "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.

### **Saint Mary's**

- Evergreen Elementary School, designed to achieve at least a Silver rating under LEED, will be a learning laboratory for energy efficiency, alternative energy, and sustainable living. Students will be 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 can be used as a learning tool for students and allows site administrators to stay updated on their energy conservation efforts.
- SMCPSS continues to educate the students, staff, and community of St. Mary's County through information found on the web site, and is in the process of developing an energy mascot and logo to further promote energy conservation.
- Training of staff in the LEED program is on-going.

### **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 writing a request for proposals for a photovoltaic solar generator through the Maryland Energy Administration to be used as a demonstration model for students.

- Is exploring the possibility of establishing an energy conservation/green schools team to review current energy practices and determine methods to increase student and staff participation in the effort to conserve energy and protect the environment.

## **II. Conserving Natural Resources**

### **Energy Conservation**

#### **Anne Arundel**

- Has a centralized Energy Management Office within the Facilities Division with a staff of three. 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 these 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.

#### **Baltimore**

- Has incorporated State-of-the-art energy management controls in the construction and renovation of approximately 125 schools to maximize energy efficiency.
- Has initiated a program of installing programmable electronic controls in portable classrooms.

#### **Calvert**

- Adjusted all heating and cooling setbacks by 4 degrees a few years ago in order to reduce fuel, gas or electrical usage.
- The custodians now turn off the lights as well as the heating and air conditioning as they progress through the buildings.
- Calvert Elementary will use occupancy sensors and zoned lighting in every classroom to fully utilize daylight.
- All 32 building HVAC systems are monitored and controlled through the JCI Metasys system to reduce energy usage when buildings are in unoccupied mode.
- Classrooms, corridors, and at least five gymnasiums have had more energy efficient fixtures and lamps installed; exit lights have been converted to energy efficient LEDs.
- The new Supervisor of Energy Management is charged with retrofitting schools with energy saving devices as funding allows.

**Cecil** Schools with vending machines have disconnected the lights to cut energy consumption.

#### **Charles**

- Sizeable savings have been achieved through the use of energy monitors in portable classrooms.
- Uses an energy management system in all facilities. The system is included in all new construction.

#### **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. Summer school activities are limited to those schools with multiple zoning capacity.

#### **Garrett**

- Buildings with newer controls are being put in the "set-back" mode during night-time operations where possible.
- Performed a lighting retrofit in 1993 to most schools to install T-8 fluorescent tubes and electronic ballasts.

**Harford** Has 44 schools with centralized energy management.

**Howard** Has had a comprehensive energy management program in place for a number of years, with recent efforts focused on technology improvements, energy performance contracting and behavior modification.

#### **Kent**

- Initiated a system-wide energy contract with Energy Education, Inc to develop and implement an energy conservation program in December, 2007.
- Reduced the work week for employees to four 10 hour days during the summer to potentially reduce energy use.
- Consolidated summer school for students to two schools in an attempt 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**

- An internet interface allows MCPS to synchronize the HVAC schedules and thermostat set points at all portable classrooms, with a high level of savings, allowing MCPS to shut down portable classrooms whenever schools are closed. The payback has been under one year.
- In FY 2005, the system 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.

#### **Prince George's**

- Three years ago, 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 CO<sub>2</sub> 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 to generate efficiencies through remote scheduling, trending, monitoring, operating, and trouble-checking of buildings and energy systems.
- The design of the Suitland Elementary School has resulted in:
  1. Reduction of energy use by 20% over ASHRAE 90.1, 1999 Standards via:
    - Improved building envelope;
    - "Right-sized" equipment;
    - More energy efficient boilers;
    - Smaller, more efficient cooling plant and chiller, and;
    - VSD pumps.
  2. Lighting loads being reduced by utilizing natural daylight and alternative switching in classroom lighting;
  3. Total annual energy costs reduced from \$62,750 to \$53,600 (approximately 16%);

4. Annual Energy Intensity reduced from 44,045 BTU/sq.ft. to 36,450 BTU/sq.ft. (approximately 21%).
- In planning the Subregion VI Elementary School and the Laurel-Beltsville Area Elementary School, the system seeks:
    1. Fundamental and enhanced commissioning to optimize energy efficiency; and
    2. At least a 24.5% and 38.8% energy savings, respectively, as compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004.

#### **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.
- Is installing on all portable classrooms 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.

#### **Saint Mary's**

- Is testing 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 winter break of 2007, the system shut down all plants for 11 days 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.

#### **Talbot**

- All schools have automated Energy Management Systems, generating efficiencies through centralized scheduling, monitoring, operating, and trouble-checking of buildings and energy systems.
- Is retrofitting all of the portable classrooms with energy smart T-stat controls.

#### **Washington**

- Is implementing direct digital control (DDC) central monitoring building automation controls to identify comfort issues and energy waste more expeditiously.
- Is performing physical audits of the schools to assure light turn on/off times and heating set points are in conjunction with school activities.
- Is re-lamping inefficient fluorescent (HID) fixtures with decreased energy consumption fixtures (T-8 fluorescent) while maintaining appropriate light levels.

#### **Wicomico**

- Over the last 15 years, all new school projects have been designed with energy conservation and efficiency in mind. Most systemic renovation projects have included an upgrade and/or expansion of the energy management system.
- Has installed energy controls on vending machines.
- Is retrofitting most portable classrooms with energy smart T-stat controls.
- Is retrofitting the remaining fluorescent lights in schools to electronic ballasts.

#### **Worcester**

- Funds were approved in FY 2007 to upgrade the existing automatic temperature control energy management system at 10 of the 14 schools. The completed EMS upgrade has expanded the capabilities of the system and reduced energy consumption and costs.

- 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.

## Water Conservation

**Cecil** Has designed water saving devices, including waterless urinals, into the Calvert Elementary project.

### Dorchester

- The North Dorchester Middle School replacement, now under construction, will incorporate, in addition to energy saving devices, water saving devices to reduce the amount of effluent, including subterranean storage of storm water to minimize pond use and area.
- The Dorchester School of Technology replacement school and the Warwick Elementary School renovation/addition, both now in design, will incorporate the same technologies, and additionally will include a water harvesting system for some non-potable applications (greenhouse, etc).

### Prince George's

- The Suitland Elementary School has such water conservation features as:
  1. Rainwater collection from an adjacent room to irrigate an outside courtyard, and;
  2. Drought tolerant, low maintenance, native species plants on the entire school ground.
- At the Oxon Hill High School project, PGCP's first LEED High School, currently in design, no irrigation will be used (the football field will use AstroTurf). Water savings of over 40% are anticipated through the use of waterless urinals and other low-flow fixtures.

**Saint Mary's** At Evergreen Elementary School, a green roof will demonstrate the value of reducing storm water runoff. The school is projected to use 90% less domestic water through the use of rainwater cisterns.

## III. Improved Practices

**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.

### Baltimore

- Created a database to identify an energy efficiency index for all schools.
- Conducted an energy audit of 50 energy inefficient 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. Additionally, random inspections for compliance with energy conservation guidelines were completed at 20 schools.

**Carroll** Has instituted utility bill payment and management reporting services to reduce costs and improve facility performance.

**Charles** Has developed 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.

**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.

**Frederick** Employs a Certified Energy Manager/Energy Procurer whose duties include monitoring billing, facility use, and promoting energy conservation;

**Garrett** Performed a five year energy audit 1999-2002, and has solicited a proposal for a new energy audit.

**Harford** Has a centralized data base to track and evaluate all utility bills.

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

**Queen Anne's** 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.

**Washington**

- Is reviewing all data generated by its Energy Management Specialist in regard to school-by-school energy use and energy accounts.
- Is reviewing information and visiting sites that have implemented "green" building 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.

**Worcester**

- 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.

## **IV. Energy Procurement Strategies**

**Allegany** The Board of Education has joined a consortium for the purchase of electrical power. Total cost avoidance for the last seven months of 2007 was over \$225,000.

**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.

**Caroline, Cecil, Kent, Queen Anne's, Somerset, and Wicomico** Are members of the Eastern Shore of Maryland Energy Consortium (ESMEC) Energy Trust, which saves costs by purchasing

electricity on the open commodities market or at rates less than the default rate. This consortium also serves as a conduit for the purchase of fuel oil, and utilizes volume purchasing.

**Frederick** Employs a Certified Energy Manager/Energy Procurer whose duties include coordinating the procurement of cost-effective utilities.

**Montgomery** Controls utility costs through joint procurement efforts with other county and bi-county agencies. MCPS is currently pursuing a new strategy of procuring blocks of electricity over time through a dedicated wholesale account on PJM, building a price portfolio for up to three years into the future. The price point efficiencies of the wholesale market saved MCPS \$2.1 million over the utility default rate in the first year of operation.

**Washington** Is continuing to participate in a consortium for electric procurement to maximize savings. In addition, the school systems purchases natural gas on the futures market to lock in a secured rate.

## V. Preventive Maintenance (PM) Programs

**Baltimore City** Engaged four Energy Service Contractors to perform, among other duties, preventive maintenance on the mechanical systems of the schools.

**Cecil** Maintains a rigorous preventive maintenance program to ensure building equipment is running optimally.

### **Dorchester**

- The school system's preventive maintenance program performs annual summer cleanings, tunings, oil analysis, etc. to minimize use of fossil fuels and maximize equipment life.
- HVAC control systems in older facilities are "re-commissioned" to optimize energy savings pending major capital projects.

**Frederick** Engages in an aggressive maintenance program of all existing equipment to maintain optimum efficiency, with such success that energy performance contractors have not been able to identify any new initiatives that would guarantee additional savings.

**Garrett** Is caulking windows during the summer maintenance programs on a yearly basis.

**Harford** A comprehensive PM program is in place to prevent equipment decline or failures in order to increase efficiency, reliability and safety.

**Kent** Maintains a PM program through its maintenance/operations management contract to ensure building equipment is operating as designed.

**Prince George's** Has commissioned two Energy Service Contractors to, among other duties, perform essential performance assurance and preventative maintenance on the mechanical systems.

**Washington** Is continuing preventative maintenance on current heating and cooling units to extend the life span of the unit and maintain or increase energy savings.

**Wicomico** Has made significant improvements to improve the preventative maintenance program.

## VI. Alternative Energy Sources

**Baltimore** Has included a geothermal ground source heating and cooling system in the construction of a new school.

**Calvert** Utilizes a geothermal system at Mill Creek Middle, with a savings of approximately \$44,000 per year compared to another school of comparable size and construction. Two new schools (Barstow Elementary and Calvert Middle) will also have geothermal systems.

**Caroline** Has installed a geothermal system at Colonel Richardson Middle School in conjunction with the renovation of that facility. The renovation of Colonel Richardson High School will also include a geothermal system. These systems are estimated to have a payback period of less than eight years.

### Carroll

- Ebb Valley Elementary School and Manchester Valley High School, scheduled to open in 2008 and 2009 respectively, include geothermal HVAC systems.
- A hybrid central-geothermal HVAC system is planned for the HVAC systemic replacement project at Westminster High School.

### Cecil

- The following schools have, or are being designed to have, geothermal heating and cooling systems:
  1. Holly Hall Elementary School (since 2000)
  2. North East Elementary School (since 2001)
  3. Calvert Elementary School (now in design)
  4. New Comprehensive High School (now in design)
- Through a grant made available by the Maryland Energy Administration (MEA), CCPS is considering 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. Depending on the grant amount received (up to \$10,000), the solar energy will be either photovoltaic (PV) electricity or solar water heating (SWH). Requests for Proposals were issued in January 2008. The project will be completed in May 2008.

**Charles** Is considering a geothermal heat pump system among other energy efficient considerations for a new high school design.

### Dorchester

- Choptank Elementary School, built over ten years ago, was the first geothermal school facility in Maryland.
- Geothermal was used in the new Mace's Lane Middle School and in the newly-renovated Judy Hoyer Center.
- All future projects in Dorchester County will utilize geothermal HVAC systems.

**Harford** Is utilizing a geothermal system at the recently modernized North Harford High School.

### Kent

- Has just completed the installation of a geothermal system at Rock Hall Elementary School.
- Is working with the Maryland Energy Administration (MEA) to pilot one school using biodiesel fuel for heating.

**Montgomery** Plans to use geothermal technology in new construction at all feasible locations, and has installed geothermal systems at the following schools:

1. Spark Matsunaga Elementary

2. Great Seneca Creek Elementary
3. Little Bennett Elementary
4. Richard Montgomery High

#### **Prince George's**

- The Laurel-Beltsville Area Elementary School, PGCP's first LEED elementary school and currently under construction, will employ a geothermal system. The piping will be buried under the parking lot and the play areas. It will have an earth-coupled heat exchanger to replace boilers and a cooling tower.
- Planning for the Subregion VI Elementary School, soon to begin construction, includes a geothermal system and possibly a solar power demonstration project.

**Queen Anne's** Has installed geothermal systems at Matapeake Elementary School and Matapeake Middle School.

#### **Saint Mary's**

- At Evergreen Elementary School, now under construction, a geothermal system is being used for one classroom wing and the energy consumption will be compared to a traditional system in an adjoining wing. The building will incorporate photovoltaic technology and a wind turbine. Overall the building is projected to use 30% less energy than a school designed with conventional systems.
- A geothermal system provides heating and cooling for the Chesapeake Public Charter School.

#### **Somerset**

- Two major projects, the renovation of Woodson Elementary School (complete) and the new Somerset Intermediate School (under construction), utilize geothermal HVAC systems.
- Is currently designing the third geothermal school, Deal Island Elementary HVAC replacement (construction to begin summer 2008).
- Will consider geothermal technology when planning for future HVAC renovations.
- Two wind energy projects are in the advanced planning stages:
  1. At Crisfield High, the school system is working with the Governor's Office on a small wind energy program to provide a modest energy savings and an environmental education enhancement.
  2. 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** Has installed a geothermal system at St. Michaels High and Elementary Schools in conjunction with the renovation of that facility.

**Washington** Is exploring geothermal systems and costs for potential consideration in future school designs.

#### **Worcester**

- The new Ocean City Elementary School includes a geothermal heating/cooling system, generating \$49,000 in energy savings during the first 12 months of operation.
- Three additional schools will include geothermal systems:
  1. The new Worcester Technical High School (under construction);
  2. The Pocomoke High School Renovation/Addition project (under construction), and;
  3. The Snow Hill High School Renovation/Addition project (construction to begin 2009).

## VII. Capital Improvements

**Allegany** Has committed funding for upgrades to HVAC controls as part of the FY08 budget.

**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.

**Calvert** The Windy Hill Middle and Elementary schools have ice storage systems. Both are experiencing costly mechanical problems.

**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 first 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.
- 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.
- At Perryville Elementary School, a FY 2008 Aging Schools Program (ASP) project will replace a portion of the school's single pane windows.

**Charles** Upgrades the efficiency of lighting, boilers, rooftop units, chillers and related systems in systemic projects.

### **Dorchester**

- The North Dorchester Middle School replacement, now under construction, will incorporate geothermal technology, motion sensors for lighting, insulated/low-E window systems, as well as water saving devices to reduce pump energy requirements.
- The Dorchester School of Technology replacement school and the Warwick Elementary School renovation/addition, both now in design, will incorporate the same technologies, and additionally will include reflective roof surfaces to minimize solar gain and reduce the cooling load.
- Standard design features for the school system are:
  1. Extra roof insulation;
  2. Insulated windows and doors;
  3. Dual fuel heating system components, and;

4. Energy management systems to permit scheduling building operation based on actual building use.

**Frederick** Incorporates energy efficient features into every major project, including:

1. Energy efficient windows and doors;
2. Air-to-air heat exchangers;
3. High efficiency boilers, hot water heaters and chillers;
4. Dual fuel heating systems;
5. Energy efficient lighting/controls;
6. An optimum R rating for building envelopes, and;
7. Retrofitting fluorescent bulbs with T-8 bulbs.

**Garrett** Replaced older boilers with energy efficient natural gas boilers at a middle school and an elementary school this year.

#### **Harford**

- The Joppatowne Elementary School Modernization project will be the system's second LEED certified building (the first was a new central office building).
- 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.
- Has installed HVAC occupancy sensors in 50 of the 103 LEA owned portable classrooms.
- Performance based contracting has been utilized since 1996; there are 22 schools currently under performance contracts.

**Howard** Is in the second year of a multi-year energy performance contract which has funded large capital projects such as chiller and boiler replacements. To date, 13 schools have been contracted for conservation measures, with a projected annual savings of \$600,000 when the two phases are complete and operational.

**Kent** Has undertaken systemic replacement of energy inefficient windows and doors during other HVAC projects or Qualified Zone Academy Bond (QZAB) projects.

#### **Montgomery**

- Has a program to upgrade all energy management systems to be DDC and web-based.
- Has undertaken comprehensive lighting retrofits, including:
  1. Replacing fluorescent fixtures and ballasts (with a 25% reduction in energy use);
  2. Replacing mercury vapor fixtures with lower wattage metal halide fixtures (with improved light output);
  3. Changing incandescent fixtures to compact fluorescent, and;
  4. Changing incandescent EXIT signs to LED type.
- In FY 2007 all existing T-8 lamps were replaced with a higher efficiency, longer life (30,000 hours) model, reducing energy used for lighting by an additional 25%.
- Is replacing unreliable mechanical time clocks for exterior lighting with modern, programmable, accurate digital clocks.
- The Division of Maintenance uses high-efficiency replacement equipment when replacing failed equipment in facilities.

#### **Prince George's**

- Has commissioned two energy service contractors 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 exits, 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, while significantly reducing greenhouse gas emissions and improving the learning environment.

- Has accomplished the last fifty 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 installed Energy Star coated built up roof systems where feasible.

#### **Saint Mary's**

- Over the past 13 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 12 years.
- All built-up roofs are now "Energy Star compliant."
- Installation of direct digital control technology for heating and cooling and replacement of outdated T-12 fluorescent lamps with new T-8 lamps have been completed.
- Major entrances are designed with a vestibule to reduce the cooling or heat load.
- High performance skylights have been installed to take advantage of daylight opportunities.

**Talbot** Is upgrading equipment to achieve greater energy efficiency as part of its normal maintenance replacement schedule.

#### **Washington**

- Is monitoring the effectiveness of an Energy Management Specialist position created during the 2006-07 school year. The system is initiating energy savings construction projects identified by the Specialist as well as other staff to lower long-term energy costs.
- Is designing, redesigning, and installing dual fuel boilers as mandated by the new National Energy Policy and to maximize cost savings to the system.
- Is constructing three new elementary schools with energy savings and several "green" school design features.

#### **Wicomico**

- Will explore a performance based contract lighting retrofit project for Beaver Run Elementary School.
- Over the last several years, most of the older boilers have been either replaced or converted to dual fuel capacity to maximize savings with regard to interruptible supply contracts.

## **VIII. The Comprehensive Approach: High Performance Initiatives**

**Anne Arundel** Without seeking LEED certification, the system employs most of the LEED strategies.

**Baltimore** Is working with environmental groups, including the Chesapeake Bay Reforestation Program, to identify properties that can be easily enhanced and redeveloped as buffers, providing outdoor classroom learning experience, contributing to the protection of water sheds and conserving energy.

**Cecil** As many LEED recommendations are designed into schools as the project budget will allow.

#### **Charles**

- Designs as many LEED recommendations into schools as the project budgets permit, without going through the LEED application process.
- High performance considerations for a new high school design include:
  1. Use of high efficiency, Energy Star equipment;

2. Centralized outside air ventilation units with heat recovery;
3. Airside economizers for "free cooling";
4. Geothermal heat pump system;
5. Displacement ventilation;
6. Carbon dioxide (CO<sub>2</sub>) sensors for outside air ventilation control;
7. Variable Frequency Drives (VFDs) on air handling units (AHUs) and pumps;
8. Three-stage domestic water heating system using solar, geothermal and propane energy sources;
9. Low-flow plumbing fixtures and metering type faucets;
10. Heat recovery and water recovery systems for swimming pool;
11. Rain water harvesting for irrigation use and possible gray water system;
12. Energy efficient light fixtures using T-5 lamps;
13. Daylighting and daylighting controls;
14. Automatic lighting shutoff controls (occupancy sensors);
15. Switching to provide multiple lighting levels;
16. Building Management System/Direct Digital Control (DDC).

#### **Frederick**

- Will strive for a LEED rating at the new Earth Space Science Lab.
- 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.

**Harford** Major projects have "LEED-like" practices regardless of whether the buildings are scheduled to be LEED certified.

**Montgomery** Seeks to certify all new buildings with at least a Silver rating under the U.S. Green Building Council's LEED program. Great Seneca Creek Elementary School was the first LEED Gold public school in Maryland.

#### **Prince George's**

- While occasionally seeking full LEED certification, PGCPs most often partially incorporates LEED strategies.
- At the Suitland Elementary School:
  - Devised six basic strategies:
    1. Maximize energy conservation;
    2. Provide excellent indoor air quality (IAQ);
    3. Provide higher levels of commissioning;
    4. Maximize use of natural day lighting in teaching areas;
    5. Select environmentally preferred building materials;
    6. Recycle construction and demolition waste.

It is estimated that annual pollution prevention savings are 808,500 lbs of carbon dioxide (CO<sub>2</sub>), 1 ton of sulfur dioxide (SO<sub>2</sub>), and 1,460 lbs of nitrogen oxide (NO<sub>x</sub>).
  - Employed the following processes:
    1. Review of potential Sustainable Design Initiatives to be incorporated;
    2. Develop "Greening" Initiatives Matrix & Guidelines specifically for the project;
    3. Prepare an Energy Analysis and Alternatives Report;
    4. Coordinate alternatives with Project Design Team, incorporating "green" information into the specifications and construction documents;
    5. Interface with Maryland State Department of Education (MSDE) for support in integrating green strategies.
  - Has such "green" features as:
    1. Clerestory windows and a classroom natural ventilation strategy;
    2. Natural daylight in the entry hall;
    3. Sun tubes to the first floor classrooms;

4. 1" of added insulation to the exterior walls;
  5. Architectural shade overhangs on west and south windows;
  6. Entrance canopy shades on the administration windows;
  7. Healthy, non-polluting, non-toxic interior finishes and construction materials.
- The School's costs and savings include:
    1. \$60,000 additional costs in enhanced commissioning and long-term monitoring to insure peak performance;
    2. Projected savings of approximately \$9,150 in annual direct energy operational costs, not including savings from reduced lighting loads, water saving features, etc.;
    3. Construction savings of approximately \$50,000 by not installing fuel storage tank, and by downsizing equipment.
  - The Oxon Hill High School Replacement project, now in design:
    - High Performance Features:
      1. Preferred parking will be provided for low-emitting and fuel efficient hybrid vehicles;
      2. Construction, demolition and land clearing debris will be diverted from disposal in landfills and incinerators;
      3. Recyclable recovered resources will be redirected back to the manufacturing process;
      4. Reusable materials will be redirected to appropriate sites;
      5. Certain materials must have recycled content, e.g. "green" finishes, fly ash in concrete, etc.
      6. A minimum indoor air quality performance will be established;
      7. There will be minimum exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke, as well as;
      8. Outdoor air delivery monitoring of CO<sub>2</sub>.
    - Energy conservation initiatives:
      1. Enhanced commissioning of the building energy systems to include heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls;
      2. Lighting and day lighting controls;
      3. Domestic hot water systems;
      4. Renewable energy systems (wind, solar, etc.);
      5. 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 90.1-2004 (without amendments);
      6. Whole Building Energy Simulation and;
      7. A 4-pipe hydronic mechanical system utilizing water cooled chillers and gas fired boilers;
      8. Provision for the ongoing accountability of building energy consumption over time.
    - The system employs 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.)

### **Saint Mary's**

- The Evergreen Elementary School has been designed to achieve at least a LEED Silver rating. Special features include use of T-5 light fixtures, light shelves to increase the effectiveness of daylight, and vegetated (green) roof surfaces. During design, the building envelope and the building systems underwent an energy modeling exercise to yield the best performance and lowest energy costs. Overall the building is projected to use 30% less energy than a school designed with conventional systems.

### **Wicomico**

- The new James Bennett Replacement High School is 'LEED-like' in its design and will include several sustainable design features, including a geothermal system, enhanced building

envelope, exterior window shading devices, vestibule airlock on all major points of egress and rain water recovery for irrigation.

## **IX. Innovations in Policies, Programs, Regulations and Guidelines**

**Anne Arundel** Educational specifications and design specifications, bolstered by Department of General Services (DGS) guidelines, promote sound design and construction practices in energy consuming and conservation elements.

**Caroline** Is in the process of developing an energy conservation policy. An energy conservation specialist will be responsible for implementing the new policy.

### **Cecil**

- The Board of Education took action on an energy conservation policy and regulation in February 2008.
- Is developing design standards that include energy efficient and environmentally friendly features.

**Harford** Design standards call for specific energy efficient features such as low-E glass, mechanical systems, centralized energy management systems, insulation values, and light sensors.

**Howard** Has recently adopted a strategy to support a Green School program which integrates educational and facility related efforts, including incorporation of LEED standards into future new construction.

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

**Saint Mary's** The Board of Education has endorsed an energy conservation plan:

1. An energy committee will develop a program, identify short and long-term opportunities, and respond to the needs of the schools.
2. Site teams at each school will determine and target specific conservation measures.
3. 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.
4. Energy coordinators at each school will work under the energy manager to increase energy conservation awareness, support training, and provide on-going guidance.

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

**Wicomico** Is developing energy conservation policy guidelines to encourage tighter energy and resource conservation measures, and to re-educate its users and staff on energy use in 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."

# THE MARYLAND HIGH PERFORMANCE BUILDINGS ACT

SENATE BILL 208 / HOUSE BILL 376

PASSED: Maryland Legislative Session of 2008

Awaiting enactment by the Governor

**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.

## 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](http://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.

**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.

**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 (CO<sub>2</sub>) sensors** - CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> and adjust the amount of outside air needed.

**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 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. EMS conserve energy by adjusting operating hours and/or cycling equipment. 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.

**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.

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

**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.

**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.

**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.

**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.

**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.

**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.