University of Maryland Center for Environmental Science

Climate Action Plan



University of Maryland
Center for Environmental Science

UMCES Environmental Sustainability Council

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Center Administration

Nancy Jones

Chesapeake Biological Laboratory

Amanda Grimes

Dennis King

Eli Moore

Charlotte Shearin

Horn Point Laboratory

Jennifer Bosch

Paul Perunko

Maryland Sea Grant

Fredrika Moser

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University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Integration & Application Network

Cover photos:
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Mountain photo: William Ward
Design & layout: Kate Boicourt

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Center for Environmental Science

Climate Action Plan

2010

Report of the UMCES Environmental Sustainability Council

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INTRODUCTION

The University of Maryland Center for Environmental Science (UMCES) is a constituent institution of the University System of Maryland with a specialized advanced research, graduate education, and public service mission related to the environment and its resources. The Center conducts these activities from three geographically distinct laboratories: the Appalachian Laboratory (AL) in Frostburg, the Chesapeake Biological Laboratory (CBL) on Solomons Island, and the Horn Point Laboratory (HPL) near Cambridge. In addition, UMCES administers the Maryland Sea Grant College Program (MDSG), located in leased space in an office building in College Park, and is one of three partner institutions operating the Institute of Marine and Environmental Technology (IMET), located at the Columbus Center in Baltimore that is managed by the University of Maryland Baltimore County. The Center Administration (CA) is located on the HPL campus.

UMCES Staff

UMCES President Donald Boesch signed a commitment to develop a plan for becoming climate neutral.

UMCES President Dr. Donald Boesch signed the American College and University Presidents Climate Commitment on December 18, 2007 with an effective date of January 15, 2008. An important part of that commitment is item 1c, which states that within two years of signing the commitment UMCES will develop an institutional Climate Action Plan (CAP) for becoming climate neutral, which will include:

- *A target date for achieving climate neutrality as soon as possible.*
- *Interim targets for goals and actions that will lead to climate neutrality.*
- *Actions to make climate neutrality and sustainability a part of the curriculum and other educational experiences for all students.*
- *Actions to expand research or other efforts necessary to achieve climate neutrality.*
- *Mechanisms for tracking progress on goals and actions.*

This Plan addresses those requirements. However, it recognizes there is more refinement to be done. Thus, it is intended as a "living document" that will be updated regularly to meet this commitment.

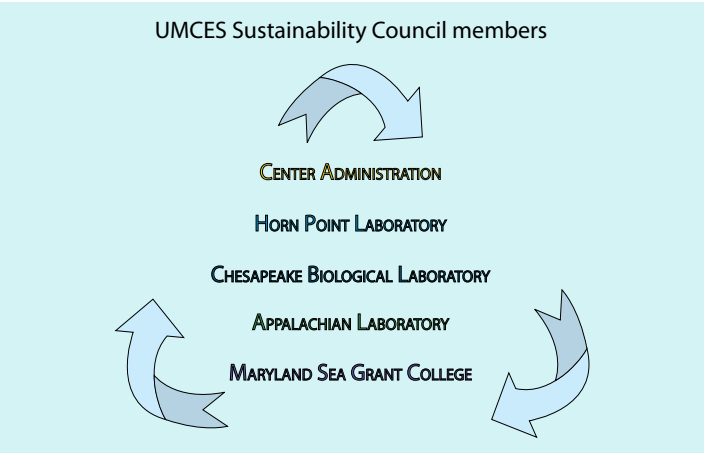
The participation of UMCES in the joint USM research center IMET will begin in July, 2010 and is not considered under the initial CAP.

Jarek Tuszynski

UMCES ORGANIZATIONAL STRUCTURE

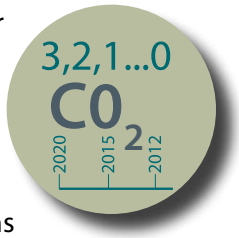
Our first action in response to joining the American College and University Presidents Climate Commitment was to establish an UMCES-wide Environmental Sustainability Council (ESC) that consists of students, faculty and staff from the Center's three laboratories, Center Administration and Maryland Sea Grant College Program. The separation of these four locations across Maryland poses a unique challenge in developing the UMCES CAP. The ESC functions as a task group and advisory body to the President and Administrative Council. The mission of the ESC includes:

- *Engage the faculty, staff and students in an ongoing dialogue about achieving environmental sustainability.*
- *Provide assessments on the sustainability of operations and make recommendations to the President and Administrative Council for improved practices and policies.*
- *Serve as the institutional structure to guide the development and implementation of a comprehensive CAP.*



Each UMCES location has its own sustainability committee to coordinate actions, communicate with the UMCES Environmental Sustainability Council, and serve as a laboratory/department level advisory council. These committees have worked to complete comprehensive inventories of greenhouse gas emissions and to complete and implement respective Climate Action Plans for becoming climate neutral. These efforts are consistent with the standards provided in the Climate Comittment Implementation Guide. The present document merges the CAPs of each location into a single UMCES CAP. Annual Greenhouse Gas Emissions (GGE) inventories are combined in a similar fashion to guide our efforts. The annual inventories are based on fiscal years, which run from July 1st of the preceding year through June 30 of the nominal fiscal year.

TARGET TIMELINE FOR ACHIEVING CLIMATE NEUTRALITY



The currently recommended goal for Maryland State institutions is to reduce greenhouse gas emissions (GGE) by 90% by 2050 with interim goals and updates. Many agencies are following this lead by setting the same or similar goals for reductions, and UMCES joins them. We will use fiscal year 2006 (FY 2006) as our baseline year for greenhouse gas emissions reduction goals; it is the first year for which we have a reasonable estimate of an UMCES-wide GGE inventory. Our FY 2006 GGE were 14,205 MT eCO_2 (million tons of CO_2 equivalents). Thus, the UMCES goal is to reduce total GGE to 1,421 MT eCO_2 by 2050. Note that the 2006 baseline estimate already contains an annual offset of 918 MT eCO_2 due to extensive forest on the HPL property, which is not projected to change in the near future.

Table 1: Goals for emissions reductions at UMCES, compared to the State of Maryland.

Fiscal Year	Green house gas emissions (MT eCO_2)	UMCES reduction goals (% below 2006 levels)	State of Maryland reduction goals (% below 2006 levels)
2006 (baseline)	14,205	N/A	N/A
2012	12,785	-10%	-10%
2015	12,074	-15%	-15%
2020	10,938	-23%	-20-50%
2030	8,523	-40%	N/A
2040	5,682	-60%	N/A
2050	1,421	-90%	N/A

UMCES CARBON FOOTPRINT: STATUS AND TRENDS

Our latest Greenhouse Gas Emissions inventory shows that UMCES' gross GGE before offsets were 12,946 MT eCO_2 in FY 2009. Of this amount, 56% was from imported electricity, 51% was from electricity use, and 5% was from electricity transmission and distribution losses (Figure 1). On-campus stationary sources contributed a total of 23% from burning natural gas and fuel oil #2. Comparatively, only 6% was from air, rail and bus transportation, 2% was from fleet use, 7% from fugitive emissions, 5% from commuter travel, 1% from solid waste disposal, and 1% from wastewater (these percentages add up to 101% due to round-off errors). Remaining sources contribute less than 1% of UMCES GGE. These values are representative of recent years. Most (approximately 75%) of UMCES GGE are associated with lighting, heating and cooling facilities, and with pumping and conditioning seawater for aquaculture operations at the Horn Point Laboratory.

Figure 1 shows that UMCES has already had success at reducing GGE since 2006. In fact, we are presently doing better than our stated reduction goals (Table 1), due to actions detailed in the following *Current and near-term actions to reduce greenhouse gas emissions* section. Significant additional reductions will be achieved in part by requirements for renewable electric supply portfolios for Maryland State facilities by 2022 (described later and in Figure 1), but achieving eventual goals will require new and creative approaches. Strategies for continued reductions are discussed in the "*Strategic actions...*" section of this report. With continued monitoring of our emissions, continued conservation efforts, gradual conversion to sustainable sources of energy, and future facilities renewal and expansion that emphasizes energy-efficiency and sustainability, UMCES should be able to achieve carbon neutrality before 2050.

The vast majority of UMCES' GGE result from the activities of three of our sites: AL, CBL, and HPL/CA. These sites have different facilities, energy requirements, and energy sources. In the "*Strategic actions...*" and "*Current and near-term actions...* sections, we first list UMCES-wide and then site-specific actions/strategies for reducing GGE. Maryland Sea Grant's actions/strategies are listed as a separate sub-heading of the "*Current and near-term actions...*" section.

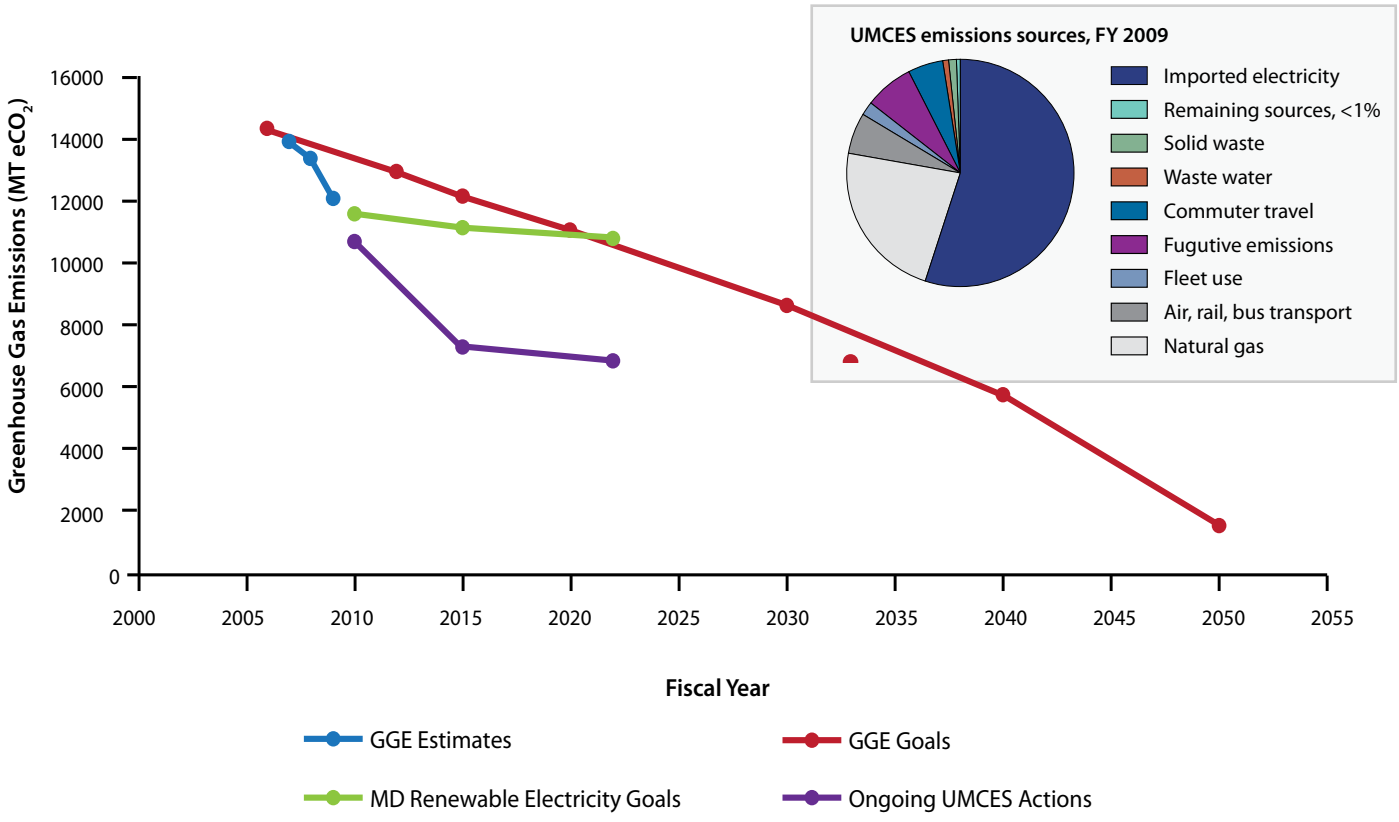


Figure1: UMCES projected greenhouse gas emissions reduction goals: (red line and Table 1), performance to date (blue line), projected improvements from Maryland Renewable Electric Supply requirements alone (green line), and additional anticipated reductions due to ongoing actions and plans for the next decade. This figure is based on reasonable estimates of projected greenhouse gas emissions reductions, but is meant for illustration only.

CURRENT AND NEAR-TERM ACTIONS TO REDUCE GREENHOUSE GAS EMISSIONS

In order to meet our reduction goals, the following strategies have already been implemented or are being explored as near-term objectives for meeting our emissions reduction goals.

Administrative practices

Through Capital Improvement Planning processes, University of Maryland Center for Environmental Science will ensure that all new buildings, renovations and additions are built to meet or exceed the LEED Silver certification. New buildings, when construction is necessary, will employ the latest technologies and be designed with up-front commitment to energy-efficiency, reducing greenhouse gas emissions and lower operating costs. Facilities renewal projects will incorporate "green" upgrades and improvements into existing buildings in order to become more sustainable.

To avoid increasing our carbon footprint with new buildings, we will continue to maximize the use of existing spaces, and will investigate ways to renovate, modernize and retrofit unused or less desirable areas to meet new needs in order to avoid the necessity for additional construction.

The State of Maryland recently mandated a Renewable Portfolio Standard (RPS, Table 2), which requires electricity suppliers to meet certain renewable energy percentages.

All UMCES sites fall under this mandate. Assuming that suppliers manage to meet this mandate, the RPS will reduce GGE automatically and significantly for another decade on its own, simply because imported electricity is such a large source of UMCES GGE. An estimate of the trajectory of UMCES GGE due to this mandate alone is shown in Figure 1 for illustration. All other measures described in this and the following section will further decrease our GGE and keep us ahead of our reduction goals until at least 2020, with all other things being equal. It is not entirely clear whether local electric suppliers will meet this mandate, however. For example, CBL buys its electricity from SMECO, which currently does not offer alternative energy sources. In any case, the CAP assumes that the State will require all of our electricity providers to meet the RPS requirements.

Bill Dennison

HPL/CA will install new, low-E windows in the DuPont building.

Facilities operations

Facilities operations are inherently site-specific, and therefore are addressed individually.

Horn Point Laboratory/Center Administration

HPL/CA is working on an **Energy Performance** Contract (EPC) with Constellation Energy. Specific improvements under this contract include:

- *In all facilities: (1) check building envelopes for air infiltration and seal and (2) replace all 32 W fluorescents with 28 W and electronic ballasts.*
- *In the Aquaculture & Restoration Ecology Laboratory (AREL): (1) modify Diamond Filter system to run at half speed during winter months; (2) install O_2 trim on boilers for better efficiency; (3) install fans above rafters in Mass Larval Tanks room to de-stratify the air column; and (4)*

Table 2: State of Maryland renewable energy requirements

Renewable Portfolio Standard %	2010 (% renewable)	2015 (% renewable)	State of Maryland reduction goals (% below 2006 levels)
Tier I	3.000	10.25	18.00
Tier II	2.500	2.50	
Solar	0.025	0.25	2.00
Total	5.525	13.00	10.00

recover heat from water flowing through oyster brood tables.
- *In the Coastal Science building: (1) upgrade roof top HVAC units and (2) install digital controls on HVAC system.*
- *In the Morris Marine building: (1) change HVAC from 100% outside air to re-circulated air; (2) install small chiller unit to handle the analytical laboratory; (3) install digital controls on HVAC system; (4) utilize chiller heat recovery; and (5) replace oversized oil fired boilers with smaller propane fired boilers.*
- *In the Maintenance building, replace leaky windows with new insulated windows.*
- *Install new low-E windows throughout the DuPont building.*

When completed, EPC projects will result in a savings of $230,545 per year and reduce our carbon footprint by 2,090 MT per year. This will be a savings of 31,350 tons over the 15-year life of the contract.

Heating and cooling thermostats are programmed to set back during non-working hours with minimum and maximum thresholds established for all building zones.

Landscaping has been simplified to minimize maintenance. HPL/CA has no irrigated areas. Grasses are mowed to keep a neat appearance but not a groomed look. All clippings are left on the ground to feed new grass.

Terence Ong

All campuses have recycling and waste minimization programs.

HPL/CA's **Recycling and waste** minimization program currently includes all mixed office paper, cardboard, paperboard, magazines, toner cartridges, plastics #1 & #2, batteries (alkaline and rechargeable), CPUs, cell phones, monitors, printers, mixed metals and used motor oil.

HPL/CA has **increased maintenance** on aging equipment to gain as much energy-efficiency as possible and non-energy-efficient equipment is being replaced with newer *Energy Star* models when available and when replacement is necessary.

Chesapeake Biological Laboratory

By addressing **air-flow problems** in the Bernie Fowler Laboatory (BFL), CBL has or soon will be able to significantly reduce its operating costs and GGE. When BFL was constructed, four air handling units (AHUs) were installed and each was operated as a 100% open air unit in order to meet the requirements of the research laboratories. By installing airtight doors, we were able to isolate the foyer and office areas to two separate AHU's. These units were converted to re-circulating units, thereby reducing our heating costs for those sections of the building and offering a predicted cost savings of $41,918/yr and approximately 380 MT eCO_2/yr.

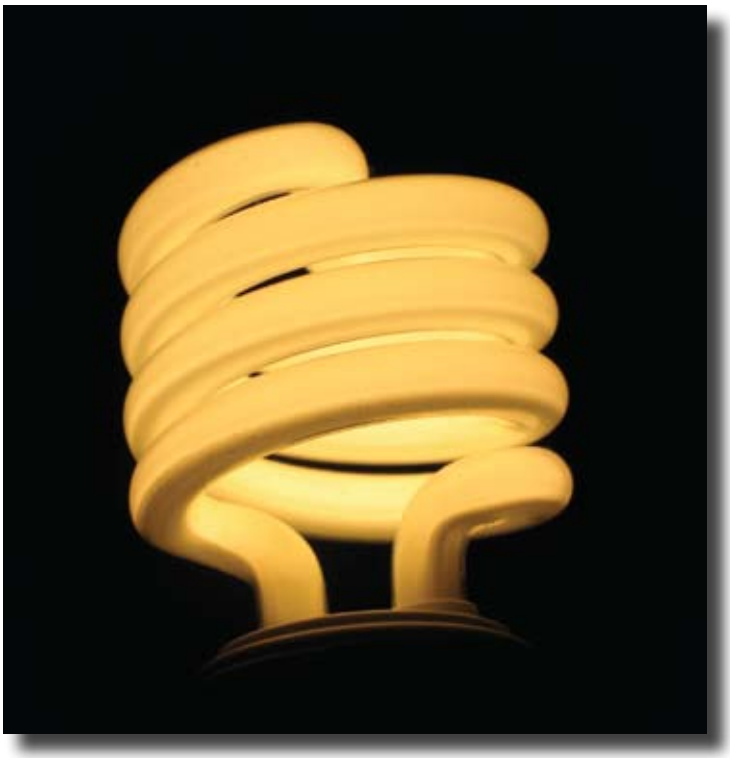
In addition, each of the individual labs in BFL has one or more fume hoods, which provide dedicated exhaust for the space and run at a constant volume 24/7. Beginning in 2010, CBL will modify the existing hoods by installing variable speed controls. The hoods will also be fitted with occupancy sensors so air-flow can be adjusted based on the current utilization of the lab. A heat recovery loop will be installed on the systems, and the warm exhaust air produced by the fume hood will be captured and used to heat the circulating glycol loop which heats the air in the building. Predicted cost savings from this project total $139,255/yr and approximately 1266 MT eCO_2/yr.

Completed in FY 2009, CBL replaced all light bulbs on campus with **compact fluorescent lights. Timers** were also put on lights in several common areas. This project will offer a predicted cost savings of $13,045/yr and approximately 119 MT eCO_2/yr.

Heating and cooling thermostats are programmed to have a maximum threshold of 68° in the winter and a minimum threshold of 76° in the summer for all buildings (this does not include research labs which must be set to their required research temperature). During long breaks (i.e. winter and spring), all thermostats in offices are reduced further. Additionally, new windows in Nice Hall and new doors with insulation stripping in BFL were installed in 2009 to prevent unnecessary heating and cooling losses. These projects are predicted to offer a cost savings of $2,000/yr and approximately 18 MT eCO_2/yr total. Light colored paint is used for exterior painting jobs in order to reflect light and keep buildings cool in the summer.

Landscaping has been simplified to minimize maintenance, with an emphasis on the use of native plants. Fifty native trees and shrubs were planted throughout the campus in FY 2009 and a rain garden was planted in front of the Fisheries Research Center.

CBL's **Recycling and waste minimization** program currently includes all mixed office paper, cardboard, paperboard, magazines, toner cartridges, plastics #1 & #2, batteries (alkaline and rechargeable), CPUs, cell phones, monitors, printers and mixed metals. Continued recycling efforts have enabled CBL to keep our solid waste to a minimum. Additionally, two compost bins were placed at two communal eating areas – outside the Bernie Fowler Laboratory and Beaven Hall – to aid in CBL's biodegradable waste reductions. "green" cleaning products are used throughout lab buildings.



J Dabow

Updated lighting fixtures gain energy savings at all UMCES locations.

Appalachian Laboratory

Appalachian Laboratory is currently reviewing the list of recommendations provided by the site audit as part of the Energy Performance Contract (EPC) with Constellation Energy. Specific preliminary energy conservation measures (ECMs) include:

- *ECM1: Installation of variable frequency drives on the central plant distribution CW and HW pumps.*
- *ECM2: Installation of variable frequency drives on the fume hood exhaust fan.*
- *ECM3: Air Balancing/retro-commissioning AHUs.*
- *ECM4: Metasys (direct digital controls) DDC Control retro-commissioning – operation check and control re-calibration due to age.*
- *ECM5: Retrofit lamps to 25-watt.*
- *ECM6: Retrofit metal halide lamps to T5.*
- *ECM7: Building envelope: caulking and sealing.*
- *ECM8: Insulation of brick wall that connects to lobby glass curtain walls.*

Preliminary recommendations need to be evaluated further to determine the validity of the ECMs as well as estimated budget costs and savings. This initial summary identifies the prevalent energy issues this facility needs to address and provides suggestions for ECMs to reduce our energy consumption. Once the report is reviewed by staff and validated, we will prepare an implementation plan that will provide the most energy and cost savings.

Heating and cooling thermostats at AL are programmed to operate in occupied mode 24 hours a day, with minimum and maximum thresholds established for many building zones, as most of the lab spaces require continuous operation. This policy was established since the temperature recovery was too long to meet the required needs, causing comfort issues. If necessary, when an area is unused for a longer stretch of time, thermostats can be set back during this unoccupied time period for maximum efficiency. Additionally, all windows have been caulked and sealed in March 2008 to prevent unnecessary heating and cooling losses.

Landscaping at AL has been simplified to minimize maintenance (i.e. grass has been planted in previously mulched/bedded areas to decrease maintenance costs—employee time and materials). Additionally a native species meadow has been planted as a demonstration area and to reduce maintenance efforts.

AL's **recycling and waste minimization** program currently includes all mixed office paper, cardboard, paperboard, magazines, toner cartridges, plastics #1 & #2, batteries (alkaline and rechargeable), CPUs, cell phones, monitors, printers and mixed metals.

Pre-2002: all of AL's recyclables were included with Frostburg State University.

January 2002: AL initiated their own recycling program, recycling all mixed office paper, magazines, toner cartridges, batteries, wet cell batteries, CPUs, cell phones, monitors, printers, and mixed metals.

February 2004: rechargeable batteries and corrugated cardboard were added to the recycling program.

September 2004: plastics 1 & 2 were added to the recycling program.

October 2007: alkaline batteries were added to the recycling program.

February 2008: paperboard was added to the recycling program.

Figure 3: Timeline of Appalachian Laboratory's recycling program

Continued recycling efforts have enabled AL to keep solid waste to a minimum. Since 2007, the amount of solid waste has decreased from a dumpster pickup once a week to once every-other week. This 50% reduction in solid waste also reduced emissions from the disposal truck and lowered lab costs.

Bill Dennison

UMCES landscaping practices emphasize native plants.

AL maintenance staff have **increased maintenance** on aging equipment to gain as much energy-efficiency as possible. Non-energy-efficient equipment is being replaced with newer *Energy Star* models when available and when replacement is necessary.

Lighting systems in the facility are largely energy-efficient 32-watt, T8 lamps with electronic ballasts. AL is looking at recommendations to retrofit existing 32-watt lamps with newer 25-watt lamps that support the new super saver electronics ballasts to further reduce electric consumption.

Ambient light in the building lobby reduces the need for lights during day hours, however this area is supplemented by 150-watt metal halide light fixtures. We are looking at retrofitting the existing lamps in the building lobby from the current 150-watt metal halide lamps to fluorescent, T5 fixtures to reduce energy consumption.

Additionally, in areas that have been over-lit, **extra lamps** are **removed**. This is a simple, inexpensive way to reduce electricity use. Almost all offices and labs have windows, so removing lamps in these areas goes mostly unnoticed.

Procurement practices

All paper purchases are now at least 30% post-consumer **recycled.** UMCES is committed to purchasing energy-efficient and environmentally friendly products and provides tools and quick tip sheets to help locate and purchase these environmental friendly products. Both of the approved USM Master Contracts for office supplies now include an extensive selection of green products.

UMCES will continue to augment its vehicle fleet with **energy-efficient vehicles** as appropriate and fiscally possible. UMCES operates under the USM fleet regulations that are mandated by the EPA; these regulations do not consider current hybrid models "alternatively fueled vehicles." Under these regulations, a hybrid can only be purchased if three alternatively-fueled vehicles are also acquired at the same time. Hopefully this will be addressed nationally and more fuel-efficient vehicles will be allowed for purchase with state funds.

Horn Point Laboratory/Center Administration

Center Administration paper purchases for all copiers and printers currently are 100% post-consumer **recycled.** Other recycled office products will be purchased when available. CA is in the process of replacing all paper products used in the break-rooms and kitchens with 100% compostable products such as stalk plates, glasses and cups and utensils.

Appalachian Laboratory

Appalachian Laboratory paper purchases for all copiers, printers, rest rooms, general use areas and special events are all currently made of 100% post-consumer **recycled** content.

Bill Dennison

The Interactive Video Network enables students and faculty to reduce vehicle miles traveled.

Technology practices

New IT purchases use computer systems that support video and sound so that meetings can be held for small groups over **web-based conferencing** software. This software is normally open-source, simple to use, and has helped eliminate the need for faculty and staff to travel in order to keep research collaborations and communications open. AL purchased such a system in 2009 for their common

use office so that it is available to the entire AL community. In addition, all UMCES sites are connected to the University System of Maryland (USM) internet-based Interactive Video Network (IVN) System. IVN is used extensively for multi-site teaching, meetings, and occasionally for seminars. HPL/CA have three locations available, CBL has two, and AL and Maryland Sea Grant have one. This system saves time, money, and energy by greatly reducing the need for physical travel between UMCES' widely separated sites, as well as other campuses of the USM and other institutions with compatible equipment.

CRT monitors are being surplused and replaced with LCD monitors. Overall, LCD monitors can reduce energy consumption by 60% when compared to an equivalent viewing area sized CRT. Additionally, LCD's are now priced comparatively to CRTs, their carbon footprint is much smaller for the equivalent veiwing area, the image quality is excellent and they reduce eye strain as there is no glare or screen flicker.

UMCES' IT administrators are currently moving toward virtualization, one path on the rapidly growing **Green IT** road. Currently, one server at each site running virtualization server software has replaced approximately 20 older servers without affecting applications or users. This is a significant decrease in energy consumption and cost without a decrease in the service provided to the UMCES community. Virtualization has eliminated wasteful network equipment, reduced energy consumption and floor space requirements.

Over long breaks and holidays, only the main critical systems in computer centers remain powered on, all other systems are powered off.

All obsolete or damaged IT equipment is cannibalized and then recycled through County recycling facilities. As newer equipment is purchased based on computational need, older viable equipment is re-deployed to areas with less demand.

Horn Point Laboratory/Center Administration

Additional server virtualization will be implemented in the near future to cut our server farm by 50-60% once the new HPL Environmental Information Center building is ready.

Appalachian Laboratory

Kill-A-Watt meters have been installed on various types of equipment such as copiers, printers, switches, and monitors (both CRT and LCD), to determine the best practices when it comes to management of this equipment, and decisions on replacement priorities.

Transportation practices

Due to our remote locations, public transportation does not play a role in most UMCES transportation practices and policies. However, many faculty and staff live locally, so biking and walking to work are often standard practice and have been encouraged by providing safe, dry, inside storage areas for bicycles.

UMCES administration has evaluated the location and distances traveled to frequent administrative meetings, revising schedules and, when appropriate, substituting face-to-face meetings with IVN.

Wikimedia Commons

All obsolete or damaged IT equipment is recycled at County facilities.

Horn Point Laboratory/Center Administration

The President of UMCES and the Director of HPL both drive Hybrid vehicles.

Chesapeake Biological Laboratory

CBL recently sold several of its campus vehicles. The laboratory is currently looking into purchasing an electric golf cart for on-campus transportation needs. Because it will only be used for short distances and is much smaller than a standard vehicle, the cart's battery charge will not be an issue. This easy and inexpensive electric vehicle option will be a start to CBL's electric fleet.

Appalachian Laboratory

In January 2006, AL purchased its first hybrid vehicle. This vehicle is used by both faculty and staff to attend collaborative and administrative meetings when web and IVN conferencing is not available or appropriate. AL will continue to augment the fleet with energy-efficient vehicles as appropriate and fiscally possible. The AL fleet manager assigns fleet vehicles based on needs and fuel efficiency. Large four wheel drive vehicles are not assigned for single person trips or used for non-field related travel except when absolutely necessary.

Actions/strategies for reducing greenhouse gas emissions at Maryland Sea Grant

Maryland Sea Grant's (MDSG) primary GGE come from staff commuting and travel. The MDSG rents office space from a building (owned by Douglas Development Corp) in College Park and has little to no control over the GGE management of the building. In 2009, MDSG installed an IVN system to reduce travel to meetings throughout UMCES. As we strive to reduce emissions by 90% of 2006 levels by 2050, we will look to reduce commuting by personal cars, increase use of public transportation and increase our use of the web for meetings beyond those that can be accessed through IVN. We can further encourage the University of Maryland College Park (UMCP), the primary lessee, to work with our landlord to make our building more GGE friendly. We have a limited fleet of vehicles that will, over time, be converted to higher energy-efficiency. We recycle in the office and purchase recycled paper for our printer. MDSG looks to reduce paper use considerably over the next decade, striving for a 90% reduction in paper use well before the 2050 deadline.

STRATEGIC ACTIONS TO REDUCE FUTURE UMCES GREENHOUSE GAS EMISSIONS

This section discusses additional actions that may be implemented at UMCES sites in the future to continue reducing our GGE. These actions are listed as possibilities followed by discussion. The planned courses of action, although certain to provide some results, have obstacles that prevent their immediate implementation. In some cases, these actions cannot be implemented at all at some sites.

Implement and enforce policies to "power down" during non-working hours

This should include computers, printers, equipment, lights, etc. All power sources that will not be harmed by being powered off should be turned off during non-working hours. It may help to implement software that automatically powers down computer monitors when not in use. This stategy is directly related to our primary emissions source (purchased electricity) and might result in a 3%-5% reduction.

Barriers: The only barriers associated with a power-down policy are personnel related. With often hurried schedules, people simply forget.

Solution: This is one of the easiest actions that can be implemented building-wide. However, just asking, does not always work. Policies and possible software to support the "power down" efforts and also to educate and train employees how to setup power save functions on equipment need to be implemented. In order to successfully implement our Climate Action Plan, all employees and students need to be fully "on board" with policies and programs where their active participation is required. This is assured through education that aims to teach the value of resources, how to use them wisely, and the consequences of not doing so. In addition, sustainability education can serve to unite the community by fostering a common understanding of the challenges faced in seeking to live and work sustainably.

Wikimedia Commons user PT35

UMCES will make efforts to "power down" during non-working hours.

Upgrade existing IVN video conferencing systems

Previous upgrades have generally helped to reduce the necessity for travel to educational and administrative meetings. We estimate additional upgrades could reduce our emissions by 1%-3%.

Barrier: The barriers to this option are the cost of an additional IVN installation and the anticipated level of usage. USM courses take precedence, so an IVN system is not always available for meetings that conflict with the class schedule. However, the inconveniences that the conflicts produce do not sufficiently offset the cost of a new system.

Solution: New IT purchases include computer systems that support video and sound so that meetings can be held for small groups over web-based conferencing software. This software is normally open-source, simple to use and has helped eliminate the need for faculty and staff to travel in order to keep research collaborations and business communications open. The purchase of an administrative meeting IVN system located in the Center Administration building would help significantly to eliminate the conflicts that arise between meeting and courses requiring the use of IVN located at the Horn Point Lab.

Install on-campus renewable energy sources

Installation of renewable energy sources on campus to supplement energy demand at UMCES sites is an attractive long-term goal, and may be necessary to continue to reduce GGE once all feasible conservation measures are exhausted. Additional research on renewal energy sources is needed before reliable estimates of emissions reductions are possible. Possibilities for renewable energy are discussed in sequence.

Solar electricity

Barrier: There are several major barriers to solar electrical generation. Currently, prices of highly efficient panels can be above $1,000 each (most applications require more than one). This makes the initial installation of solar panels very costly, thus use of solar power depends heavily on the development of more efficient technology. Solar energy is only able to generate electricity during daylight hours and weather or pollution can significantly reduce generation.

Solution: Although at first glance this does not appear to be the most viable or practical application for UMCES laboratories in the near term, installations of solar arrays to power specific facilities might be excellent demonstration/test projects and are being explored. One possibility is using a photovoltaic solar system as an alternate energy source that could be grid-tied or off-grid depending on the final application of the system. HPL is considering solar for its algal or submerged aquatic vegetation greenhouses or its environmental education buildings and AL is considering solar for its greenhouse. Prospective sites would need to be surveyed by certified installers to determine options for location, size, and type of solar systems.

Solar hot water

Solar hot water technology is more mature than solar electric technology, and might be considered as an option for facilities with significant water heating needs such as the HPL aquaculture facilities. This will be investigated more in the future.

Wind energy

***Barrier*:** Site locations for wind turbines must meet Class one or at least 4.4 mps average wind speed in order to be an effective alternate energy source. After review by the Maryland Energy Administration in November 2007 and confirmation from wind speed history reports from AL's greenhouse anemometer, it was determined that the AL location does not meet the minimum recommended speed for use of a wind turbine, thus this would not be a viable option at this time.

Wikimedia Commons

Solar hot water technology is currently a more mature technology than solar electric.

Solution: Since the HPL/CA and CBL sites are situated in flatter terrain and closer to the water, small-scale wind turbines might be feasible in the same test/demonstration sense as solar electric above. Prohibitive installation costs in the present funding climate preclude wind turbines as near term options, but they should be considered for future installation. The prospects for wind-power generation offshore of the Delmarva Peninsula are being actively pursued presently. If they come into production, this could substantially increase the contribution of renewable energy available in commercial market, particularly at HPL.

Fuel cells

While not a viable option in the near term because of installation costs, on-site fuel cell electric generation is much cleaner than imported electricity and is likely to become both more available and less expensive over the next one or two decades. It will be considered as a long-term option.

Convert on-site fossil fuel use to biofuels use

This option is currently not available to UMCES sites in a practical sense. It may be possible in the future, especially for bio-oils to dilute or replace fuel oil #2. Potential emissions reductions are not known at present, but since on-site burning of fossil fuels for heating is UMCES second largest GGE source, reductions may be significant.

Selectively redesign or replace HVAC systems and further insulate facilities.

Horn Point Laboratory/Center Administration

Geothermal HVAC systems are much more efficient at heating and cooling than conventional heat pump systems because they utilize the almost constant temperature of deep groundwater for heat exchange instead of highly variable air temperatures. They are strong candidates for installation in new construction; less so for upgrades of old, inefficient HVAC systems. The DuPont building already is heated and cooled using a closed-loop geothermal system. The student dormitory would be an ideal candidate for a geothermal HVAC system. Geothermal HVAC in the new EIC building will be considered as well.

Barriers: During Constellation Energy's survey, geothermal HVAC in the dormitory was identified as a potential savings project. However the initial cost of the system was too high and the payback was too long to make it viable for inclusion in the EPC.

***Solution*:** Alternative funding sources, possibly state appropriations for facilities renewal, could be requested to complete this project. The overall savings of both energy and dollars would be well worth the initial outlay.

Appalachian Laboratory

AL's chemical laboratories, designed as negative pressure labs for containment purposes, are the major loss of heating and cooling in the building (similar to the Bernie Fowler Laboratory at CBL). Designs to re-engineer the facility to allow more control over these individual rooms and adjust the exhaust when facility use and needs change have been discussed. This could significantly decrease the building's energy usage.

Bill Dennison

Energy-efficient geothermal systems like this one (in Center Administration) are a possibility for Horn Point Laboratory's dorm.

Barrier: This option was not one that was further recommended for implementation during our energy audit in 2009 because the audit showed that the re-engineering costs are more than what could be recouped from savings over 15+ years.

Solution: There may be other options to modify this system to reduce energy loss without a full re-design. These options are being investigated further as recommended by our energy audit in the following ECMs: ECM1: Installation of Variable Frequency Drives on the central plant distribution CW and HW pumps. ECM2: Installation of Variable Frequency Drives on the fume hood exhaust fan; ECM3: Air Balancing/Retro-Commissioning AHUs; ECM4: Metasys (direct digital controls) DDC Control Retro-Commissioning– operation check and control re-calibration due to age

Insulating window films reduce the amount of solar heat transmission through the glass by increasing the solar reflection (not necessarily visible reflection) and solar absorption. This reduces cooling needs in summer and reflects more of the interior room heat back into the room to save on heating costs in winter. Additional insulation in the attic would help increase energy-efficiency of the entire building and reduce emissions.

Barrier: The primary barriers to these options are cost and displacement of personnel during the installation. Additionally, since it is not a critical need, renewal funds for this type of project are difficult to obtain, especially in tough budget years.

Solution: Plans to find other ways to fund these options are being discussed.

Capture and re-use gray water and rainwater

These options, while attractive because of their water management and water-saving benefits, are likely to produce few GGE savings because wastewater accounts for less than 1% of UMCES GGE. Nevertheless, they are listed here as viable options that are important for other sustainability reasons, such as reducing runoff. Additional research on gray water and barrel systems is needed before an estimate on the emissions reductions can be established.

Jane Thomas

A rain garden was planted at CBL this past year (2009).

A **gray water** (wash-water) system is designed to collect, treat and re-use water from wash areas in the building as a source of plant irrigation, to reduce use of fresh (drinking) water and to reduce the water sent to treatment plants.

Barriers: The main barriers to a gray water system are the costs associated with retrofitting building facilities in order to re-route wash-water to a gray water system. Local authorities and health officials would need to be contacted regarding any special/local concerns and regulations with respect to gray water systems. A professional engineer would also need to be involved to insure that only wash-water (i.e. bath, dish, and laundry water excluding toilet wastes and free of garbage-grinder residues) is re-routed.

Solutions: Additional data collection to determine if the amount of eligible wash-water would warrant the installation of gray water systems.

A rain barrel system is designed to collect and store rainwater for later use on demand.

***Barriers*:** The main barriers to a barrel system are, again, the costs associated with retrofitting the building facilities in order to re-route rainwater to the barrel system. A well designed system that would provide for overflow, insect and mosquito control and easy access to water is a requirement.

Solutions:

Appalachian Laboratory

To decrease the cost associated with the design, a barrel system could be engineered to collect rainfall from the AL greenhouse only. This water could then be used to operate the greenhouse. As the greenhouse facility is the largest consumer of water at AL, it would be good business practice to make this the first structure to be fitted for this type of system. Again, this would be an excellent case study that could be expanded to other structures if successful and feasible. AL's stormwater management facilities are scheduled to be upgraded, so it may be possible to engineer a barrel system as part of the upgrade.

Chesapeake Biological Laboratory

To decrease the cost associated with the design, a barrel system could be engineered to collect rainfall from a central location such as Nice Hall and used to water nearby plants and trees. This would provide a test case for a larger, more inclusive rain barrel system that could be later implemented campus-wide.

Rooftop gardens increase building insulation and intercept stormwater. They are particularly effective for flat or shallow-pitch roofs. The Mansuetti, Fisheries Research Center and Truitt buildings might be good candidates for rooftop gardens.

Barrier: The current roof warranties for these building prohibit the installation of a rooftop garden. A waiver must be received from the company, or a new roof installed, before the installation of any project. Cost would also be

a barrier to implementation for this practice. Most likely, this would require hiring a professional firm to design and plant the gardens and increased maintenance costs after the gardens are completed would also add to the total. The roof must also be sufficiently stable and strong to hold the added weight of the garden, as well as relatively flat. These issues may pose a problem for any or all buildings.

Jane Thomas

Rooftop gardens are potential options for reducing runoff and energy use at Chesapeake Biological Laboratory.

Solution: If one or more buildings could be verified in terms of structural stability and a waiver is received from the roofing company, a simple container garden could be started without much more cost than the purchase of the plants. If there is enough interest, volunteers could take responsibility for planting and tending to the garden(s).

Utilize Renewable Energy Certificates and/or Carbon Offsets

These options compensate for GGE reductions that cannot be attained on-site. Given UMCES current GGE reduction trajectory, conservation efforts, and renewable electric energy purchase plans, it is unlikely that either renewable energy certificates or offsets will be necessary in the near future. However, in the long term as other sources of reductions are exhausted it is likely that these options will be necessary to reach carbon neutrality.

Renewable energy certificates, or RECs, represent one megawatt-hour (MWh) of energy generated from a clean, renewable source, such as wind, solar, hydro, or certain types of renewable biomass. RECs bought—either from the utility as "clean energy" or from independent suppliers—in addition to the actual electricity, are usually used to neutralize Scope two emissions by matching out each "dirty" megawatt of electricity an institution uses with a "clean" megawatt represented by a REC.

Barriers: Renewable technologies are still relatively expensive and usually require up-front investments, which then get offset by "free fuel" over a longer period of time. Each form of renewable energy, be it wind power, solar power, biomass, hydropower, or geothermal, has its own set of environmental problems and/or limitations that need to be investigated further before the purchase of RECs is considered.

Solutions: RECs allow for procuring green power across a wide geographical area and applying the renewable attributes to the electricity used at a facility of choice. This flexibility allows organizations to support renewable energy development and protect the environment when green power products are not locally available. Many electric companies offer the option to buy renewable energy in place of traditional energy at an additional cost per kwh, therefore making the transition to a renewable energy source simpler. RECs can be considered once all other energy reductions and offset projects are complete and in place.

A **carbon offset** is a reduction or removal of carbon dioxide equivalent (CO_2e) greenhouse gas emissions that is used to counterbalance or compensate for ("offset")

Maggie Chou

Carbon offsets are one option for becoming climate neutral.

emissions from other activities of the institution. Carbon offsets represent the act of reducing, avoiding, destroying or sequestering the equivalent of a ton of greenhouse gas in one place to "offset" an emission taking place somewhere else. Offsets generally represent direct emission reductions or sequestration and can be from non-electric sources, such as planting new tress on previously un-forested acreage. Offsets should be used to reduce Scope one and

Scope three emissions ensuring that each ton emitted is wholly counterbalanced by an emissions reduction.

Barriers: Offsets face strict rules for approval, including the requirement that the emissions reduction credited be real, permanent, verifiable, and most importantly, additional to a business-as-usual scenario. This will present an actual cost to the institution. Budget concerns always impact all new projects, especially ones that provide no tangible products or results.

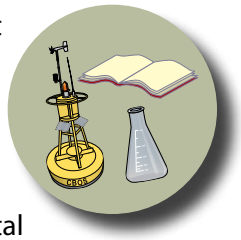
Solutions: Offsets provide for a direct reduction in an institutions carbon footprint, usually from Scope one and three emissions. Emissions must be reduced by all other methods in order to reach the lowest reduction point. Once this is done, the quantity of offsets that needs to be created in order to offset emissions from sources that cannot be reduced or avoided will be more attainable.

COSTS AND FINANCING

Affordability is a key issue when dealing with any changes to UMCES business practices. In order to see that our CAP is successful, we must implement the changes that will provide the most return for our dollars. As the University, State and Nation deal with continued budget cuts, non-critical projects and programs are the first to go, therefore funding for sustainable projects will need to be a justifiable expense that will guarantee a return in order to be financially supported. The UMCES Administration is committed to provide available funding for green initiatives.

An alternative to public funding is private fund-raising. To the extent that some of the proposed actions outlined in the previous section are publicly visible or educational, UMCES may be able to use donor funding to offset otherwise prohibitive initial capital outlays. Installations of on-campus renewable energy demonstration projects are an obvious possibility for private fund-raising.

EDUCATION AND RESEARCH



UMCES primary mission is to carry out environmental research, train graduate students, and advise the State of Maryland on environmental matters. While we teach a significant number of graduate-level courses related to climate change and its environmental consequences and environmental management, to date there have been no courses or seminars offered on sustainability, per se. However, most UMCES graduate students are enrolled in the USM multi-campus graduate program in Marine-Estuarine-Environmental Sciences, which is currently undergoing significant reform to better address contemporary and future issues. It is anticipated that the program structure and curriculum will more directly address issues related to global climate change and environmental sustainability. The UMCES Environmental Sustainability Council and its individual laboratory counterparts do include graduate student members.

Jane Thomas

A child pets a sturgeon during Horn Point Laboratory's open house.

Within the Center's broad portfolio of research, faculty members carry out cutting-edge research on the

environmental consequences of climate change, options for mitigating climate change, and possible approaches for adapting to the consequences of climate change. One of the four strategic directions of UMCES research is a focus on Regional Consequences of Climate Change and Variability. While research within UMCES does not specifically address sustainable practices in institutional operations, it does contribute to the development of sustainable environmental management, particularly on regional scales

One way in which sustainability issues can and will be introduced to new UMCES students is through introductory lectures. When new graduate students arrive at the beginning of the fall semester and when new summer students arrive in May, they are presently required to attend "Right to Know" presentations on laboratory procedures and safety issues. We will add a module on Sustainability practices to these lectures.

Cheryl Nemazie

As a leader in environmental research, UMCES is working to incoporate climate change research more fully into the graduate program.

COMMUNICATION AND DISSEMINATION

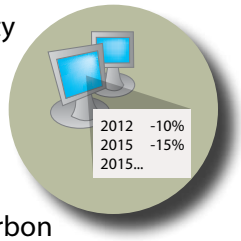
UMCES will use a variety of sources in order to communicate sustainability efforts and progress to the UMCES community and the general public.

UMCES, as a signatory to the Climate Commitment, will make our Climate Action Plan, inventory, and progress reports publicly available by providing them for posting and dissemination on the American College and University Presidents Climate Commitment website per timelines based on our signing date. In August 2009, UMCES joined the Maryland Green Registry, a self-certification program offering tips and resources to help organizations set and meet their own goals on the path to sustainability.

Information on CBL's sustainability initiatives is disseminated bi-weekly through our internal newsletter, while *Solomons Sketches*, CBL's external newsletter, provides updates on our initiatives (such as the rain garden) to the general community. The lab has also held several outreach seminars for the general public that cover issues such as understanding climate change, building a rain barrel and constructing a rain garden. An open door policy for suggestions, ideas, comments etc, has always been in place within the CBL community and will continue to be the policy for our sustainability program.

The AL Sustainability website is designed to educate, encourage and promote sustainability efforts. It was launched in July 2008. The website contains the sustainability reports, recycling efforts, "green" tips as well as other information relating to a sustainable campus.

TRACKING AND MONITORING



The UMCES Environmental Sustainability Council (ESC) and its site-specific counterparts will be responsible for continuing preparation and maintenance of annual GGE inventories as a guiding tool for sustainability and ongoing efforts to reduce our carbon emissions. Efforts will be monitored through the Clean Air Cool Planet carbon calculator and actions adjusted as needed to stay on course towards meeting our climate commitment. UMCES GGE inventories will be posted on the American College and University Presidents Climate Commitment Reporting System every other year, as per instructions.

CONCLUSIONS

With implementation of some of the key strategies presented here, UMCES anticipates meeting the climate commitment goals we have set in place. Indeed, to date we are ahead of our goal trajectory, largely through conservation efforts. By purchasing a higher fraction of our imported electric power from renewable sources as mandated by the State, continuing to pursue energy conservation measures that save operating funds as they reduce our GGE, making sustainability a high priority in any future facilities additions or upgrades, and installing on-campus renewable energy sources as these technologies mature and become more affordable, we should be able to stay ahead of our goals for the next 20-30 years (Figure 1).

Challenges to a continued downward trend in UMCES GGE are most likely to be associated with growth. The two most immediate of these challenges are construction of a new oyster setting pier to expand production from the oyster culture facilities at HPL. This facility should become operational in FY 2011, and it will present a significant additional energy requirement. It may provide an excellent opportunity for exploring installation of onsite renewable energy sources. In addition, as mentioned earlier, UMCES will be one of the operational partners in the Institute of Marine and Environmental Technology in Baltimore. Although UMBC will be managing the physical plant, it has not yet been determined how the three partner institutions will work collectively there to meet their GGE reduction commitments. Finally, UMCES primary source of GGE offsets is the extensive forest on the HPL property. We will need to maintain the productivity of this forest to maintain its offsets.

Ultimately, when emissions have been reduced as much as possible through the above strategies, our carbon reductions may need to be further reduced by the purchase of carbon offsets from reputable traders or renewable energy credits in an amount equal to the number of tons of carbon dioxide equivalents remaining. Moreover, future federal and state legislation and regulations regarding GGE emissions from power and vehicles will undoubtedly play a role in achieving the UMCES emission reductions.

This plan will need to be revised and enhanced continually to keep up with new developments, personnel, and facilities, but these changes will not alter our overall commitment to achieving and maintaining sustainable campuses.

Cheryl Nemazie

Maryland's Governor Martin O'Malley, joins UMCES on the newly commissioned *R/V Rachel Carson*.

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