



Climate Neutrality Implementation Plan
First Update – 2011

1.0- Introduction

Bowdoin College has made a commitment to become carbon-neutral by the year 2020. This report is the first biennial update to the Climate Neutrality Implementation Plan issued in fall 2009.

In 2007, Bowdoin President Barry Mills signed the American College and University Presidents' Climate Commitment (ACUPCC)—a pledge by leaders of more than 640 colleges and universities to move their campuses toward carbon neutrality and build new academic pathways for addressing sustainability issues.

After a year of intensive study, the College developed a detailed implementation plan for becoming carbon neutral by 2020.

Bowdoin's Climate Neutrality Implementation Plan was developed by a team of Bowdoin staff, faculty, students, trustees and consultants from Competitive Energy Services who evaluated a wide range of strategies for increased energy efficiency, transportation adaptations, renewable-energy generation, and carbon offset options that will be necessary in order to erase our carbon footprint. Download the full 2009 Climate Neutrality Implementation Plan at:

<http://www.bowdoin.edu/sustainability/carbon-neutrality/pdf/implementationplan.pdf>.

Bowdoin also developed a concise summary of the Climate Neutrality Implementation Plan called the Blueprint for Carbon Neutrality. The Blueprint for Carbon Neutrality is an overview of the basic goals and strategies of that plan, with an explanation of the rationale, costs, and outcomes associated with these important steps. Download the 2009 Bowdoin Blueprint for Carbon Neutrality at:

<http://www.bowdoin.edu/sustainability/carbon-neutrality/index.shtml>.

The Climate Neutrality Implementation Plan is dynamic and is intended to be revisited and updated every two years so that Bowdoin community members can measure the effectiveness of strategies, evaluate the financial feasibility of specific projects, and incorporate new technological advances.

This update report has been developed by the Sustainability Implementation Group, whose members are:

Don Borkowski, Director of Capital Projects

Catherine Longley, chair, Sr. VP for Finance and Administration & Treasurer

Keisha Payson, Coordinator for a Sustainable Bowdoin

Andrew Price, Senior Energy Analyst, Competitive Energy Services

Theodore Stam, Director of Facilities Operations and Maintenance

Delwin Wilson, Director of Finance and Campus Services

In addition, Phil Camill – chair of the Working Group on Sustainability and Program Director and Rusack Associate Professor of Environmental Studies and Earth and Oceanographic Science – provided valuable input on section 3 of this update. We are

pleased to report that at the end of Fiscal Year (FY) 2011, the College is on track to achieve carbon neutrality by 2020, as a result of campus-wide conservation efforts, specific initiatives in the Climate Neutrality Implementation Plan, and other factors which are detailed in the following sections.

2.0- Greenhouse Gas Emissions: Inventory, Trends, Mitigation, and Targets

2.1- Greenhouse Gas Inventory

Bowdoin's greenhouse gas (GHG) emissions in FY 2011 were 16,085 metric tons.¹ **This is 16% lower than the FY 2008 baseline total of 19,153 metric tons.** Scope 1 emissions made up 58% of the total; the remaining 42% is from Scope 2 and Scope 3 emissions.² The following table provides Bowdoin's detailed GHG inventory for each of the past four years.

Scope 1	Baseline				Units
	2008	2009	2010	2011	
Stationary, On-site Fuel Combustion	8,660	9,430	8,056	8,938	metric tons
College Vehicle Use	340	392	391	444	metric tons
Fugitive Refrigerants	62	62	130	8	metric tons
SCOPE 1 TOTAL	9,062	9,884	8,577	9,390	metric tons
Scope 2					
Purchased Electricity	7,264	7,287	6,837	4,968	metric tons
Purchased, Cogeneration	0	0	0	0	metric tons
Purchased, District Cooling	0	0	0	0	metric tons
SCOPE 2 TOTAL	7,264	7,287	6,837	4,968	metric tons
Scope 3					
College Travel	534	392	421	349	metric tons
Employee Commute	1,722	1,722	1,628	1,466	metric tons
Transmission Loss from Electricity	464	465	410	298	metric tons
Transmission Loss from Cogeneration	0	0	0	0	metric tons
Transmission Loss from District Cooling	0	0	0	0	metric tons
Waste	108	108	7	-385	metric tons
SCOPE 3 TOTAL	2,828	2,687	2,467	1,728	metric tons
OVERALL TOTALS	19,153	19,858	17,881	16,085	metric tons

¹ Short tons were used throughout the fall 2009 Climate Neutrality Implementation Plan to match the units of the Regional Green House Gas Initiative (RGGI). However, a decision was subsequently made to use metric tons. Using the International System of Units allows for easier comparison to other ACUPCC respondents and is more commonly used by the international scientific community. Hereafter “metric tons” or simply “tons” are used interchangeably and are equivalent to 2,204.62 pounds.

² For a more detailed discussion of Scopes and how the six greenhouse gases accounted for in this inventory are equated to common units of carbon dioxide equivalent (CO₂e) please refer to the 2009 Climate Neutrality Implementation Plan.

A brief discussion of each emission source included in the 2011 GHG inventory is provided below. Significant changes in calculation methodologies are noted as are changes in emissions relative to the 2008 baseline.

2011 GHG Emissions

Scope 1 emissions account for 9,390 metric tons of CO₂e, approximately 58% of the total. Over 95% of Scope 1 emissions are associated with on campus fuel combustion of natural gas, #2 distillate oil and propane for heating purposes. Smaller contributions came from fuel consumed by College-owned vehicles and the inadvertent release of refrigerants, which contributed 5% and less than 1%, respectively.

Scope 1 emissions were nearly 4% higher in 2011 than in the 2008 base year, a 328 metric ton increase.

Higher fuel usage at the central heating plant was the largest factor in the Scope 1 increase. The central heating plant used 13% (16,000 MMBtu) more natural gas in 2011 compared to 2008. Most of this increase was weather related – a colder winter increased demand in 2011. As measured by heating degree days, 2011 was 7% colder than the 2008 base year. During this time, many of the College's satellite facilities were converted from No. 2 heating oil to natural gas, a conversion that typically reduces GHG emissions by about 30% per Btu consumed. If these conversions had not taken place, the College's 2011 Scope 1 emissions would have been approximately 136 metric tons higher.

Vehicle use made up 5% of the Scope 1 totals or 444 tons. Actual gasoline consumption data were used from two primary sources: purchases for College-owned central fuel tanks (22,001 gallons) and from the fleet vehicle fuel purchasing card program (22,574 gallons). Purchases for College-owned fuel tanks were 1,400 gallons less than the 2008 base year. Purchases for fleet vehicles, however, were 7,900 gallons higher than the 2008 base year.³

Fugitive refrigerants make up less than 1% of Scope 1 emissions or 8 tons. This is a considerable improvement over FY 2008 when 62 tons were emitted.

Scope 2 emissions were associated with Bowdoin's purchase and consumption of 20,236 MWhs of electricity. The total GHG emissions from electricity consumption amounted to 4,968 tons of CO₂e, about 31% of the total GHG emissions in 2011. Bowdoin's scope 2 calculations used average power generation emission factors for the state of Maine as published by the United States Environmental Protection Agency (EPA).⁴ While

³ Gasoline from the fleet vehicle fuel purchasing card program was consumed off of Bowdoin's campus and it is likely to have been used in both owned and rented vehicles. It has been included in Scope 1 in its entirety as a simplifying assumption.

⁴ The most recent GHG factors available are from EPA's eGRID2010 Version 1.1 and were released in May 2011. This is the seventh edition of eGRID and provides actual GHG emissions from power plants in Maine from calendar year 2007. The improvement in eGRID2010 is related to a number of factors including the following: 1) A significant reduction in the output of Wyman Station. Wyman Station is an old and inefficient 846 MW oil fired power plant in Yarmouth, Maine, that is increasingly used only for

electricity usage was down only slightly in 2011 compared to 2008, scope 2 emissions were almost 32% lower in 2011 than in 2008, a 2,296 metric ton reduction.

It should be noted that a change in electricity-specific emissions factors published by the EPA, and used in Bowdoin's emissions modeling, accounted for the majority of the Scope 2 reduction. While electric emissions factors are updated periodically by the EPA, and a gradual improvement is expected each year for Maine as a higher percentage of renewable energy is integrated into the State's portfolio of power plants, the improvement in the most recent factors from the EPA were more significant than anticipated.

Scope 3 emissions at Bowdoin result from employee travel and commuting, the loss of purchased electricity through the transmission and distribution process, and the disposal of solid waste. These activities were responsible for the release of 1,728 tons of CO₂e, 11% of total GHG emissions in 2011.

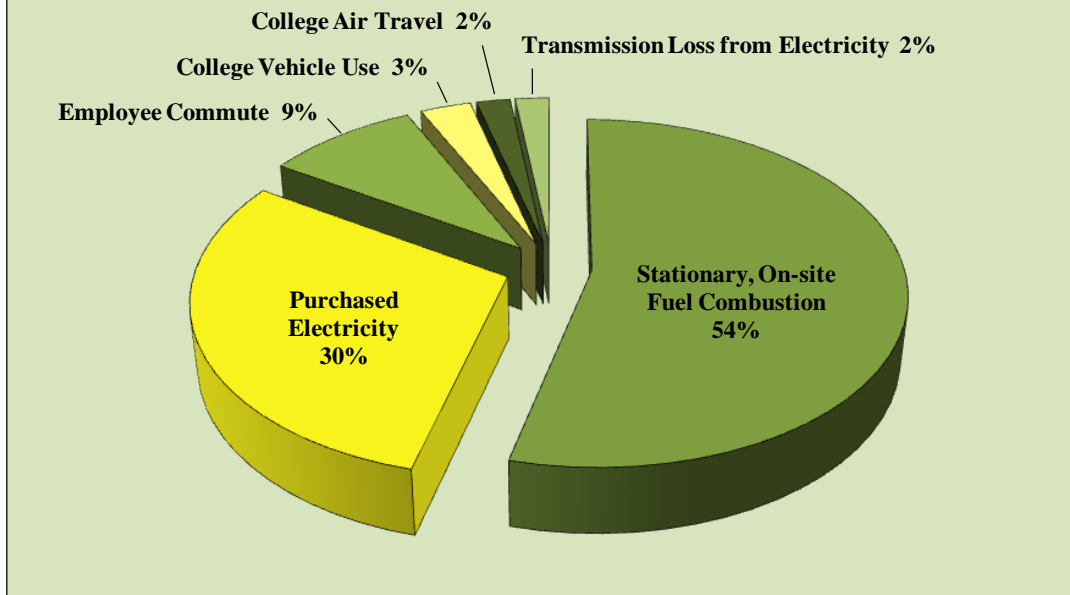
Employee commuting makes up the majority of Scope 3 emissions at 85% or 1,466 tons. Transmission line losses were 17% of the Scope 3 total or 298 tons. College travel, which consists primarily of air travel by College employees, made up 20% of the Scope 3 totals or 349 tons. Bowdoin generated approximately 595 tons of solid waste in 2011. About 29% of this, or 175 tons, was recycled. Of the remaining 421 tons, 107 tons was sent to a landfill that does not currently use gas recovery systems while 314 tons was sent to a waste-to-energy facility. Waste-to-energy facilities and recycling both have negative GHG emissions factors and more than offset the emissions associated with the waste that was sent to a landfill. In total, waste emissions were calculated to be *negative* 385 tons of CO₂e, or -22% of the Scope 3 total, using factors from Environmental Protection Agency's Waste Reduction Model (WARM).⁵

A breakdown of the estimated 16,085 metric tons of CO₂e emissions for 2011 is shown by major category in the following chart.

grid reliability purposes. Compared to the eGRID 2006 Version 2.1 factors used for the FY 2008 base year emissions calculations, Wyman production declined 46%. 2) A 5% increase in the share of total Maine electrical generation that came from hydroelectric facilities. 3) A 5% increase in the share of total Maine production that came from biomass facilities. Hydro and biomass production are both carbon neutral in EPA's eGRID models and the increase in production from these renewable sources corresponded to a proportional decrease in production from natural gas fired electric generation and a reduction in GHG emissions. [See eGRID2010 Version 1.1 State File (Year 2007 Data) and eGRID2006 Version 2.1 State File (Year 2004 Data)].

⁵ www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html

Bowdoin's 2011 Greenhouse Gas Emissions



2.2 Greenhouse Gas Mitigation Strategies

Bowdoin's progress towards completing the initiatives identified in the fall 2009 Carbon Neutrality Implementation Plan are summarized in the following table along with the projected impact on carbon emissions and relative cost.⁶ Projects highlighted in light orange are completed, while projects highlighted in dark orange are underway or partially completed. Projects with no highlighting have not been started.

⁶ The last two columns of this table show how the expected carbon reduction relates – as a percentage – to both the 2008 baseline inventory emissions and the expected 2020 business-as-usual emissions. Business-as-usual GHG emissions are the expected emissions that would occur if Bowdoin took no action to mitigate emissions and grew according to its long term master plan.

Scope	Item Name	Description	Annual Offset (tons CO2e)	Cost/ton CO2e	Online Date	% of 2008 Base Case	% of 2020 Business As Usual Case
Energy Conservation							
2	Computers	Setting 600 public & shared PCs to sleep mode	4	-263	2009	0.02%	0.02%
2	Lighting - CFL Bulbs	Change 3,874 incandescent 60w bulbs to 15w CFL - replace CFLs every 2 years	406	-150	2009	2.12%	1.89%
2	Lighting - Super T8	Change 4,953 T12 lamps at 82w per lamp to 50w Super T8 - replace every 6 years	369	-87	2010	1.93%	1.72%
2	Lighting - LED Bulbs	Change 3,874 15w CFL to 6w LED - replace every 11 years	81	-76	2013	0.42%	0.38%
2	Lighting - LED Tubes	Change 4,953 Super T8 lamps at 50w per lamp to LED - replace every 11 years	231	-144	2015	1.20%	1.08%
1 & 2	Energy Star	Use Only Energy Star rated equipment and appliances	461	0	Ongoing	2.41%	2.15%
<i>Energy Conservation Subtotal</i>			1,551			8.10%	7.24%
Physical Plant							
1	OLC Boiler	Replace boiler at the Schwartz Outdoor Leadership Center	6	-76	2009	0.03%	0.03%
1	Steam Line	Phased replacement of old steam line	172	308	2011	0.90%	0.80%
1	Central Plant Boiler	Replace oldest boiler at central heating plant	311	6,053	2011	1.63%	1.45%
1	Heating Plant Cogen	Install 400 kw + backpressure steam turbine in central heating plant	544	-65	2013	2.84%	2.54%
1	H&L Windows	Replace all single pane windows with thermal pane low-e argon or better	62	201	2016	0.32%	0.29%
1	Coles Tower Windows	Replace all single pane windows with thermal pane low-e argon or better	118	315	2016	0.62%	0.55%
2	Coles Tower Elevator	Replace elevator at end of its useful life with Otis Gen2 with regeneration or better	7	TBD	2019	0.04%	0.03%
<i>Physical Plant Subtotal</i>			1,221			6.38%	5.70%
Fuel Switching							
1	Fuel Oil Conversion 1	Conversion of satellite facilities from #2 oil to natural gas	372	-64	2014	1.94%	1.73%
1	Vehicle Fleet	Transition Vehicle Fleet First to 100% Hybrids	141	-95	2020	0.74%	0.66%
<i>Fuel Switching Subtotal</i>			513			2.68%	2.39%
New Construction & Renovation							
1 & 2	New Building Improvements	New building improvements: 20% by 2009 and 46% by 2020 compared to 2008	753	-134	Ongoing	3.93%	3.51%
Behavioral Changes							
1 & 2	Behavioral Changes	Sustained and increasing behavioral changes by staff, faculty and students	541	N/A	Ongoing	2.82%	2.52%
Onsite Renewables							
1	OLC Solar Thermal	Solar thermal Installation on the Schwartz Outdoor Leadership Center	1	364	2009	0.00%	0.00%
1	Solar Thermal II	Farley complex and Thorne Hall solar thermal system	93	TBD	2012	0.48%	0.43%
2	Farley PV	100 kW solar PV system at Farley Field House	69	272	2017	0.36%	0.32%
2	Navy Base PV	2,000 kW PV system on dual axis tracker on 10 acres at former Naval Air Station	1,863	0	2020	9.73%	8.69%
1 & 2	Geothermal	Expand use of geothermal for heating and cooling	225	TBD	Ongoing	1.17%	1.05%
<i>Onsite Renewables Subtotal</i>			2,250			11.75%	10.50%
Total			6,830			35.66%	31.87%

Additional detail is provided below on each of the initiatives that were identified in the 2009 Carbon Neutrality Implementation Plan and summarized in the table above. We have continued to divide these initiatives into two categories: (1) projects that are underway currently, ongoing, or expected to be completed by 2020; and (2) projects that are planned or under consideration for implementation by 2050, but which are currently cost prohibitive or technologically unfeasible.

By 2020 & Ongoing

- By 2020 achieve a 100% reduction from the business as usual scenario from all sources. (From 21,429 metric tons to 0 tons of CO₂e)
 - ✓ Status: Bowdoin is on track to achieve its goal to become carbon neutral by 2020.
 - ✓ Cost: N/A
- Improve metering, tracking and auditing capabilities of GHG emissions and energy usage on campus.
 - ✓ Status: The College has greatly expanded its Web-based Building Dashboard®, which makes Bowdoin's energy use visible, engaging, and easily understood by students, faculty, staff and guests. Currently, there are a total of 51 electric meter points covering most buildings on the main campus

and there are 10 steam meters on buildings of varying sizes and uses. The FY 2012 annual operating budget will support the installation of 10 more steam meters.

- ✓ Cost: The College has spent about \$150,000 to-date on electricity and steam sub-meters and has plans to spend about \$50,000 in FY 2012 to install additional steam sub-meters and connect these meters to the Building Dashboard®.
- ✓ Funding Source: Annual Operating Budget.

- ✓ Status: The College has implemented a new GHG project tracking template that will capture the key metrics of the many physical projects that take place each year. The intent of the tracking template is to incorporate GHG considerations into the initial project planning process and to memorialize project details, including cost, throughout the year. This will help the College track actual spending on projects related to the Carbon Neutrality Implementation Plan.
- ✓ Cost: N/A

- Complete the repair and upgrade of the underground steam distribution system.
 - ✓ Status: The multi-phase plan to excavate and replace 1,551 feet of old and leaking sections of steam line is nearing completion. After completion, the new lines are expected to reduce fuel usage at the central plant by 3,250 MMBtu each year. Approximately 1,000 feet of old line has been replaced to-date with the remaining 551 feet scheduled for completion by summer of 2012.
 - ✓ Cost: The College has spent approximately \$2 million to-date and estimates that the total project will cost approximately \$3.5 million.
 - ✓ Funding Source: Major Maintenance and Capital Renewal Budget.

- Complete the cogeneration and boiler replacement project for the campus central heating plant.
 - ✓ Status: Bowdoin has completed the replacement of its two oldest boilers with a single more efficient boiler.⁷ The new boiler has been in operation since fall of 2010 and is expected to reduce fuel usage by about 5% or 6,000 MMBtu per year. The installation of a cogeneration system is still scheduled for fall 2011. The 630 kW backpressure turbine arrived on campus in July 2011 and, once in operation, is expected to produce about 1,740,000 kWh of “free” electricity each year or about 9% of Bowdoin’s annual electrical requirements.⁸ Also included in the project is Bowdoin’s first green roof. A pilot test area of 450 square feet on the west side of the central heating plant will be covered with modular trays of sedum and other low maintenance plantings to help reduce water runoff and heat island effect.

⁷ RMF Engineering, Inc. Baltimore, Maryland. Cogeneration Feasibility Study: Bowdoin College. September 2008. Hard copy located in Bowdoin College Facilities Management.

⁸ See Bowdoin Cogeneration Project Metering And Verification Plan.

- ✓ Cost: Bowdoin plans to spend approximately \$3.4 million when this project is completed later this year.
 - ✓ Funding Sources: Capital Project supplemented by a \$400,000 grant from the Efficiency Maine Trust.

- Continue the conversion of College facilities from higher carbon distillate oil and propane to natural gas. Continue to collect and use fry oil produced by dining services.
 - ✓ Status: Of the 38 satellite locations identified in the 2009 Carbon Neutrality Implementation Plan, 36 were targeted for natural gas conversion by 2020. By the end of FY 2012 Bowdoin will have completed 19 conversions, or 50% of the total. This puts Bowdoin well ahead of its anticipated conversion schedule. The full conversion of satellite facilities from #2 oil and propane to natural gas is now expected to be substantially completed by 2015. The College no longer burns waste fry oil at the central heating plant. Starting in September 2011, a recycling company began buying Bowdoin's waste oil and selling it offsite as heating oil.
 - ✓ Cost: Bowdoin spent approximately \$130,000 between FY 2009 and FY 2011 on these conversions and has planned about \$225,000 in #2 oil and propane to natural gas conversions for FY 2012.
 - ✓ Funding Source: Annual Operating Budget.

- Evaluate solar thermal for the two largest users of hot water on campus: Greason Pool and Thorne Hall.
 - ✓ Status: The Thorne Hall installation was completed in two phases. In March 2010, Bowdoin announced it had been awarded a \$50,000 grant from the Efficiency Maine Trust toward the Thorne project. A 960-square-foot solar thermal array was installed atop Thorne Hall in June 2010. The array was then doubled in size in January 2011 when Bowdoin received another \$50,000 grant, again from the Efficiency Maine Trust, but funded through the federal American Recovery and Reinvestment Act (ARRA). The total system consists of 48 flat plat solar thermal collectors with a 1,920 square foot surface area. Bowdoin students and members of the Brunswick community can monitor the output of the Thorne solar thermal system on site via an LED monitor in the lobby or by visiting Thorne Hall's building dashboard at: <http://www.buildingdashboard.net/bowdoin/>. This site allows visitors to see key statistics for the system. Between January 2011, when the system became fully operational, and September 2011, the solar hot water system at Thorne heated approximately 116,000 gallons of useful hot water or about 240 million Btu. Bowdoin continues to evaluate opportunities to install a solar thermal system at Greason Pool.
 - ✓ Cost: \$221,000 for both phases.
 - ✓ Funding Sources: Annual Operating Budget supplemented with grants from the Efficiency Maine Trust.

- ✓ Status: Bowdoin has also evaluated plans to install a solar photovoltaic array on Farley Field House multiple times. Bowdoin narrowly missed being awarded a grant to install a 12 kW system at Farley in 2010. Bowdoin has also looked at installing a larger 100 kW system at Farley on multiple occasions. Due to its high cost per avoided ton of CO₂e, Bowdoin has not yet implemented this project but the rapid decline in price will likely make solar PV viable at Bowdoin in the near future.
 - ✓ Cost: In 2007 the 100 kW system was quoted to cost almost \$800,000. In 2010 the same system was quoted to cost \$500,000 and in 2011 it was quoted to cost approximately \$400,000.

- Implement all conservation measures that have attractive economic returns immediately. These include setting inactive public computers to sleep mode, weatherizing buildings and various lighting upgrades.
 - ✓ Status: Bowdoin has substantially completed the 2007 recommendations contained in a detailed lighting audit of its facilities. The College has replaced incandescent light bulbs on campus with compact fluorescent bulbs and has upgraded all T12 fluorescent tube lights throughout the campus to T8 and “super T8” fluorescents. Over the summer of 2011, 170 campus pole lights were retrofitted with compact fluorescent bulbs and the College estimates that this project will save approximately 43,000 kWh annually. It is now College policy to stock only compact fluorescent lights in the lighting inventory.⁹ The remaining lighting audit recommendations are being undertaken as time and funding permit.
 - ✓ Cost: The College identified \$257,000 in lighting efficiency spending from FY 2009 through FY 2011.
 - ✓ Funding Sources: Annual Operating Budget supplemented by rebates from the Efficiency Maine Trust’s Business program which provides cash incentives for lighting upgrades, heating/cooling equipment, etc.

 - ✓ Status: Bowdoin has substantially implemented the recommendations of two energy audits received in 2009 for many of its satellite buildings. The first audit was commissioned based on the seven biggest fuel users on a per square foot basis;¹⁰ the second was done on the 13 faculty rental houses on campus.¹¹ Measures included improving the building envelopes, converting from oil to natural gas, and controlling the interior temperature of each building more precisely.
 - ✓ Cost: Excluding all major capital projects (which included significant weatherization upgrades to several dorms) the College has identified \$76,000

⁹ At least until diode lighting or another technology with similar efficiency benefits becomes viable for widespread adoption.

¹⁰ Richard Grondin, Integrated Energy Systems, PLLC, Falmouth, Maine. Energy Audit: Bowdoin College. 26 March, 2009. Hard copy located in Bowdoin College Facilities Management.

¹¹ Justin Pizzolato, Maine Green Energy Audit, Harpswell, Maine. Hard copy of audits located in Bowdoin College Treasurer’s Office.

in weatherization specific upgrades from FY 2009 through FY 2011. \$20,000 has been identified for FY 2012.

- ✓ Funding Sources: Annual Operating Budget supplemented by rebates from the Efficiency Maine Trust's Home Energy Savings program.
 - ✓ Status: The College will investigate sending all of its non-recyclable waste to a waste-to-energy facility when its next waste contract is negotiated. Currently some of Bowdoin's non-recyclable waste continues to go to a landfill without energy or GHG recovery.
 - ✓ Cost: Unknown.
- Evaluate the performance of diode bulb lighting at the current and future pilot projects. Monitor improvements in the technology and the experience of other institutions with diode lights. Plan for widespread adoption of diode lighting as a replacement to compact fluorescent lighting.
 - ✓ Status: Bowdoin has been testing diode lighting at several pilot projects. Some of these projects include Lancaster Lounge, Kresge Auditorium, Beam Classroom, the Peary-MacMillan Arctic Museum and the locker rooms and laundry rooms in Farley Field House. Pilot projects for Hubbard Hall and Pickard Theater are planned for FY 2012.
 - ✓ Cost: Since 2009, the College has spent more than \$40,000 on diode lighting.
 - ✓ Funding Sources: Major Maintenance and Capital Renewal Budget, Annual Operating Budget, and supplemented by rebates from the Efficiency Maine Trust's Business program.
- Update the GHG emissions inventory each year and this action plan every second year.
 - ✓ Status: The College's energy consultant, Competitive Energy Services, LLC in Portland, Maine, continues to assist Bowdoin in modeling and tracking GHG emissions each year. With ongoing advice from Competitive Energy Services, the College continues to track electricity and fuel consumption as well as waste recycling and disposal.
 - ✓ Cost: N/A
- Establish new efficiency standards/targets for renovations and construction.
 - ✓ Status: The College continues to adhere to a comprehensive set of sustainable design standards¹² for all major renovations and seeks the United States Green Building Council's (USGBC) LEED certification for all new construction. Bowdoin's design standards for renovations rely heavily on Stanford University's "Guidelines for Sustainable Development," which are based on USGBC's LEED¹³ rating system. Bowdoin has set goals to make near term construction and renovation projects at least 20% more efficient than the average of its 2008 building stock, increasing to 45% more efficient by 2020.

¹² www.bowdoin.edu/sustainability/sustainable-planning/designstandards.shtml

¹³ Leadership in Energy and Design. See www.usgbc.org.

Bowdoin continues to improve its ability to measure progress towards these goals by continuing its current practice of installing electricity, water and steam sub-meters on newly constructed and renovated buildings.

- ✓ Cost and Funding Source: Incremental costs associated with achieving LEED certifications were part of approved capital project budgets.
 - ✓ Status: The College has decided that building retro-commissioning should be considered for buildings with complex HVAC systems. A pilot retro-commissioning study, which was partially funded by the Efficiency Maine Trust, was completed for Druckenmiller Hall. Corrective measures such as air rebalancing, optimizing air handler and heat pump operations, and repairs to other building equipment were completed, thereby reducing energy consumption.
 - ✓ Cost: The initial study cost \$23,000 and implementation of corrective measures and repairs cost \$42,000. All measures taken anticipate a short term payback.
 - ✓ Funding Sources: Annual Operating Budget supplemented by a grant from the Efficiency Maine Trust.
- Replace single pane windows in Coles Tower and Hawthorne-Longfellow Library.
 - ✓ Status: Project has not been started but is under investigation.
 - ✓ Cost: N/A
 - Make efficiency a key criteria when the Coles Tower elevators need to be replaced at the end of their useful life.
 - ✓ Status: Project has not begun. The College has engaged an elevator consultant to perform a maintenance and modernization evaluation of certain campus elevators. The suggested modernization timeframe for the Coles Tower elevators is 5 – 7 years from now. When the College modernizes the Coles Tower elevators, it will specify high efficiency drives to reduce energy consumption.
 - ✓ Cost: N/A
 - Consider geothermal HVAC systems or new heat pump technologies for renovations and new building projects. Implement mechanisms to better evaluate payback and performance metrics compared to an equivalent facility without geothermal systems.
 - ✓ Status: Bowdoin has several buildings utilizing ground source geothermal heating and cooling: Osher and West Halls and Studzinski Recital Hall. Unfortunately, a geothermal system at the Walker Art Building did not perform as expected and was replaced with a conventional heating/cooling system. Bowdoin will proceed cautiously with geothermal solutions.
 - ✓ Cost: Incremental costs associated with geothermal systems were part of approved capital project budgets.
 - ✓ Funding Source: Capital Projects.

- Use only Energy Star rated or better equipment when replacing any non-lighting equipment on campus.
 - ✓ Status: The Energy Star policy has been established and is in place. Compliance is ongoing as equipment is retired and replaced at the end of its useful life.
 - ✓ Cost: N/A; equipment is only replaced at the end of its useful life.

- Prioritize the purchase of hybrid vehicles within the College-owned fleet when current vehicles are up for replacement with the goal to be 100% hybrid by 2020.
 - ✓ Status: Currently the College operates about 60 cars, vans, and trucks, 1 of which is electric and 6 of which are hybrids. This is up from 5 hybrids in operation when the 2009 plan was published. Bowdoin is currently exploring a subsidized installation of a vehicle charging station on campus for pure electric vehicles or plug-in-electric hybrids.
 - ✓ Cost and Funding Source: Vehicles are purchased according to Bowdoin's vehicle replacement cycle and are funded out of an annual vehicle replacement reserve. Outside funding may be available for an electric vehicle.

- Consider planning for a potential 2,000 kW solar PV installation on land that will be acquired at the Brunswick Naval Air Station.
 - ✓ Status: Bowdoin will acquire land at the former Naval Air Station later this year or early in 2012. The College will continue to monitor this opportunity.
 - ✓ Cost: In 2009 this system would have cost about \$6 per watt installed, or about \$12 million, and would have produced electricity at a levelized cost of about 30 cents per kWh. As of mid 2011 this system would cost about \$3.75 per watt installed, or about \$7.5 million, and would have produced electricity at a levelized cost of about 19 cents per kWh. The levelized cost could drop to grid parity within the next 10 years, making it a zero cost alternative for Bowdoin.

Beyond 2020 Projects

- By 2050 achieve a 36% reduction in purchased renewable energy credits or carbon offsets required to maintain neutrality.
 - ✓ Status: No change.

- Continue to use only Energy Star rated or better equipment when replacing any non-lighting equipment on campus.
 - ✓ Status: Ongoing.

- Expand the existing educational efforts of campus faculty, staff and students in order to affect behavioral changes that lead to sustained reductions in energy usage and associated carbon emissions.
 - ✓ Status: See section 3, below.

- Complete the conversion of College satellite facilities from higher carbon distillate oil to natural gas.
 - ✓ Status: Of the 38 satellite locations identified in the 2009 Carbon Neutrality Implementation Plan, 36 were targeted for natural gas conversion by 2020. By the end of FY 2012 Bowdoin will have completed 19 conversions, or 50% of the total. This puts Bowdoin well ahead of its anticipated conversion schedule. The full conversion of satellite facilities from #2 oil and propane to natural gas is now expected to be substantially completed by 2015.

- Pursue building envelope and HVAC system improvements for each renovation and new building project. Attempt to achieve a 70% improvement by 2030 and an 80% improvement by 2050 compared to current building stock.
 - ✓ Status: No change.

- Monitor the improvement of full electric vehicles and begin to phase in their use as soon as the technology becomes commercially viable.
 - ✓ Status: Of the 60 vehicles maintained by the College currently, 1 is an all electric vehicle. The College is considering a partnership with Central Maine Power in 2012 to obtain and test an electric vehicle such as the Chevrolet Volt.

- Continue to support high quality renewable energy projects and carbon reduction projects with a sustained commitment to renewable energy credits and/or offsets. Prioritize local projects that have an impact on the local economy and air-shed.
 - ✓ Status: The College has continued to purchase renewable energy credits in the voluntary market from the Worumbo hydroelectric project in Lisbon Falls, Maine as well as the Mars Hill wind project in Mars Hill, Maine. Since 2006 Bowdoin has purchased 12,000 renewable energy credits each year from the Worumbo hydroelectric project that have been certified by the Low Impact Hydroelectric Institute (LIHI). Since 2008 Bowdoin has purchased 570 Green-E certified renewable energy credits each year from the First Wind project in Mars Hill Maine. First Wind has notified Bowdoin that it will not be able to sell RECs to Bowdoin from the Mars Hill Wind farm beyond the end of 2011 due to a new contract structure. Bowdoin recently purchased 4,000 LIHI RECs from the Rumford Falls project in Rumford Maine owned by Brookfield Energy Marketing. This purchase “trued up” purchased REC offsets to match actual usage for FY08, FY09 and FY10 so that 100% of emissions associated with actual electricity usage were covered by either RECs purchased in the voluntary market or the minimum Maine Renewable Portfolio Standard.¹⁴ Similar to the Worumbo hydroelectric project, the Rumford Falls project is within easy traveling distance of the campus and has been certified as low impact by the Low Impact Hydroelectric Institute.

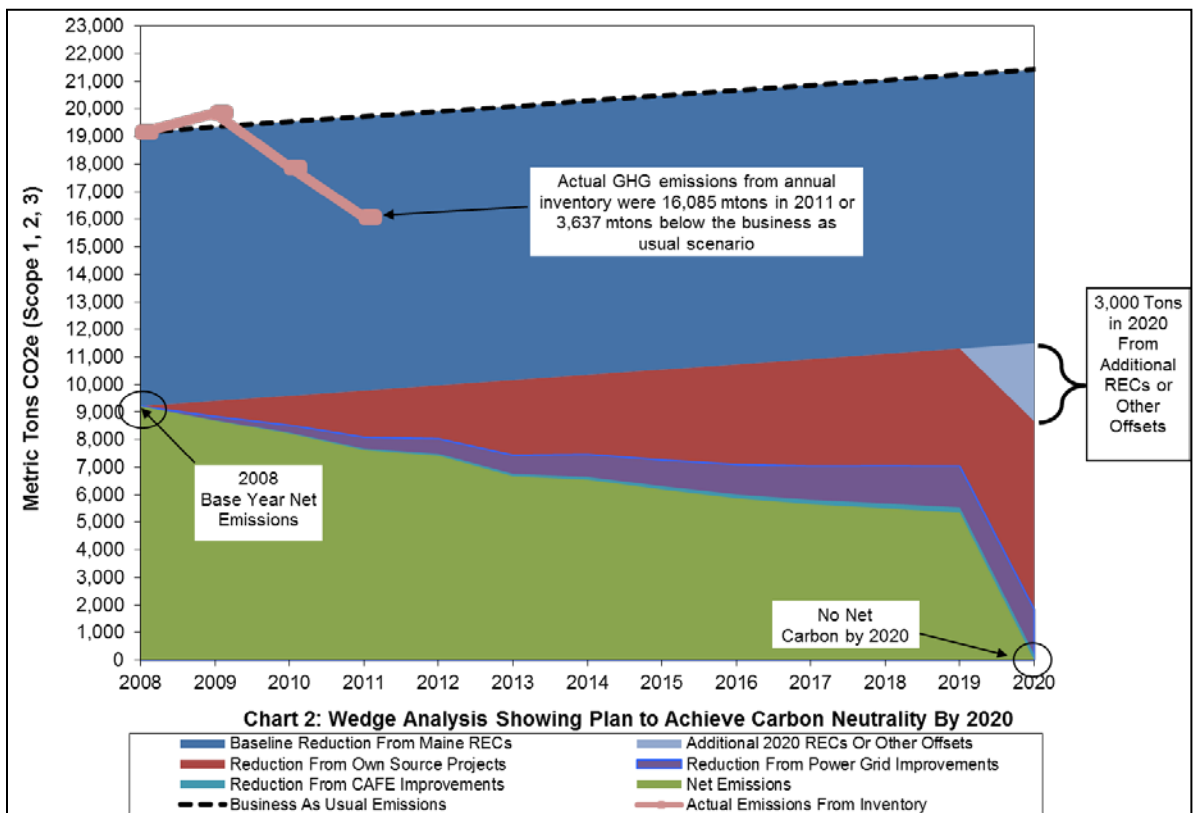
¹⁴ Under the current Maine renewable portfolio standard, at least 34% the electricity provided to end users in 2011 must be generated by qualifying renewable sources. This increases 1% per year until 2017. Therefore, the College knows that at least 34% of the power it consumes (6,880 MWh in 2011) produces little or no net CO₂e emissions.

- ✓ Cost: In aggregate, Bowdoin has spent about \$35,000 per year on Maine renewable energy credits.

2.2 Greenhouse Gas Mitigation Target

A key target of Bowdoin’s fall 2009 Carbon Neutrality Implementation Plan was to reduce greenhouse gas emissions from business as usual by approximately 2,500 tons of CO₂e by 2015. **Bowdoin has actually reduced emissions from business as usual by 3,637 metric tons through a combination of discrete projects and other sources.**

The Fall 2009 Plan contained a “wedge analysis” that showed graphically how Bowdoin planned to achieve carbon neutrality by 2020 through a combination of own source onsite renewable energy and efficiency projects, renewable energy credits or other offsets, and regional grid improvements. This chart is recreated below with a new line showing actual GHG emissions for FY 2009, 2010 and 2011 from Bowdoin’s annual GHG inventory.



3.0- Education, Research, and Community Outreach

Bowdoin has been working on strategies to increase energy conservation awareness on campus. This effort is being led by the Working Group on Sustainability (WGS), a two-year initiative by faculty, staff, and students with the purpose of helping the College identify ways that everyone who works and lives at Bowdoin can contribute to energy/emissions reductions as part of a broader goal of infusing sustainability into campus culture. Specifically, the WGS – chaired by Phil Camill, Program Director and Rusack Associate Professor of Environmental Studies and Earth and Oceanographic Science – is focused on the behavioral dimensions specifically outlined in the climate action plan, in which the campus community will collaborate to help the College reduce its emissions by 590 metric tons of CO₂e per year (approximately 500 pounds of CO₂e per person per year). WGS plans to begin implementation of the following proposals:

- making the behavioral goals of the carbon neutrality plan visible, clear, and easy to understand;
- generating bottom-up support and engagement through the development of specific action items that help attain energy conservation and emissions reductions;
- developing ways to build a campus culture that includes sustainability as a core principle; and
- assessing the effectiveness/meaningfulness of carbon neutrality/sustainability as an overall part of the Bowdoin experience.

Additional detail is provided below on the status of each of the education, research and community outreach initiatives that were identified in the 2009 Carbon Neutrality Implementation Plan. Each initiative is either underway currently, ongoing, or expected to be underway by 2020. While many of these activities are funded within the College's annual operating budget, several initiatives are supported by external grants.

- Strive to be a national leader in the role of liberal arts education in preparing students for a world that will experience wide-ranging impacts of a warming world.
 - ✓ Status: The College is achieving this goal with the involvement of faculty offering courses, independent research opportunities, and primary research (funded by NSF and NASA) focused on the topics of climate change and sustainability.
- Work closely with academic departments to infuse the topics of climate change and sustainability throughout the curriculum. Community based learning will continue to provide opportunities to engage students and faculty with the local community and provide students the experience to address the topic of climate change.
 - ✓ Status: The Environmental Studies (ES) Program has been working with other departments and programs not traditionally affiliated with the environment to begin collaborations that examine sustainability within a broader context that includes human health and social justice. One such initiative is a multi-disciplinary examination of Race, Environment, and Power—a collaboration

among the ES Program, Africana Studies Program, Sociology/Anthropology Department, and History Department.

- Continue to offer co-curricular programming in order to inform Bowdoin faculty, staff and students about climate change and provide opportunities for members of the Brunswick community to continue to learn more about this topic.
 - ✓ Status: Over the past two years, the ES Program has collaborated with a number of other departments and programs to sponsor events to raise awareness about climate change and sustainability.

- Connect with Bowdoin College alumni working in the field of climate change and sustainability in order to keep abreast of evolving technologies and initiatives and to connect students with future internship or employment opportunities in this field.
 - ✓ Status: The College is beginning to develop such connections through its Career Planning Center.

- Build upon the success of the first Climate Days. This could include an annual lecture by a prominent speaker from the environmental community focused on climate action, an annual themed meal similar to the “locavore” dinner, and/or other events designed to engage students and employees in the College’s commitment.
 - ✓ Status: In the fall of 2011, the College will initiate the “Bowdoin Carbon Neutral by 2020” campaign to raise awareness among students, faculty, and staff and to help the Bowdoin community develop simple ways to achieve the goal of cutting 500 pounds of CO₂e per person per year. Events include video presentations in collaboration with Residential Life, action item lists that demonstrate ways to reduce emissions, dorm energy wars, and academic building energy competitions using the College’s Web-based Building Dashboard®.

- Participate in national climate action events such as “Climate 350” and Power Shift.
 - ✓ Status: A group of Bowdoin students attended Power Shift 2011 in Washington, DC. Inspired by their experience, they returned to Bowdoin to start a new student group on campus named the Green Bowdoin Alliance, an umbrella group connecting different efforts to support environmental sustainability.

- Develop a sustainability and climate-focused pre-Orientation trip that will introduce first-year students to climate action and the College’s commitment to carbon neutrality.
 - ✓ Status: These projects are in development. The College has added alternative spring break opportunities that focus on sustainability.

- Organize an educational outreach program to promote energy conservation across campus.
 - ✓ Status: Many of these initiatives are underway as described elsewhere in this document.

- Develop an “eco-award” to promote energy conservation and environmentally friendly behaviors among faculty and staff as part of the annual employee recognition program.
 - ✓ Status: As part of the College’s annual employee recognition program, the Polar Star Award for Innovation has been changed to incorporate sustainability. This award now recognizes an individual who generates and/or facilitates ideas or suggestions to make Bowdoin a better or more sustainable place.

- Develop a wider array of first year courses that can provide more academic opportunities for environmental literacy among Bowdoin students.
 - ✓ Status: Several first-year seminars and sub-100-level courses have been added across the curriculum that focus on environmental science, climate change, and sustainability.

- Explore models such as “writing across the curriculum” as a mechanism for integrating more content focused on climate change and sustainability throughout the curriculum.
 - ✓ Status: This project has not yet been initiated.

- Continue to support faculty and student scholarship on topics related to climate change.
 - ✓ Status: Several faculty have externally funded research projects focused on climate change and/or sustainability.

- Explore the potential for acquiring carbon offsets through the development of community based energy efficiency programs that could involve faculty, staff and students similar to the programs at Brown University and Oberlin College. The capstone course offered by the Environmental Studies Program in which students will craft community climate action plans could provide a framework for moving this type of program forward.
 - ✓ Status: This project has not yet been initiated.

- Expand the student Eco-Rep program to include one Eco-Rep for each of the 22 dorms on campus. Possibilities also exist for the creation of a renewable energy technology club, led and organized by students.
 - ✓ Status: For the 2011-2012 academic year, Bowdoin doubled the size of its student peer-to-peer Eco-Rep program, increasing from 8 to 16 students. Inspired by the success of this influential student team's work, the College has implemented an Office Eco-Rep program, with one or more representatives

from each department and office educating their colleagues about sustainable practices.

- Increase the use of videoconferencing to reduce travel to meetings and conferences and expand faculty/staff alternative transportation options to reduce employee commute miles.
 - ✓ Status: Bowdoin has taken a variety of steps to make videoconferencing readily available, including: obtaining an enterprise license for Webex; supporting, through Audio Visual Services, webinars for a wide variety of departments; installing Skype on all lab and classroom computers; supplying laptops with Skype and iChat for events; and installing videoconferencing equipment in several locations on campus.
 - ✓ Status: The College maintains an alternative transportation Web site at: <http://www.bowdoin.edu/sustainability/campus-initiatives/alternative-transportation/index.shtml>. The site contains a list of resources that can be used by employees who would like to connect with other interested carpoolers or learn more new local transportation options such as the Brunswick Explorer, which provides public transit service throughout Brunswick. Buses run hourly, Monday through Friday from 6:00 am to 9:00 pm.
- Secure funding for faculty and student scholarship.
 - ✓ Status: As described above, several faculty have externally funded research projects focused on climate change and/or sustainability.
- Provide opportunities for faculty, staff and students to be active participants in the identification of solutions at the local, state and federal levels.
 - ✓ Status: Several courses and independent studies in the ES Program have worked towards achieving this goal. One example was a project to develop a simplified methodology for assessing sea level rise impacts in coastal Maine communities, using Brunswick and Harpswell as case studies.

4.0 – Financing Options

The following table shows Bowdoin’s progress on the specific measures outlined in the 2009 Climate Neutrality Implementation Plan to reduce GHG emissions directly associated with campus operations (“own-source” emissions). The table also includes the amount spent on each measure through FY 2011, along with the projected impact on GHG emissions. Capital projects are typically funded outside the operating budget so have not been included in the table below.

Description	Actual Project Cost	Grants	Estimated Annual CO2 Reduction (metric tons)
FY 2009			
Energy Conservation Lighting	\$7,534		
Energy Conservation Other	\$48,548	\$7,504	45
Fuel Switching	\$34,110		
New Construction & Renovation	\$7,500		
RECs	\$34,560		5,855
FY 2009 Total	\$132,252	\$7,504	5,900
FY 2010			
Energy Conservation Lighting	\$157,836	\$4,810	80
Energy Conservation Other	\$10,460		
Fuel Switching	\$8,196		46
New Construction & Renovation	\$79,690		
Other	\$54,040		
RECs	\$34,560		5,855
FY 2010 Total	\$344,782	\$4,810	5,981
FY 2011			
Energy Conservation Lighting	\$91,641	\$10,295	22
Energy Conservation Other	\$207,267	\$10,000	0.3
Fuel Switching	\$86,019		111
New Construction & Renovation	\$75,614	\$22,000	
Onsite Renewables	\$221,181	\$100,000	42
Other	\$94,537		
Physical Plant	\$145,000		1
RECs	\$37,560		7,718
FY 2011 Total	\$958,819	\$142,295	7,894
Grand Total	\$1,435,853	\$154,609	19,775

4.1 – Overview of Financing Options

The College has successfully used a number of the financing options outlined below to implement many of the energy-savings and emissions-reducing initiatives outlined in the 2009 Climate Neutrality Implementation Plan. To achieve complete climate neutrality, the College will need to identify additional funding sources in the future. Based on a review of strategies employed at other colleges and universities as well as the creative ideas of students, faculty and staff, the College plans to explore some specific funding strategies to evaluate their possible use in the future.

4.1.1 – Financing Options Successfully Used to Date:

Annual Operating Budget

Several initiatives outlined in sections 2 and 3 of this report continue to be funded in the College's annual operating budget. Examples include: renewable energy credits to offset the carbon associated with the College's electricity usage, summer fellowships that place students in 10 week stipend fellowships often focusing on some dimension of climate change, Environmental Studies faculty and staff, McKeen Center initiatives and Sustainable Bowdoin activities. Through the Student Activities Fee, several student organizations have been funded such as the Green Bowdoin Alliance, Green Global Initiatives, Evergreens, and the Yellow Bike Club.

Use of Projected Annual Operating Budget Savings

Many energy conservation or carbon reducing initiatives with a payback of 0 – 3 years have been funded within the existing annual operating budget. The conversion of satellite boilers from #2 distillate oil to natural gas and investing in onsite renewable energy generation have dominated this category of projects. From FY 2009 through FY 2011, the College's annual operating budget has contributed more than \$800,000 in funding. When the implementation of carbon reducing initiatives will result in significant and short term budget savings, the College will continue to consider funding these projects within the annual operating budget.

Capital Projects

Major capital projects, such as new construction and significant renovation projects, are typically funded outside the operating budget through gifts, grants and long-term debt. Recent capital project carbon reduction achievements include the Peter Buck Center for Health and Fitness¹⁵ which was awarded LEED Silver certification by the USGBC – and the previously noted and soon to be completed boiler replacement and the cogeneration turbine at the central heating plant.

¹⁵ The full article may be viewed at:
<http://www.bowdoin.edu/news/archives/1bowdoincampus/006465.shtml>.

Fundraising

Alumni now have the option of designating their annual alumni gifts towards sustainability initiatives at Bowdoin by making a gift at:

<http://www.bowdoin.edu/support-bowdoin/makeagift/give-green.shtml>.

Grants

A number of external grants have been used to fund carbon reducing initiatives. With funding from the Efficiency Maine Trust's programs that provide cash incentives to businesses to save energy and money and improve the environment, the College has completed the solar thermal installations on Thorne Hall, weatherized two multi-unit rental properties, and upgraded lighting and heating/cooling equipment in a variety of locations. Since 2009, the College has received more than \$150,000 from the Efficiency Maine Trust rebate programs. In addition, Bowdoin received a \$400,000 grant from the Efficiency Maine Trust to help fund the central heating plant's new cogeneration system. Grant funded educational initiatives include three Mellon Global Scholars and Mellon Global Symposia as well as climate research supported by the NSF, NASA and others. A group of administrators and faculty meet regularly to explore grant funding opportunities for carbon reducing initiatives.

Use Major Maintenance and Capital Renewal Budget Savings

Starting in 2010, the College began using savings from approved budgeted major maintenance projects to fund certain unbudgeted energy conservation projects. The major maintenance and capital renewal budget has funded energy conservation projects totaling more than \$600,000 through FY 2011.

4.1.2 – Additional Financing Options Identified:

Pilot Projects

By partnering with manufacturers of new energy saving products to test these products at Bowdoin, the College could evaluate new technology at no cost or at reduced cost.

Internal Revolving Fund

The College is using certain Efficiency Maine Trust rebates – primarily those received for completed lighting projects – to help finance the costs of other efficiency improvements or carbon reducing initiatives.

4.1.3 – Financing Options for Further Exploration:

Energy Service Companies (ESCOs)

The College may consider contracting with an ESCo which would implement energy-savings initiatives on a performance-contracting basis. An ESCo could provide third-party financing as well as guarantee savings in energy costs. To date, the College has not chosen to contract with an ESCo due to its high credit rating and ability to access debt markets at a lower cost of capital than most ESCos.