Bates | College

JANUARY//2010

Climate Action Plan

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BATES COLLEGE

March 8, 2010

Dear members of the Bates College Community,

Since its founding in 1855, Bates College has nurtured the principles of civic engagement and strong connection to Maine's natural landscape we were founded upon. This tradition of social responsibility and environmental stewardship is embedded in our history and campus culture, and Bates has been recognized as a national leader in sustainability.

In 2007, Bates signed the American College and University Presidents Climate Commitment (ACUPCC) as one of a growing number of institutions exerting leadership to reduce greenhouse gas emissions. As a college, we know we are in a unique position to lead the way in shaping solutions through education and sustainable planning.

When we signed this commitment we did not know how we would go about achieving climate neutrality, but we knew that in working towards this goal we would be heading in the right direction. Indeed, in the past two years we have already accomplished a lot toward integrating a climate consciousness into our curriculum, operations and planning:

- We have undertaken immediate actions to reduce our emissions including setting LEED Silver equivalent as a baseline for all new construction and purchasing almost 100% of our power from Maine renewable resources.
- We have developed a complete baseline inventory of our campus emissions by source.
- We have incorporated climate change and sustainability into our curriculum, outreach and campus educational programs.
- Our campus Committee on Environmental Responsibility (CER) has worked with members of the Master Planning Steering Committee and the Energy Task Force to insert the mitigation strategies presented in this report into campus operations and development plans.

I introduce this climate action plan as a roadmap for continuing to work toward climate neutrality. It calls on the Bates community at all levels to work together to conserve energy, to be purposeful in how we develop our campus in order to minimize our environmental footprint, and to instill in students an awareness of the responsibility we each have as stewards of the environment.

Regards,
Elaine Tuttle Hansen
President

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Executive Summary //

Summary of our Greenhouse Gas Emissions

For fiscal year 2009, Bates' campus emissions totaled 18,953 metric tons of carbon dioxide equivalents (MTCDE). Of this 8,487 MTCDE were mitigated through the purchase of electricity generated through 100 percent Maine renewable resources, resulting in remaining net emissions of 10,466 MTCDE.

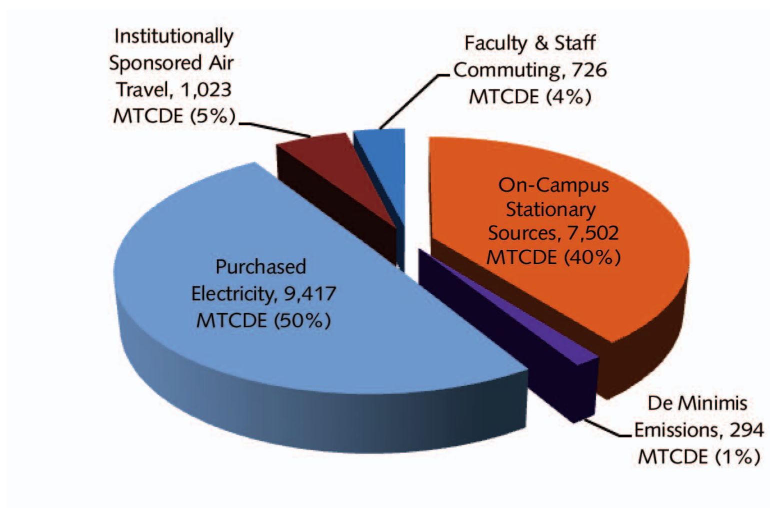
Overall, Bates' two largest sources of gross emissions are from purchased electricity (50 percent) and "on-campus stationary sources" or heat and hot water generated from the main steam plant and boilers in individual buildings (40 percent).

Campus Emissions by Scope & Source (FY 2009*)

Scope	Source	Emissions (MTCDE)
1	On-Campus Stationary Sources	7,502
1	College Fleet	127
1	Refrigeration	160
1	Agriculture	8
2	Electricity	8,570
3	Faculty/Staff Commuting	726
3	Institutionally Sponsored Air Travel /Study Abroad	1,023
3	Solid Waste	(11)
3	Transmission and Distribution Losses	848
	Total Campus Emissions (FY 2009)	18,953
	Emissions Reductions (RECs)	(8,487)
	Net Campus Emissions	10,466

Sources highlighted in gray represent de minimis *emissions.* *See page 11.*

Emissions Distributions FY2009



Drivers in developing our CAP

Even before we began developing mitigation strategies, two external factors emerged to help drive our process. First, anticipating continued instability in energy prices, Bates developed an Energy Task Force to reduce energy consumption and costs across campus. Second, the College began a scheduled update of our Campus Facilities Master Plan. Both of these actions provided us with an opportunity to develop our climate action plan in conjunction with existing operations and planning processes. Thus our planning process required us to look at not only a variety of mitigation strategies, but also how to phase them in a way that would fit with campus goals. As a result, we worked to integrate mitigation strategies into projects wherever possible rather than propose them as additional (and perhaps competing) projects.

Target Date for Achieving Climate Neutrality

With this in mind, we plan to adopt the following measures to achieve climate neutrality at Bates:

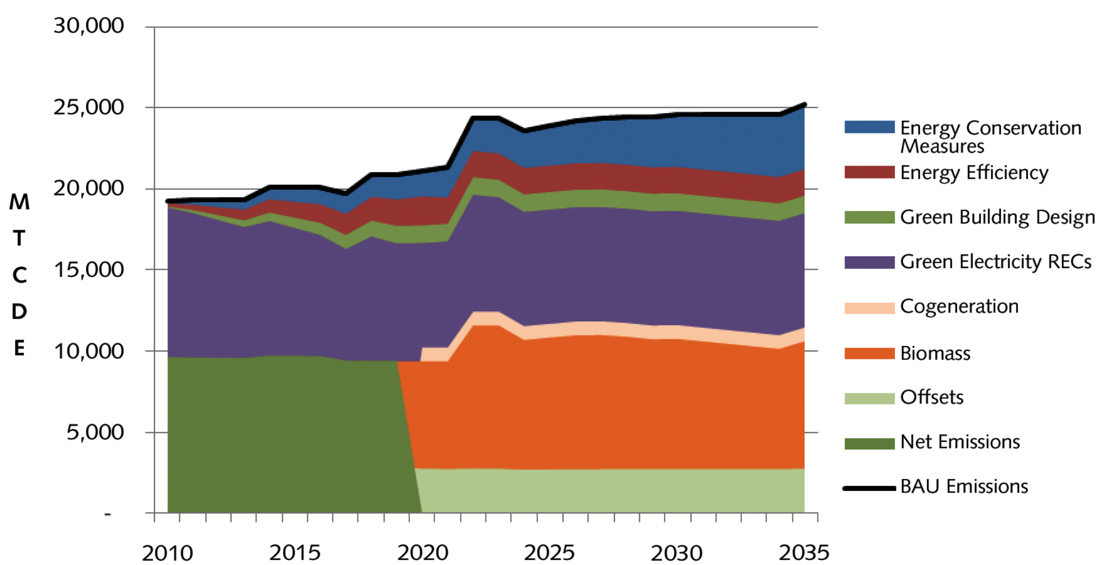
	Mitigation Strategy	Capital cost to Implement	Energy Output	Annual Energy Savings	Simple Payback (Years)	MTCDE Reduction	Capital cost per MTCDE
Step 1 (BAU)	Energy Conservation	$0	N/A	$134,215	<1 per project	1,430	$0
	Energy Efficiency	$0	6,860 MMBTU	$150,922	N/A	1,610	$0
	Green Building	1.5-3% of construction costs	31,000 MMBTU	$682,066	6	1,092	$1,464
	Green Electricity	$0	0	0	N/A	8,487	$0
Steps 2 + 3 (CAP)	Cogeneration	$1,500,000	1,347,806 kWh	$183,302	10.6	816	$1,838
	Biomass Boilers	$7,500,000	100,000 MMBTU	$560,000	13.4	7,279	$1,030
	Offsets	$13,700	0	0	N/A	2,740	$5

Step 1 in the mitigation strategies listed above summarizes Bates' continued commitment to reduce energy consumption and minimize campus emissions. Together, the strategies of energy conservation, the continued purchase of green electricity, implementation of energy efficiency projects and green building practices represent "business as usual" (BAU) at Bates College. This is far from a "do-nothing" scenario BAU typically suggests. This is an acknowledgement of many of the best practices already in place and the work already under way. But these practices alone won't achieve climate neutrality.

Analyzing campus growth under the master plan, and needs and opportunities associated with each of the mitigation strategies studied, **we plan to achieve climate neutrality in 2020* through converting our main steam plant to a biomass cogeneration facility and offsetting remaining emissions** (steps 2 and 3). We will further evaluate opportunities for on-site renewable energy after 2020.

By 2020, the new construction and renovations planned under the Campus Facilities Master Plan are expected to produce emissions reductions from conservation, efficiency, green building design and the continued purchase of green electricity. Bates recommends going beyond these BAU reductions and replacing the fossil fuel boilers at the main steam plant with a biomass co-generation system to achieve climate neutrality. These mitigation strategies will reduce emissions by more than 8,000 MTCDE, bringing total on-site reductions to 60 percent of gross emissions:

Mitigation Strategies (FY 2010-2035)



We came to this determination after evaluating all viable mitigation strategies, and identifying a spectrum of three possible scenarios beyond BAU for achieving climate neutrality:

Climate Neutral Now (Option 1)	Climate Neutral in 2020* (Option 2)	Climate Neutral in 2020* (Option 3)
0% Reductions	60% Reductions	69% Reductions
45% RECs	27% RECs	19% RECs
55% Offsets	13% Offsets	12% Offsets
Incremental Capital Cost: ~$60,000	Incremental Capital Cost: ~$7,000,000	Incremental Capital Cost: ~$17,600,000
Purchase offsets to mitigate all of our emissions beyond BAU.	*Convert our main steam plant to a biomass cogeneration facility and offset remaining emissions (further evaluating opportunities for on-site renewable energy after 2020).*	*Pursue an ambitious plan to install onsite renewable energy technology wherever viable including: biomass, solar, wind, and geothermal technologies, reducing our emissions as much as possible and purchasing offsets only for emissions we cannot directly mitigate in 2020.*

Finally, we recognize that this plan is a dynamic strategy directly linked with the College's Facility Master Plan. As such, we will upgrade this plan as the master plan is updated.

** 2020 is the date Bates anticipates needing to add capacity to its main steam plant in order to accommodate new facilities south of Campus Avenue. During this upgrade, we propose converting the main steam plant to a biomass cogeneration system. Thus the date is driven by building a new facility south of Campus Avenue. If the Campus Facility Master Plan schedule shifts, Bates will adjust its Climate Neutral date to match.*

List of Acronyms //

AASHE	Association for the Advancement of Sustainability in Higher Education
ACUPCC	American College & University Presidents' Climate Commitment
BAU	Business As Usual
CAP	Climate Action Plan
CACP	Clean Air-Cool Planet
CCC	Campus Carbon Calculator
CDE	Carbon Dioxide Equivalent
CER	Committee on Environmental Responsibility
CER	Certified Emissions Reduction
CO2	Carbon Dioxide
eGrid	Emissions & Generation Resource Integrated Database
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FY	Fiscal Year
GHG	Greenhouse Gas
GSF	Gross Square Feet
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
kW	kilowatt
kWh	kilowatt hour
LEED	Leadership in Energy & Environmental Design
MT	Metric Ton
PV	Photovoltaic
REC	Renewable Energy Certificates
RDF	Refuse Derived Fuel
T&D	Transmission & Distribution
USGBC	U.S. Green Building Council
VER	Verified Emissions Reduction
VMM	Virtual Met Mast
WRI	World Resource Institute

Introduction //

Climate change is the predominant environmental issue of the 21st century. Given the potential for large-scale deleterious effects on the world's inhabitants if greenhouse gas emissions remain unchecked, the American College & University Presidents' Climate Commitment (ACUPCC) was born. It now incorporates 650 signatories who have committed their institutions to achieve climate neutrality. Bates College became a signatory in February 2007, and this document outlines the timelines and strategies by which we propose to fulfill our commitment.

We have compiled a complete inventory of campus greenhouse gas emissions and subsequently the reductions necessary to achieve net climate neutrality. Our burden is in excess of 10,000 metric tons of carbon dioxide equivalent (MTCDE) per annum, not including electricity purchased from renewable sources. In the absence of our commitment to purchase green power, our yearly emissions would be in excess of 18,000 MTCDE — a significant number.

At the time we signed the Presidents' Climate Commitment, we did not have a specific plan in place to reduce these emissions to zero. Using the best available information, we have weighed different options and timelines, while paying careful attention to their viability and cost. Recognizing the important role of technological development in providing new avenues for carbon reductions, as well as the potential for cultural change that makes emissions reductions a factor in how individuals choose to live every day, it's best to think of this plan as a dynamic document. It outlines the path we choose now, ever mindful of alternate routes that may avail themselves to us. Inevitably, some emissions remain and must be "offset." In time, we strive to reduce offsets to a minimum.

Our Climate Action Plan (CAP) is the result of a collaborative effort by students, staff and faculty who comprise the Committee on Environmental Responsibility, along with input from The Stone House Group, our sustainability consultants. We also worked with members of the Bates Energy Task Force and Campus Facilities Master Planning Steering Committee to integrate this strategy into operational goals and campus planning. Equally as important through the years will be the response of the individuals who comprise the Bates *community*. While our electrical power and thermal generation sources may generate the bulk of emissions that must be reduced, the individuals at Bates will play important roles through adoption of conservation and innovation. As an institution of higher education that "prizes both the inherent values of a demanding education and the profound usefulness of learning, teaching and understanding," we apply ourselves to the threat of climate change.

This Climate Action Plan summary report follows the general format provided by the ACUPCC Implementation Guide. Section 1 discusses Bates' ACUPCC commitment and the tasks before us. Sections 2 and 3, respectively, present the campus emissions and mitigation strategies. Section 4 discusses the role of offsets. Section 5, Educational, Research, Community Outreach Efforts, describes how we are making sustainability part of our curriculum and educational programs on and beyond campus. This plan has costs associated with its implementation and Section 6, Financing, outlines the cost and strategies to finance our mitigation plans. Change is inevitable and Section 7 describes how we will implement this plan and track our progress. Section 8 contains the assumptions we used to complete Bates' CAP to ensure that future users of this document are able to understand the rationale for selecting various strategies and making specific decisions.

Campus Emissions //

Bates' greenhouse gas emissions have been tracked for almost two decades. The College completed its first campus-wide emissions inventory in 2000, covering emissions from the period 1990–2000. In 2007, we updated and expanded the inventory. Because the College has not traditionally categorized data into specified sources, our greenhouse gas emissions analysis has evolved over time and will continue to change as we develop better systems for tracking and capturing data. Therefore we anticipate that our emissions may increase slightly as we capture more detailed data and perhaps expand what we cover in our emissions inventory, giving us a clearer picture of our overall carbon footprint. [For methodology used in conducting the GHG inventory, see Appendix A.]

Emissions are reported in terms of metric tons of carbon dioxide equivalents (MTCDE). MTCDE is the accepted unit of measure for greenhouse gas emissions. This unit is derived by multiplying the individual greenhouse gas by its 100-year global warming potential (GWP). For example, if we emit one metric ton of methane and its GWP is 23, the associated MTCDE is 23.

Emissions by Scope & Source

The Greenhouse Gas Protocol: A Corporate Accounting Standard, published by The World Resources Institute (WRI), specifies the method upon which GHG Inventories are performed. The method categorizes emissions into three different scopes or classes. Each scope contains several subcategories, which address different emissions sources.

Scope One emission sources are those sources which are directly under the control of the College. It is composed of the following sectors: on-campus stationary sources, campus fleet, fugitive emissions and agriculture.

Scope Two emissions are those that are attributable to purchased electricity, steam and chilled water; those utilities that the College purchases and/or consumes, over which it has no direct control.

Scope Three sources are those for which Bates has the least amount of direct control, but for which it does exert some influence. These sources comprise: directly financed air travel and student study abroad, student/staff/faculty commuting, solid waste generation/disposal and transmission and distribution losses.

Scope 1

On-Campus Stationary Sources

On-campus stationary sources, comprising 39 percent of Bates' greenhouse gas emissions, include fuel consumed on campus to produce energy for heating and domestic hot water. Bates uses distillate fuel oil (No. 2 fuel) and natural gas for on-campus energy production. The campus central heating plant uses predominantly natural gas (although it has dual fuel capability — the ability to burn either fuel oil or natural gas) and the small structures not served by the centralized infrastructure use either fuel oil or natural gas.

College Fleet

Bates owns and operates vehicles to assist in the daily operations of the College. Through an examination of the composition of the College fleet, we calculated the total volume of gasoline and diesel fuels used to power these vehicles. Electrically powered carts are used on campus as well, and those emissions are included below in the "Electricity" section.

Refrigeration

Bates uses refrigerants for cooling in various areas of the College. The impact of refrigerants varies by type according to GWP. Quantification of the loss of refrigerants over time married with the GWP allows for the calculation of the resultant greenhouse gas emissions, often referred to as fugitive emissions.

Agriculture

Agricultural activities at Bates are limited to the application of fertilizer on the athletic fields, as an animal husbandry program does not exist. The nitrogen content of the fertilizer contributes to the emission of nitrous oxides, and also influences carbon dioxide emissions from soil-based microbes.

Scope 2

Electricity

The electricity section of the inventory examines both the total amount of kilowatt-hours of electricity purchased by the College and the carbon intensity associated with the generation of the consumed electricity.

Scope 3

Faculty/Staff Commuters
The total commuter miles driven annually by faculty and staff were calculated in order to determine the greenhouse gas emissions associated with this travel.

Institutionally Sponsored Air Travel/Study Abroad
The College sponsors travel for faculty, staff and students to various events throughout the year. We reviewed the data for the cost of air travel for staff and faculty in order to obtain an estimate of the number of air miles. Because Bates encourages students to study abroad, we included the actual air mileage associated with this activity. It is important to note that the ACUPCC does not require colleges to include study abroad in this calculation. Hence Bates' "air travel" figures may appear slightly higher when compared to institutions that do not include these data.

Solid Waste
Bates College generates waste (unrecyclable trash) through its daily operations. Depending on the method of waste disposal, solid waste may generate greenhouse gases, or may reduce the emissions based upon a beneficial reuse of the material or destruction of emitted greenhouse gases via flare or other control technology. Solid waste from Bates is incinerated as a refuse-derived fuel and results in an overall greenhouse gas benefit.

Transmission and Distribution Losses
Losses of electricity which occur between the generation sources and the end user are sources of GHG emissions. These emissions represent a subcomponent of electricity. The purpose for recording emissions from transmission and distribution sources separately is that even when purchasing power from a "green" source, the delivery of this electricity remains through the grid and therefore generates emissions from losses equal to the standard mix.

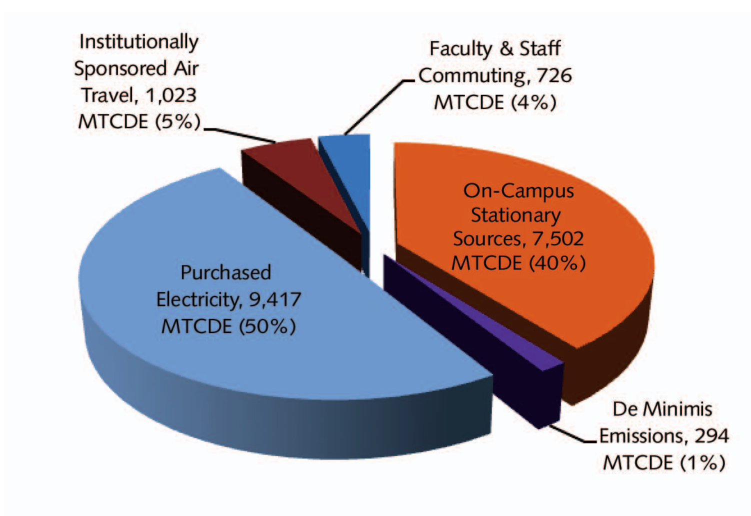
From the sum of these sources (or scopes), Bates can obtain an estimate of our total greenhouse gas emissions. For fiscal year 2009, our campus emissions totaled 18,953 MTCDE of which 8,487 MTCDE was reduced through the purchase of green power, resulting in net emissions of 10,466 MTCDE. A summary of GHG emissions by scope and sector is presented in the Figures 2-1 and 2-2 below.

Figure 2-1 Campus Emissions by Scope and Source (FY2009*)

Scope	Source	Emissions (MTCDE)
1	On-Campus Stationary Sources	7,502
1	College Fleet	127
1	Refrigeration	160
1	Agriculture	8
2	Electricity	8,570
3	Faculty/Staff Commuting	726
3	Institutionally Sponsored Air Travel /Study Abroad	1,023
3	Solid Waste	(11)
3	Transmission and Distribution Losses	848
	Total Campus Emissions (FY 2009)	18,953
	Emissions Reductions (RECs)	(8,487)
	Net Campus Emissions	**10,466**

The sources highlighted in gray in the table above represent *de minimis* emissions sources. *De minimis* emission sources are those which comprise 5 percent or less of the total GHG emissions for the campus. While not insignificant sources of emissions, GHG inventory guidelines allow us to "baseline" these data for a period of five years, meaning that we will only have to verify their accuracy every five years. For ease of data manipulation, we will lump these emissions together in the charts and graphs provided hereafter.

Figure 2-2 Emissions Distribution FY2009



Campus Growth & "Business as Usual" Trends

Setting aside *de minimis* sources, 99 percent of our gross emissions — approximately 18,660 MTDCE — come from three primary sources: on-campus stationary (i.e., heating and domestic hot water), electricity and transportation.

The first two categories comprise emissions from energy used in buildings. This is 90 percent of our total emissions. If we proceed in a "do-nothing" scenario, our energy usage and emissions will continue to increase/grow over the next few decades as we renovate and expand our campus buildings.

Bates is currently in the midst of updating its Campus Facilities Master Plan for FY 2010. This update reflects anticipated future campus growth in terms of residential, academic and campus center functions. We realize our need for improved residential quarters for our students is upon us, as well as the need to improve academic and associated campus life facilities in order to continue to provide the quality educational and life experience to our constituents that we have maintained in the past. The Campus Facilities Master Plan Update provides for the growth of the campus from its current 1.5 million gross square feet (GSF) to approximately 1.8 million GSF over the next 20 years. The plan includes a mix of new and renovated student residences, new and renovated academic and administrative facilities, as well as new and renovated facilities for campus center functions.

The Campus Facilities Master Plan Update results in the renovation of approximately 282,000 GSF, the addition of approximately 665,000 GSF and the demolition of approximately 248,000 GSF. Figure 2-3 provides data regarding Capital Projects associated with the Campus Facilities Master Plan Update, Figure 2-4 provides a vision of what the campus would look like at the completion of the Campus Facilities Master Plan Build-Out, and Figure 2-5 provides data regarding campus growth as predicted by the Campus Facilities Master Plan Update.

Figure 2-3 Capital Projects, Bates College Campus Facilities Master Plan Update

	GSF		
Building Project	Add	Reno	Demo
Hedge/RW	7,500	33,000	0
Page	22,000	30,455	
Villages 1, 2, 3	69,875		
Frye Street	16,150	38,500	
JB		21,383	
Lane		31,089	
CCF & SOC	188,875		83,645
Chase		25,000	38,270
Integrated Math & Science	135,000		61,137
Carnegie, Dana, Hathorn		70,400	65,266
Wood Street Quad 1	26,650		
Wood Street Quad 2	26,650		
Wood Street Quad 3	14,950		
Schaeffer	15,209	31,712	
Athletics	55,000		
Winter Garden	87,000		

Figure 2-4 Campus Build-Out, Bates College Facilities Master Plan Update

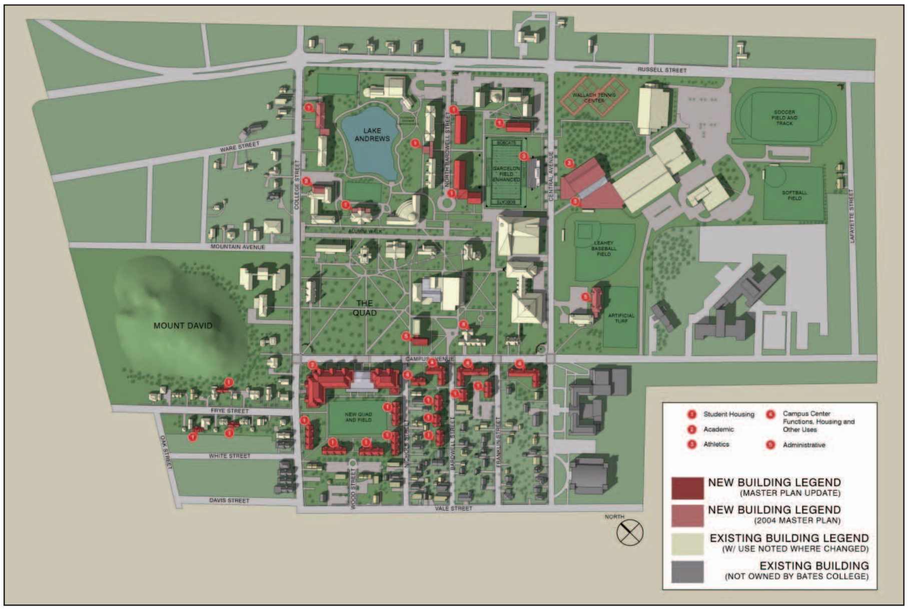
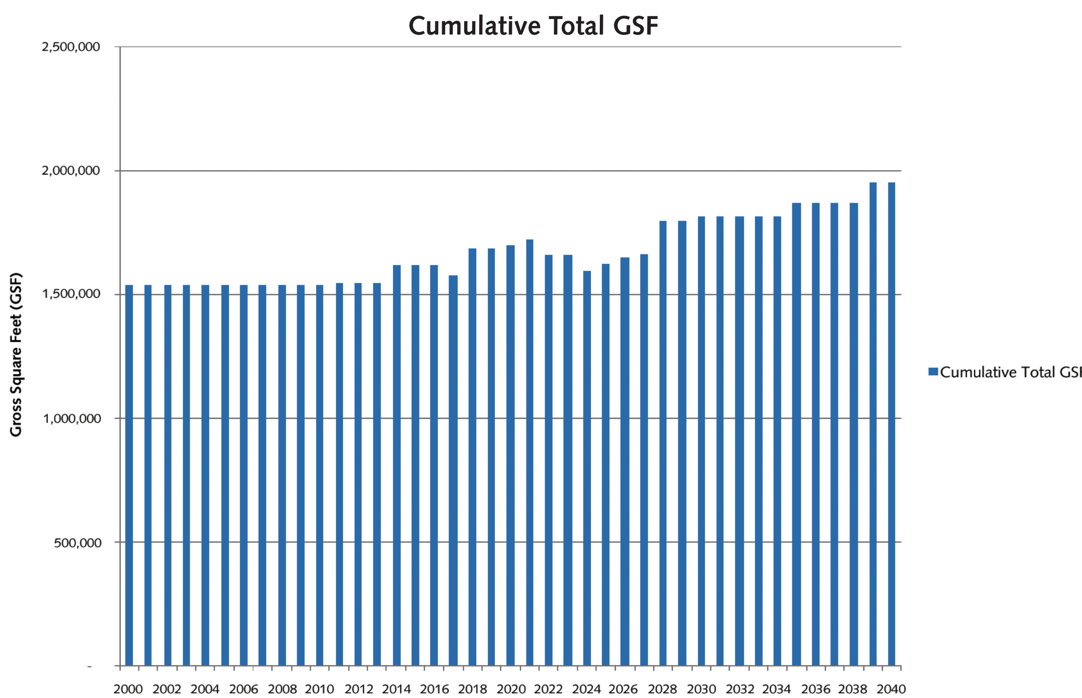


Figure 2-5 Cumulative Growth in GSF as Predicted by Facilities Master Plan Update



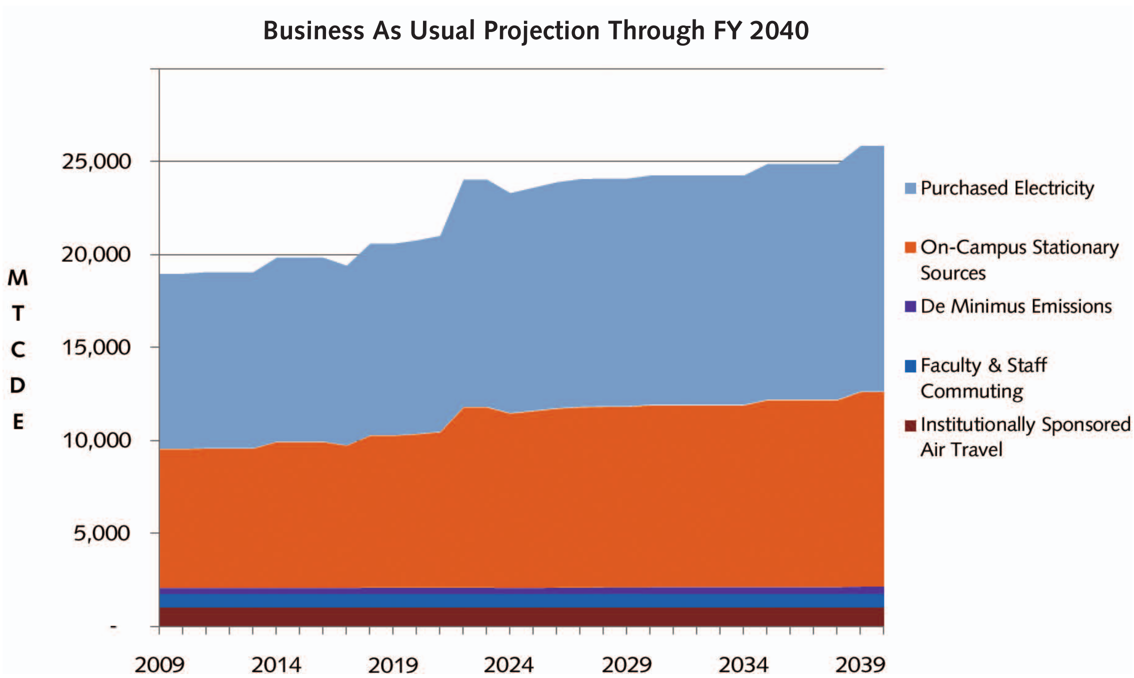
A construct of the climate change world, "business as usual" (BAU) is a scenario wherein the institution takes no steps or actions to mitigate its emissions. Carried forward in our CAP, BAU gives us an idea of what Bates' future emissions profile might look like if we elect to take no action with regard to global warming and climate neutrality. BAU does not take into account future regulatory demands that might affect fuel efficiency in cars and trucks, renewable energy standards for utility generators, potential technology breakthroughs or behavioral changes that might occur. Rather it projects a worst-case scenario based upon current consumptions and efficiencies. BAU does take into account projected campus growth, both in terms of physical size and the number of faculty, staff and students. Since Bates' CAP has been developed simultaneously with our Campus Facilities Master Plan Update, the projected growth in BAU is as accurate as possible.

The amount of energy Bates consumes ties directly into our GHG emissions. Buildings use fossil fuels for heating, air conditioning and lighting. As we add GSF to the campus, we increase the amount of fossil fuels consumed. While newer and renovated buildings may use energy more efficiently, they may also use more of it, as building codes now require larger amounts of conditioned air to be introduced into the structure, thereby requiring increases in energy for the more substantial HVAC system. While our campus building standards dictate that we build "green," even with the use of highly efficient systems some buildings may consume more energy than their older predecessors. Figure 2-5 below provides a graphical representation of GHG emissions in the BAU scenario. Please note that the purchased electricity and on-campus stationary sources closely mirror the shape of the data presented in the Cumulative Total GSF chart presented above. BAU growth in emissions is directly related to the anticipated growth of the campus' physical size, in terms of gross square feet (GSF).

The BAU projection includes purchased electricity, which at this time Bates mitigates with the purchase of a 100 percent Maine Renewable Resource Product. Come December 2012, Bates will be purchasing Renewable Energy Certificates (RECs) through our contracted energy producer. The projection reflects gross, not net, emissions, so as to present our GHG emissions in their entirety. This approach assists us with our analysis as we review mitigation strategies and look to demonstrate the impact of energy efficiency and renewable energy mitigation strategies on future electrical consumption and associated REC purchases.

As demonstrated in the graph below, the majority of our GHG emissions are associated with the campus heating plant and purchased electricity. While other emissions sources are a factor that should not be considered insignificant, emissions reduction measures associated with the central heating plant and purchased electricity will have the greatest impact on our GHG emissions profile in years to come.

Figure 2-6 Business As Usual Projection



Mitigation Strategies //

Bates' overall approach to achieving climate neutrality is shown in Figure 3-1 and is through:

Figure 3-1 Bates' Approach to Climate Neutrality

First Reducing the amount of energy we use

Second Using energy as efficiently as possible

Third Employing renewable energy

Last Offsetting any remaining emissions

Even before we began developing mitigation strategies, two external factors emerged to help drive our process. First, realizing the instability in energy prices, Bates developed an Energy Task Force to reduce energy consumption and costs across campus. Second, the College began a scheduled update of our Campus Facilities Master Plan. Both of these actions provided us with an opportunity to develop our Climate Action Plan in conjunction with existing operations and planning processes. Thus we approached the development of mitigation strategies from two angles: reducing our current energy use in existing buildings and avoiding future growth in energy usage and emissions.

The concurrent development of this CAP and Campus Facilities Master Plan Update has also allowed us to better define and understand the current physical face of the College, how it may evolve over the next decades, and the impact of campus change on our emissions profile and overall environmental footprint. The BAU scenario provided in Section 2 takes into account the projected campus growth based on the Campus Facilities Master Plan Update. This planning process required us to look at not only a variety of mitigation strategies, but also how to phase them in a way that would fit with campus goals. Thus we worked to integrate mitigation strategies into projects wherever possible rather than propose them as additional (and perhaps competing) projects.

With this in mind, we will take the following measures to achieve climate neutrality at Bates:

Step 1: We will continue to reduce energy consumption and minimize campus emissions.

- **Purchase RECs for electricity**

  Reductions in electrical consumption will translate into both reductions in emissions and REC purchases. GHG emissions attributable to electricity consumption are 8,750 MTCDE, or 45 percent of our overall GHG emissions (pre-REC numbers). To normalize our emissions with the rest of the nation, the generation assets used to calculate the GHG emissions were the national averages. This method lends parity to the comparison of Bates against and among various institutions across the country.

  By the purchase of Renewable Energy Credits (RECs), Bates currently mitigates 99 percent of our emissions attributable to electrical consumption (and offsite generation) through the purchase of 100 percent Maine Renewable Resources. Currently Bates' cost associated with "green" electrical power is approximately $73,000 per year. The other 1 percent, used in our smaller stand-alone buildings, is purchased under the Maine Public Utilities Commission's "Standard Offer." This Standard Offer requires at a minimum 30 percent of the power be provided by renewable energy.

Starting in December 2010, when our existing contract ends, Bates negotiated a two-year contract to purchase RECs (Green-e Wind Power) to offset 99 percent of our electricity purchased at a cost similar to our existing contract.

- **Use natural gas at the steam plant where economically feasible**
  Bates will continue to use natural gas at the main steam plant until infrastructure can be modified to support even more environmentally preferable fuels. Our central heating plant has the capacity to burn both oil and natural gas, giving the College the opportunity to burn the lowest cost fuel. On the basis of both per unit (gallons and therms) and heat content (British thermal units), natural gas is the fuel with the smaller carbon footprint. At present natural gas is also the more financially advantageous fuel. This financial benefit may change, at which time we may re-examine our options. We have not applied a cost to this strategy as it does not currently represent a cost to the institution, and we endeavor to move our fuel to a climate-neutral fuel as soon as is practical.

- **Implement the Energy Task Force's efficiency projects as funding allows**
  Bates College has formed an Energy Task Force (ETF) whose goal is to contain future energy costs. It will meet this goal by reducing energy consumption across campus and aggressively pursuing lowest unit energy costs. To that end the ETF has identified a series of energy efficiency and energy reduction projects. Examples of measures for implementation include: energy efficient motor and pump replacements, lighting retrofits, occupancy sensors, air handling unit controls retrofits and upgrades, and installation or retrofit of equipment with variable frequency drive motors. Approximately 1,400 MTCDE of GHG emissions will be avoided through the implementation of these projects. The projects are funded on a recurring annual basis. They will be implemented as funding allows and prioritized on the best simple payback. Total cost to implement all of the current proposed projects is approximately $1.1 million.

- **Engaging the community in energy conservation programs**
  In addition to improving efficiency, it will be equally important to engage the campus community in energy conservation practices and programs. From individual actions (such as turning off lights, powering down computers, lowering thermostats, etc.) to campus-wide measures like those listed below, conservation saves costs and avoids the release of greenhouse gas emissions.

  A. Energy
  Campus-wide temperature reductions and changes to building scheduling can result in reductions in GHG emissions. While not exact, a rule of thumb is that lowering a thermostat 1 degree Fahrenheit in the heating season can produce fuel savings of approximately 1 percent. One percent is equivalent to a 51.5 MTCDE reduction per degree reduced.

Our policy with regard to building access and use is such that we strive to ensure that our students, faculty and staff have access to facilities as needed. Understanding that some of our students and faculty study and work late at night, while others are early risers, our scheduling of building hours has been relatively relaxed. Revising and posting building hours will enable us to set buildings systems to an unoccupied/standby mode, reducing temperature set points, fans, and turning off lights. Estimates of emissions reductions range from 5 to 10 percent, or 805 to 1,610 MTCDE, depending on how aggressively we choose to schedule buildings while balancing the need for access.

Adopting a holiday curtailment program to consolidate students who remain on campus over academic breaks into a small number of residence buildings could result in significant reductions of GHG emissions. With this type of program we could reduce building temperatures and electrical loads in residential halls and houses across campus during holiday breaks. Analysis of our energy consumption for FY 2009 reveals that approximately 625 MTCDE emissions could be avoided via holiday curtailment programs. As such, we will work to consolidate students over break whenever possible.

Using conservative numbers, the above conservation measures could result in a GHG reduction of approximately 1,430 MTCDE, with a zero cost to implement.

B. Faculty/Staff Commuting
Faculty and staff commuting comprises 4 percent of our GHG emissions, or 726 MTCDE. Mitigation strategies to be pursued include the following:

- work with local and regional bus services to develop stops at Bates
- create incentives for carpooling, vanpooling and local bus use
- create a Web-based tool to facilitate carpooling
- participate in Go Maine’s Commute Another Way to Work Week
- reserve desirable parking spaces for hybrids, electric vehicles and/or carpools
- encourage telecommuting and/or compressed work schedules where appropriate
- minimize the number of new parking spaces anticipated with renovations and new construction under the Campus Facilities Master Plan
- continue to encourage local living (rental properties available to faculty and staff) to encourage walking/bicycling to and from campus

The estimate of GHG emissions avoided through implementation of some or all of the above commuting strategies is 5 to 10 percent or 36 to 72 MTCDE over the next 10 years based upon 2009 mileage and fuel economy figures. We expect that future regulatory actions with regard to vehicle fuel economy, changes in how we live and commute, as well as other as yet unforeseen technological advances, may well drive the avoided emissions up another 5 to 10 percent.

- **Extending our comprehensive and progressive green building practices**
  In 2006, Bates agreed to pursue certain green building practices, specifically that new construction and renovation projects on campus should achieve, at minimum, equivalency to LEED Silver level certification. Bates also agreed to revisit its green-building targets, as needed, for each new project. Campus energy consumption per GSF at Bates is currently 117 MBTU or 117,000 British thermal units (BTU). Except for the potential new Integrated Natural Science and Math Center, which would consume substantially more energy than a typical academic or residential building, we anticipate that the continued use of green building measures — daylighting techniques, motion sensor switches, efficient heating systems, etc. — will reduce energy consumption to 80 MBTU/GSF on average. This action could result in a reduction of approximately 2,800 MTCDE.

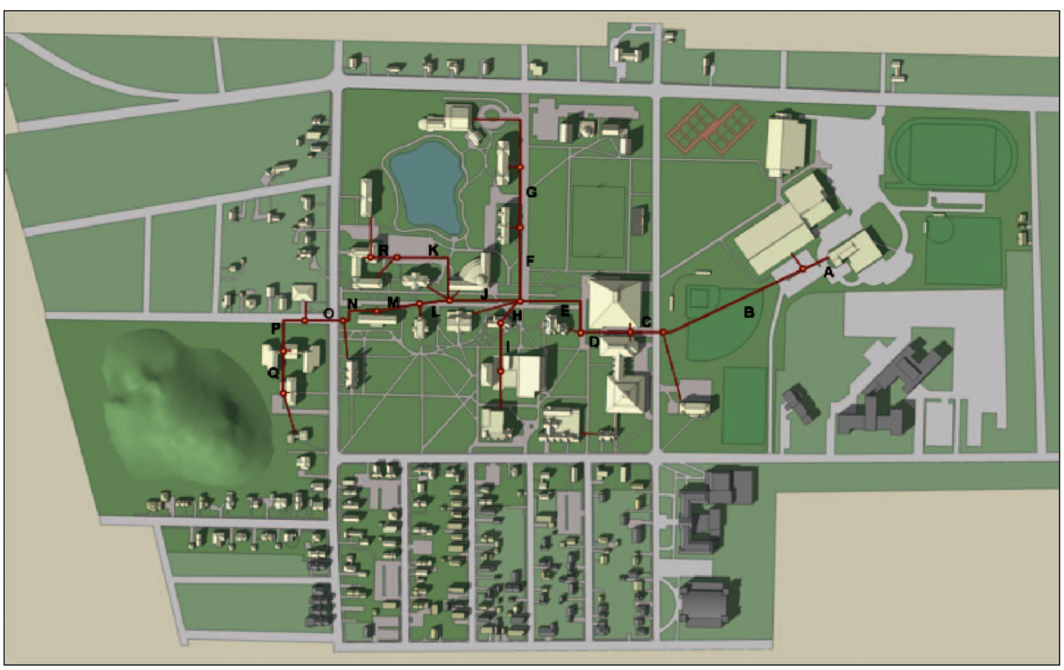
Step 2: We will replace the boilers at Bates' main steam plant with a biomass cogeneration system to provide steam heat, hot water and electricity once construction begins south of Campus Avenue, a move that requires greater capacity at the steam plant.

** Implementing this recommendation would reduce our net GHG emissions (after RECs) more than 80 percent and its completion will define our date for achieving climate neutrality.*

Our on-campus central plant and infrastructure provides steam for heating and domestic hot water needs to over 80 percent of the structures on-campus. Emissions from the physical plant are 7,279 MTCDE and represent 39 percent of our greenhouse gas emissions.

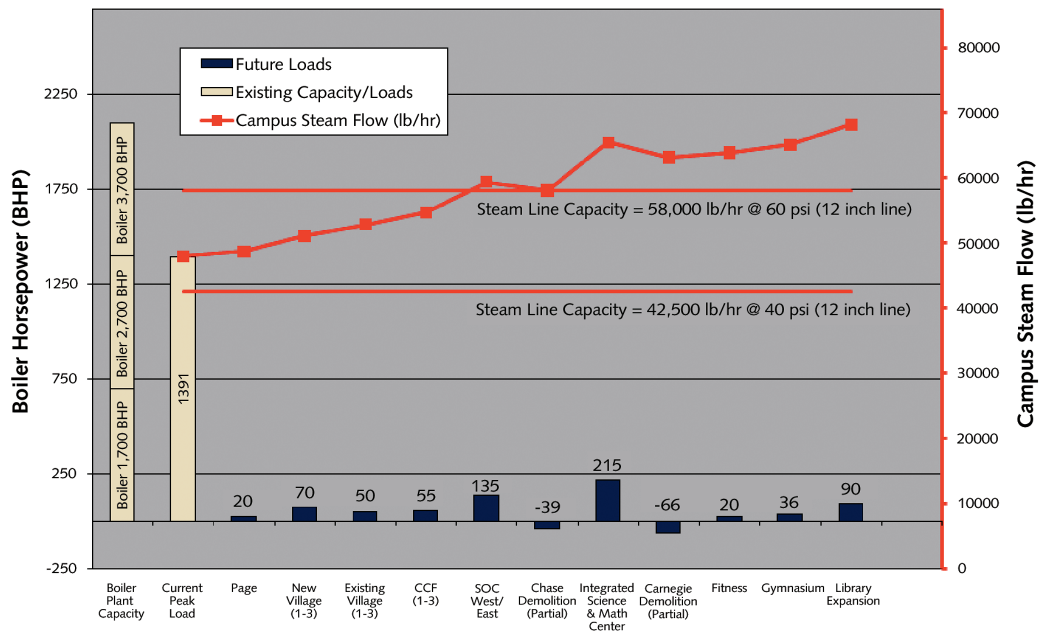
Figure 3-2 below provides a diagrammatic representation of the current steam infrastructure, which is fed from Cutten Maintenance Center.

Figure 3-2 Current Steam Infrastructure



The boilers typically operate from October to June each year. Currently, the physical plant has the capacity to meet the campus' steam and domestic hot water requirements, with sufficient boiler capacity that should one of the three boilers in the plant go offline, campus heating and hot water needs could still be met. Figure 3-3, Boiler Capacity & Campus Growth, demonstrates the current boiler capacity, and the ability to support the campus growth through renovations and additions on the north side of Campus Avenue.

Figure 3-3 Boiler Capacity & Campus Growth



The Campus Facilities Master Plan Update has campus GSF growing approximately 23 percent from just over 1.5 million GSF to approximately 1.89 million GSF by year 2040. As seen in the figure above, Bates' physical plant will have insufficient boiler capacity to maintain the needs of the campus once construction begins south of Campus Avenue (SOC). At this time, increased steam delivery pressures and reduced reserve capacity will necessitate the upgrade of the physical plant infrastructure. Under the Campus Facilities Master Plan Update, the required systems upgrade is directly tied to building south of Campus Avenue. The fact that the existing physical plant would be inside the final third of its life expectancy, and approaching the time when replacement would be required, further supports this time frame.

Installation of biomass fired boiler systems, in addition to existing infrastructure, will create the additional capacity required with sufficient reserve capacity to ensure an adequate margin of safety. According to the IPCC, wood chips (the proposed fuel for the physical plant) are a biogenic source of carbon and do not contribute to global warming or climate change, as long as reforestation occurs where harvesting activities have taken place. As such, conversion of the physical plant to a biomass boiler system will reduce the physical plant GHG emissions to net zero, a reduction of 7,279 MTCDE, at an incremental cost of approximately $5.5 million to implement.

Cogeneration is the ability to generate electricity and steam/hot water simultaneously from the same source. Following the installation of the new biomass systems at the physical plant a backpressure steam turbine will be installed at the plant. The turbine is not proposed for installation in conjunction with the new boilers so that an accurate determination of steam pressure delivery levels to the campus can be made and compared to the load capacities of the boiler(s). The accuracy of the differential between the high steam pressure at the boilers and the steam delivery pressure to campus determines the sizing of the turbine. This turbine will simultaneously reduce the steam pressure to the correct campus delivery pressure and generate electricity for the campus. A 500 kW turbine with a 140-pound per square inch (psi) pressure drop would generate approximately 1.35 million kilowatt hours of electricity per year, which is about 10 percent of the campus' total annual electricity use, and reduce our GHG emissions by 816 MTCDE at a cost of approximately $1.5 million to implement.

Step 3: Upon Bates' conversion of its main steam plant to a biomass cogeneration system, we will begin purchasing offsets for the remaining GHG emissions in order to achieve climate neutrality. We will need to offset ~2,700 MTCDE/year. Estimates of offset costs are currently between $4-20/MTCDE.

See the "Role of RECs and Offsets" section on page 23 for more information.

Step 4: Once Bates achieves climate neutrality, we will continue to evaluate opportunities for on-site renewable energy to increase our direct use of clean energy and further decrease our purchase of RECs and offsets.

- **Wind — a 900 kW turbine on campus could provide as much as 9 percent of our total annual electricity needs.**
  As part of the climate action planning process, Bates commissioned a Virtual Met Mast (VMM) wind energy study to evaluate the feasibility of installation of wind power generation assets on-campus. A VMM study uses computers to analyze historic weather data, and the analysis becomes the equivalent of a virtual meteorological mast or tower from which we would have traditionally gathered data such as wind strength and direction, rainfall, temperature and humidity via tower or mast mounted equipment. Results of the study revealed that at a hub height of 75 meters (246 feet) there is sufficient wind power to support the installation of a 900- kilowatt (kW) wind turbine. Several locations were identified at Bates that would be suitable for such an installation, taking into account such factors as logical electrical tie-in location, minimized transmission distances, zoning setback requirements and ecological impacts. Installation of the 900-kW wind turbine would generate approximately 1.6 million kilowatt hours of electricity per year, resulting in a GHG emissions reduction of 1,085 MTCDE. Cost to implement this mitigation strategy is $2.7 million.

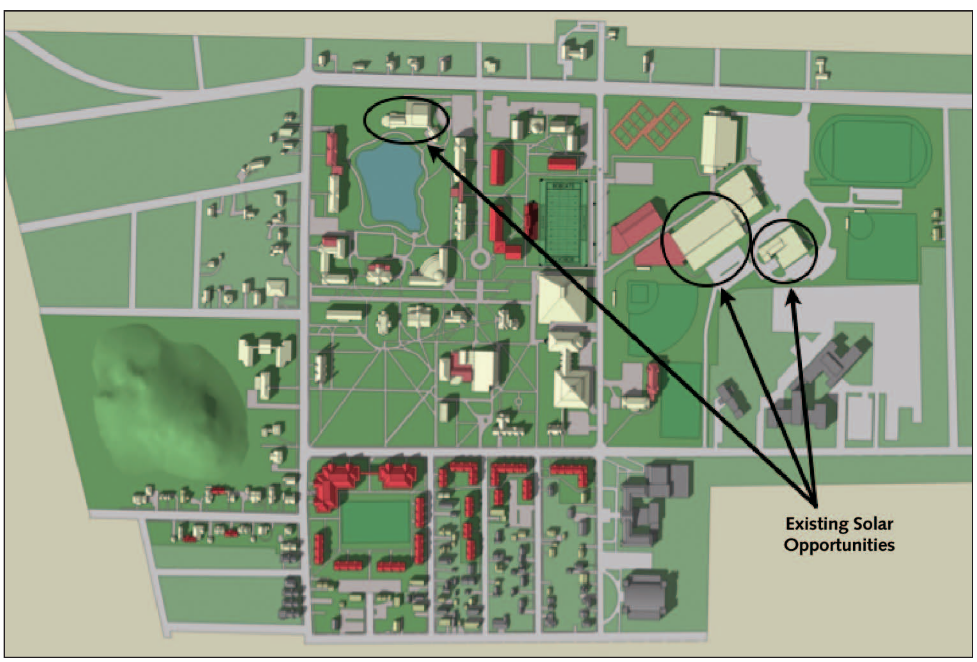
- **Photovoltaics — Olin, Merrill and Cutten buildings have been identified as potential locations, and we could develop additional sites as new construction design commences.**
  The feasibility of installing of photovoltaic (PV) solar power on campus buildings was evaluated with regard to solar orientation (azimuth), additional weight-loading capacities, usable roof area (size and free of shading) and ease of installation. Using the PV-Watts calculation tool, installation sizing and generation capacities were determined for those buildings where

azimuth and roofing materials/substrates were deemed suitable. Looking at future campus growth in accordance with the Campus Facilities Master Plan, we developed estimates for potential future facilities which could support photovoltaic applications. Table 3-1 provides a summary of those facilities, both current and future, where the installation of solar power panels is potentially sensible. Generation capacities and GHG reductions in MTCDE are also provided.

Table 3-1 Solar PV Opportunities: Location, Generation Capacity, and Emissions Reductions

Location	Annual Generation Capacity (kWh)	Emissions Reduction (MTCDE)
Merrill Gymnasium	316,563	192
Cutten Maintenance Center	101,753	62
Olin Arts Center	107,405	65
Future Athletic Facilities	245,337	149
Future Academic Facilities	151,498	92
Future Housing Facilities	192,200	116
Future Campus Center Functions	200,114	121
Totals	**1,314,870**	**797**

Figure 3-4 Solar PV Opportunities: Existing Locations



- **Ground Source Heat Pumps on Frye Street**

  Ground source heat pumps were evaluated as another option for attaining net climate neutrality. It was generally concluded that at current fuel costs and with the ability to connect larger buildings to the physical plant, ground source heat pumps were not a financially attractive option for most of the campus.

  However, for stand-alone small buildings that are not able to connect to the physical plant, ground source heat pump technology may well prove advantageous at some or all of these structures when they need to be renovated or as a study/research opportunity. Efficacy of ground source heat pumps will continue to be evaluated going forward, as continued cost escalation of fuels could make this technology more financially attractive.

Table 3-2 Summary of Mitigation Strategies

	Mitigation Strategy	Capital cost to Implement	Energy Output	Annual Energy Savings	Simple Payback (Years)	MTCDE Reduction	Capital cost per MTCDE
Step 1 (BAU)	Energy Conservation	$0	N/A	$134,215	<1 per project	1,430	$0
	Energy Efficiency	$0	6,860 MMBTU	$150,922	N/A	1,610	$0
	Green Building	1.5-3% of construction costs	31,000 MMBTU	$682,066	6	1,092	$1,464
	Green Electricity	$0	0	0	N/A	8,487	$0
Steps 2 + 3 (CAP)	Cogeneration	$1,500,000	1,347,806 kWh	$183,302	10.6	816	$1,838
	Biomass Boilers	$7,500,000	100,000 MMBTU	$560,000	13.4	7,279	$1,030
	Offsets	$13,700	0	0	N/A	2,740	$5
Step 4 (TBD after 2020)	Renewables: Wind Power	$2,700,000	1,630,001 kWh	$221680	10.8	1,085	$2,488
	Renewables: Photovoltaics	$7,900,000	1,314,870 kWh	$178,822	36.7	797	$9,903

Target Date For Climate Neutrality //

Step 1 in the mitigation strategies listed above recommends that Bates continue to reduce energy consumption and minimize campus emissions. Together, the strategies of energy conservation, using natural gas to fuel the central heat plant, the continued purchase of green electricity, implementation of energy efficiency projects and green building practices represent “business as usual” (BAU) at Bates College. This is far from a “do-nothing” scenario BAU typically suggests. In many ways this is an acknowledgement of many of the best practices already in place and the work already under way. But these practices alone won’t achieve climate neutrality.

Implementation of these strategies could reduce net emissions by more than 4,000 MTCDE over the next 10 years, leaving just over 8,000 MTCDE remaining.

Analyzing campus growth under the Campus Facilities Master Plan, and needs and opportunities associated with each of the mitigation strategies presented in steps 2 through 4 above, **we elected to achieve climate neutrality in 2020* through converting our main steam plant to a biomass cogeneration facility and offsetting remaining emissions**. We will further evaluate opportunities for on-site renewable energy after 2020.

We came to this determination after evaluating all viable mitigation strategies, and identifying a spectrum of three possible scenarios beyond BAU for achieving climate neutrality:

Climate Neutral Now (Option 1)	Climate Neutral in 2020* (Option 2)	Climate Neutral in 2020* (Option 3)
0% Reductions	60% Reductions	69% Reductions
45% RECs	27% RECs	19% RECs
55% Offsets	13% Offsets	12% Offsets
Incremental Capital Cost: ~$60,000	Incremental Capital Cost: ~$7,000,000	Incremental Capital Cost: ~$17,600,000

Purchase offsets to mitigate all of our emissions beyond BAU.

Convert our main steam plant to a biomass cogeneration facility and offset remaining emissions (further evaluating opportunities for on-site renewable energy after 2020).

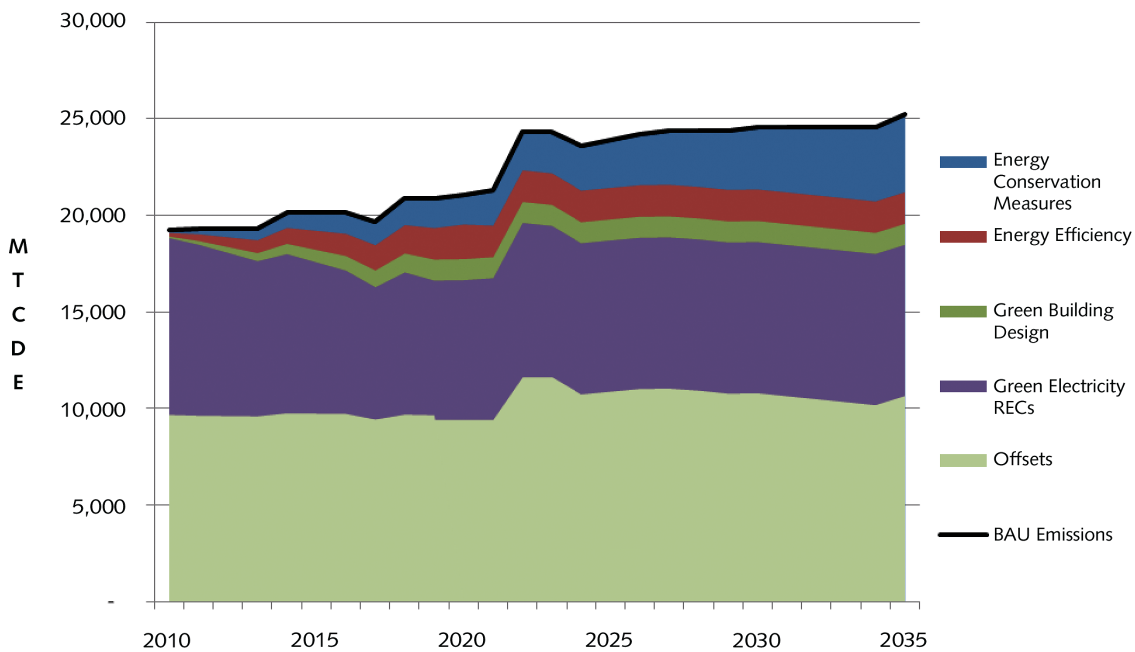
Pursue an ambitious plan to install onsite renewable energy technology wherever viable including: biomass, solar, wind, and geothermal technologies, reducing our emissions as much as possible and purchasing offsets only for emissions we cannot directly mitigate in 2020.

** Bates anticipates needing to add capacity to its main steam plant in 2020 in order to accommodate the addition of new facilities south of Campus Avenue. During this upgrade we propose converting the main steam plant to a biomass cogeneration system. Thus the 2020 date is driven by building a facility south of Campus Avenue. If the master plan schedule shifts, Bates will adjust its climate neutral date to match.*

Option 1: Climate Neutral Now

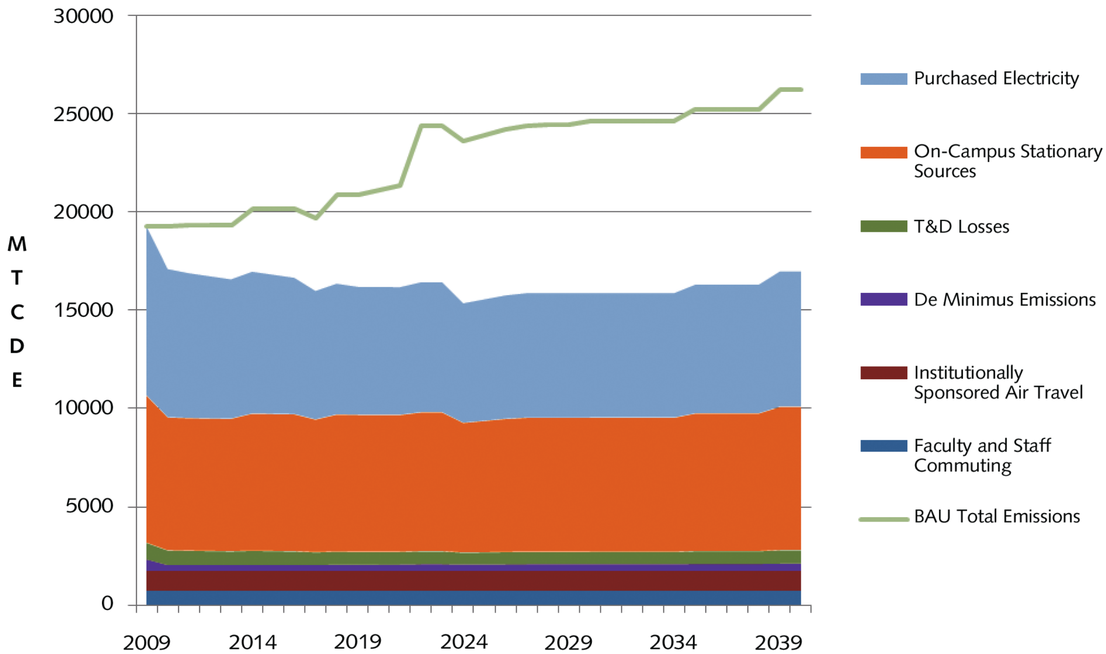
The *Climate Neutral Now* option proposes offsetting all emissions remaining starting in 2010 after the purchase of green power. Emissions reductions from energy conservation and efficiency measures as well as green building design under BAU would incrementally reduce the need for offsets as the campus grows, but no additional mitigation strategies would be pursued on-site, as shown below in Figure 4-1:

Figure 4-1 Mitigation Strategies (Option 1)



Beyond BAU (captured in the first four wedges of the graph), under this option all remaining emissions would need to be mitigated via the purchase of offsets and RECs:

Figure 4-2 Emissions to be Mitigated Via RECs and Offsets (Option 1)



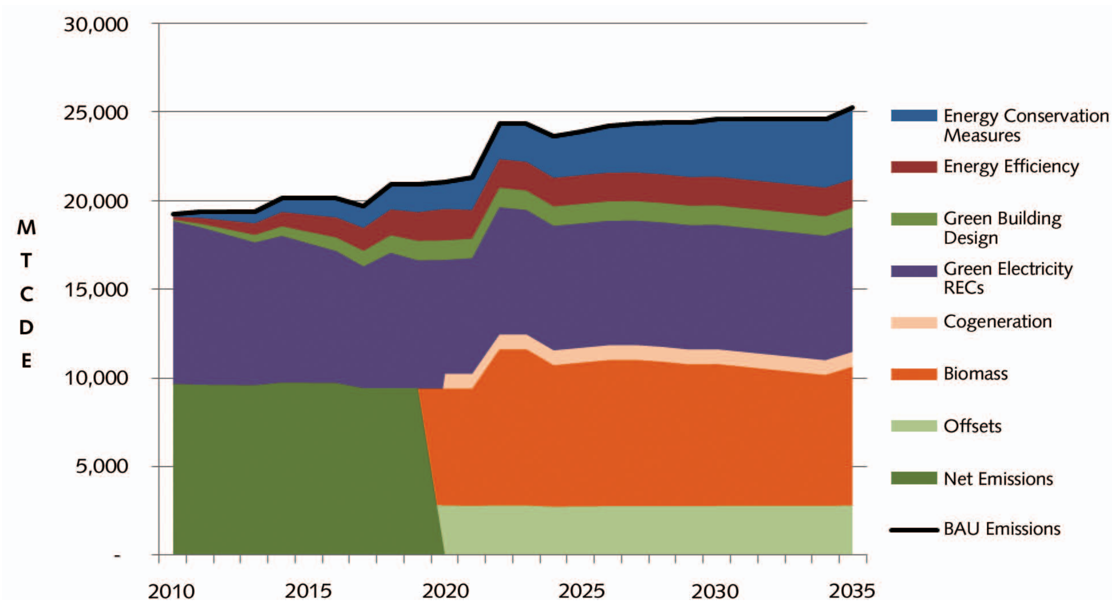
While it is possible for Bates to fulfill its commitment to achieving climate neutrality by purchasing offsets entirely, this option would be contrary to the College's traditional role as a leader and a model of sustainable practices.

Furthermore, while this option appears to be the most cost-effective, it means double purchasing. First, we are purchasing fossil fuels for energy and then we are purchasing offsets to counterbalance their emissions. Over time it would amount to significant money spent without a meaningful benefit. We therefore dismissed this option.

Option 2: Climate Neutral in 2020* [Planned]

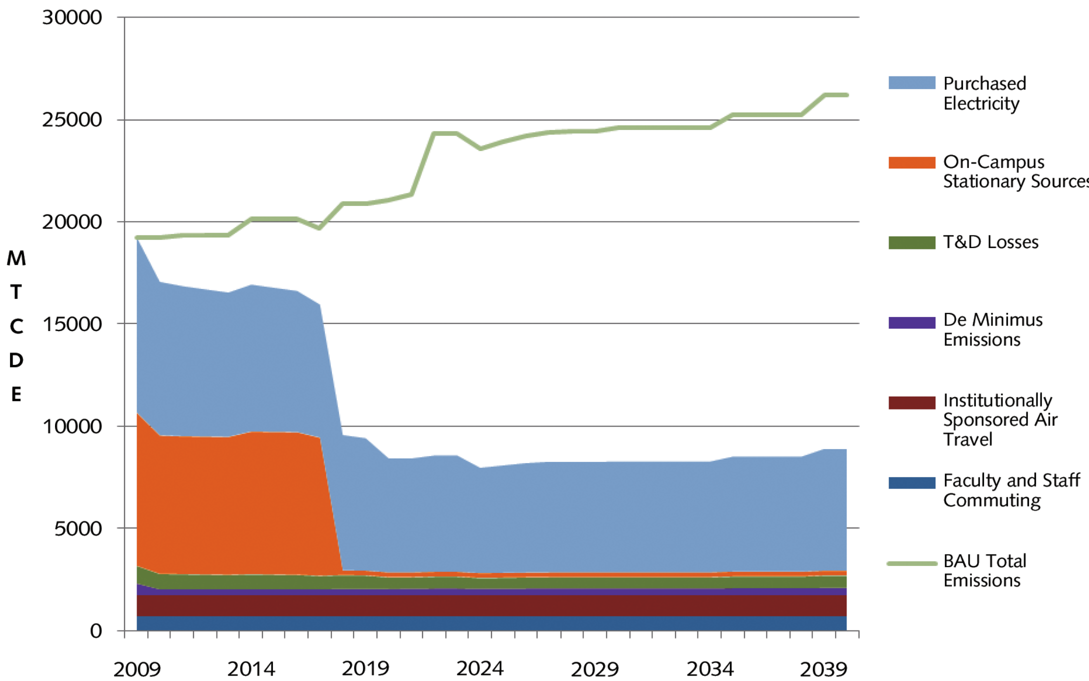
By 2020, 39 percent of new construction and renovations will be complete, capturing emissions reductions from conservation, efficiency, green building design and the continued purchase of green electricity. *Climate Neutral in 2020* Option 2* goes beyond these BAU reductions with the replacement of fossil fuel boilers at the main steam plant with a biomass cogeneration system. These mitigation strategies will reduce emissions by more than 8,300 MTCDE, bringing on-site reductions to 60 percent of gross emissions, and are shown below in Figure 4-3:

Figure 4-3 Mitigation Strategies (Option 2)



Beyond BAU (captured in the first four wedges of the graph), biomass boilers reduce gross emissions by 7,502 MTCDE and cogeneration reduces the need for purchased RECs by 816 MTCDE. Remaining emissions to be mitigated through RECs and offsets include:

Figure 4-4 Emissions to be Mitigated Via RECs and Offsets (Option 2)

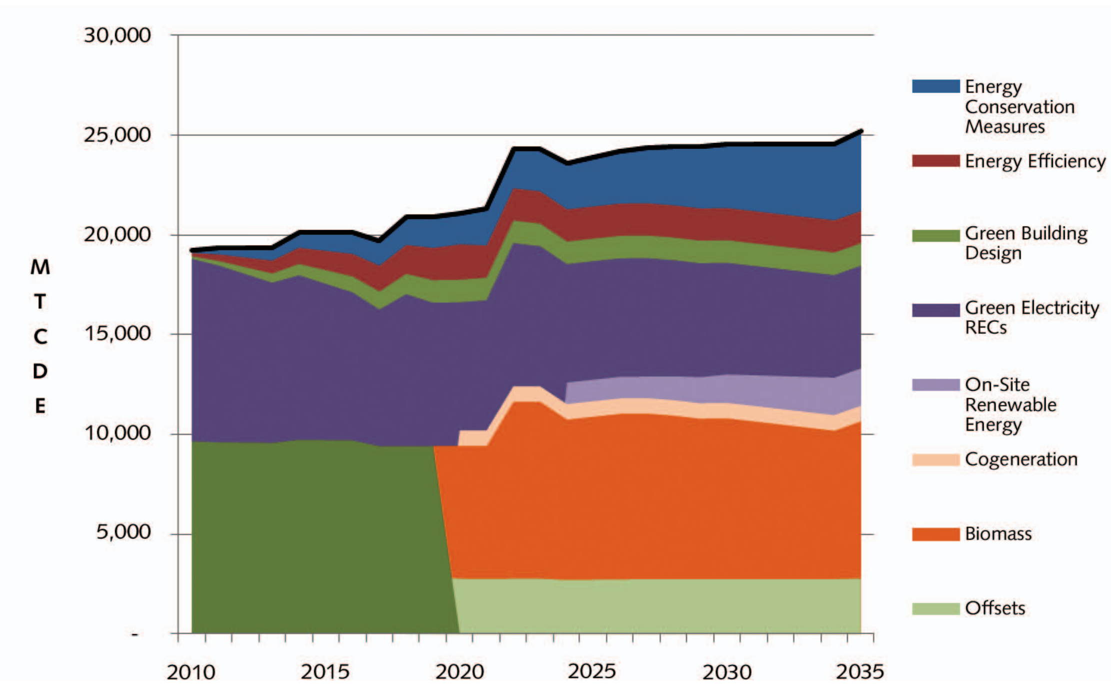


This option makes sense on several levels. First, it reduces our net emissions more than 75 percent, minimizing the role of offsets in our achievement of climate neutrality. Second, the investment has a strong ROI, making it a sound business decision, and third, while it will require adjustments and new facilities, the operating cost of biomass is more stable than fossil fuels. We therefore made this option the center point of our CAP.

Option 3: Climate Neutral 2020*

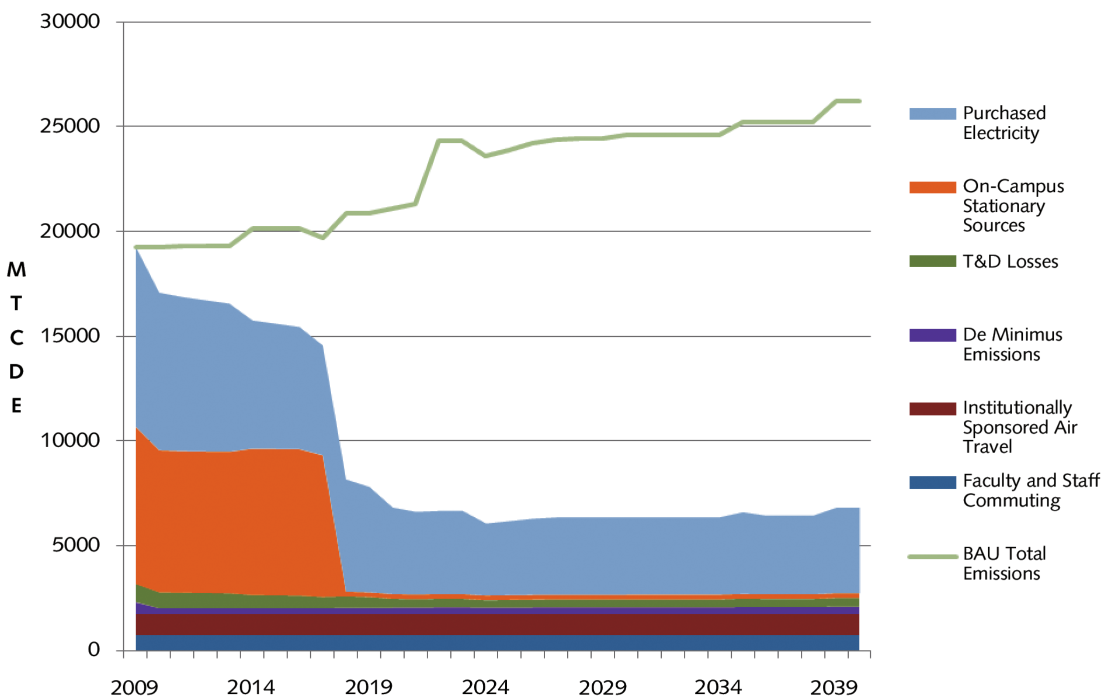
The final option builds on *Option 2*, adding wind and photovoltaic renewable energy generation systems to campus. These additions would not impact gross emissions because Bates' electricity is already mitigated through the purchase of RECs. They would reduce the amount of RECs we purchase. Figure 4-5, below, shows the impact of these additional strategies:

Figure 4-5 Mitigation Strategies (Option 3)



Beyond BAU (captured in the first four wedges of the graph), biomass boilers and a steam turbine for cogeneration, this ambitious approach would commit Bates to reducing emissions as far as possible prior to offsetting:

Figure 4-6 Emissions to be Mitigated Via RECs and Offsets (Option 3)



By definition, sustainability takes into account and attempts to balance the environmental, social and economic impacts of a decision or behavior. While it is appealing from an environmental standpoint to build renewable energy systems on campus wherever they are technically feasible, it is not an economically viable option for the College at this point.

The addition of both wind and solar photovoltaic systems on campus would reduce our emissions by a relatively small percentage at a high cost. We therefore decided against this option, but remain committed to continuing our evaluation of renewable energy options on campus in the future.

The Role of Offsets //

Renewable Energy Certificates (RECs) and carbon offsets are both ways to counteract emissions that either cannot be eliminated entirely (e.g., faculty and staff commuting, refrigeration, College fleet vehicle emissions, etc.), directly (e.g., electricity), or are too expensive to practically reduce on-site. The primary difference between RECs and offsets is whether they reduce emissions directly or indirectly, and as such, their unit of measure.

RECs represent one megawatt hour (MWh) of electricity generated from renewable sources such as wind, solar, hydropower and biomass. Since these sources generate little to no greenhouse gas emissions as they produce electricity, their use provides an indirect reduction of emissions because it replaces the use of fossil fuels to produce electricity.

In practice, "green" electricity purchased through RECs is delivered through the grid along with electricity generated by fossil fuels, and the two "products" are indistinguishable. The premium paid for RECs goes toward increasing the amount of electricity a power plant purchases from renewable sources, which may be locally or nationally depending on what types of RECs are offered.

A carbon offset is measured in MTCDE, and pays for projects which will directly reduce GHG emissions elsewhere to counteract the release of emissions on-site. Since greenhouse gas emissions are global in scope, reducing emissions in one area to counteract emissions released in another area is considered a legitimate way of achieving climate neutrality.

To date, there is no regulatory mechanism in place in the United States to regulate or ensure the quality of offsets on the market. Offsets purchased in the United States are considered Verified Emission Reduction (VER) offsets. This means they are subject to voluntary third-party verification, but not certified under Kyoto Protocol standards. These offsets typically range from about $4.50 per MTCDE to approximately $16 per MTCDE.

Organizations and institutions are also developing their own programs to offset emissions directly in their community. Such programs might entail purchasing and installing programmable thermostats for community residents or carrying out winterization programs in low-income homes, for example.

In both purchasing offsets and/or developing our own program, Bates pledges to consider the following factors:

- **Additionality —** Are purchased offsets truly creating a net reduction in GHG emissions that otherwise would not have occurred?
- **Real, Measurable and Verifiable — I**s a mechanism in place to ensure that the reductions have occurred or will imminently occur, are objectively quantifiable and have been subject to third-party verification?
- **Enforceable —** Are the offsets purchased backed by legal instruments which define creation, transparency and exclusive credit ownership?

The Committee on Environmental Responsibility (CER) will continue to research offset markets leading up to 2020, when the College will begin to operate as a climate neutral institution. The CER will also work on ways in which it may be possible to offset GHG emissions locally through projects in our own community. This is an attractive option for Bates. We view the development of local offset projects as an opportunity for environmental education and community outreach — two of Bates' strengths.

Education, Research, Community Outreach //

Effective climate action requires an understanding of the importance education plays in the lives of the people who work at Bates and students who choose to study here. As such, we incorporate climate change and sustainability into the education of our community members (students, staff and faculty) and the citizens of Lewiston/Auburn through a variety of offerings. The Bates curriculum includes courses, or sections within them, which focus on climate change/sustainability in the Environmental Studies (ES) major, General Education Concentrations (GECs), First-Year Seminars and Short Term offerings. Faculty members have ongoing research projects directed at various aspects of climate change and engage students in them. The required senior thesis provides an opportunity for students interested in climate change or sustainability to conduct their own research and present the results to their department or interdisciplinary program. In addition, less formalized opportunities for climate change and sustainability education reside in efforts by the Sustainability Coordinator, Harward Center for Community Partnerships, student clubs and the Bates faculty and staff.

Education/Curriculum

The academic program at Bates provides students the opportunity to immerse themselves in one or more courses emphasizing climate change and sustainability. The **ES Program** is an interdisciplinary program and believes that offering courses across the disciplines better prepares our students for the environmental challenges ahead of them. As such, past and present members of the ES Program Committee have been instrumental in developing courses that bridge the human/environment interface and have encouraged faculty in other departments to do the same. Examples of Bates courses incorporating climate change and/or sustainability are:

- **Scientific Approaches to Environmental Issues**
- **Environment and Society**
- **Environment and Culture**
- **Ethics and Environmental Issues**
- **Global Change**
- **Climate Change and Public Policy**
- **Environmental Economics**
- **Energy and Environment**

In addition to individual semester-length or five-week Short Term courses, we offer an ES major and several **General Education Concentrations** (GECs) which emphasize climate change and/or sustainability. The ES majors are immersed in the topics of climate change and sustainability within their required core courses and their selected concentration. Students choosing one of the following GECS will have significant exposure to climate change and sustainability in the four classes offered within that concentration:

- **Environment, Place, History**
- **Field Studies: Natural Science**
- **Hazards in Nature**
- **Water and Society**
- **The Geosphere**

The First-Year Seminar is another avenue for faculty and students to engage with one another. First-year students enroll in a seminar during their fall semester that also forms their core adviser-advisee group for the next two years. This course is an opportunity for focused discussions, reading and writing in the areas of climate change and sustainability. The seminars' offerings change from one year to the next, but a few examples particular to these areas of study are:

- **Changing Climate and Planet Earth**
- **Into the Woods: Rewriting Walden**
- **Issues in Oceanography**

Encouraging more Bates faculty to incorporate the topics of climate change and sustainability into their courses is a goal of the CAP, since educating a majority of our students about these issues is most easily accomplished through the curriculum.

All Bates seniors are required to complete a one- or two-semester **thesis** or equivalent research project. Students propose research topics in consultation with faculty members. Climate change and sustainability have been underlying themes for some senior theses and faculty have willingly engaged with students in their research. Selected titles for climate change or sustainability theses include:

- **Windmills: Their Importance in Today's Society and the Physics that Governs their Operation**
- **Breaking the Black Box: An Introduction to the Fundamentals of Climate Modeling**
- **An Analysis of Ground Source Heat Pumps and Their Application**
- **Keep ME Warm: Practicality of Photovoltaic Systems and Solar Space Heating in Maine**
- **Adapting Conservation Plans to the Potential Effects of Climate Change: a case study with Three-Birds Orchid** *(Triphora trianthophora)*
- **Assessing and Reducing Bates' Greenhouse Gas Emissions**
- **Using the Millennium Development Goals as a Framework for Environmental Sustainability in Sub-Saharan Africa: Prospects for Effective Implementation**
- **Seeing the wind: The Danish case of wind energy policy**
- **Green Design vs. Modern Conventional Design: A Comparative Case Study of Oakes Hall of the Vermont Law School and Pettingill Hall of Bates College**
- **An Energy Analysis of Organic and Conventional Apple Production**

Research

Some of Bates' faculty members are actively engaged in research that pertains to climate change and sustainability; their specializations span the disciplines. Examples of 2007–2008 publications pertaining to these research areas are:

- **William G. Ambrose Jr., Professor of Biology**
  Renaud, P. E., M. L. Carroll, and W. G. Ambrose Jr. "Effects of global warming on Arctic sea-floor communities and its consequences for higher trophic levels." pp. 139–175 in Duarte, C. and S. Agusti (eds.), *Effects of Global Warming on Polar Ecosystems*, Fundacion BBVA, Madrid, 2007.
- **Holly Ewing, Assistant Professor of Environmental Studies**
  Gutiérrez, Á. G., O. Barbosa, D. A. Christie, E. del-Val, H. A. Ewing, C. G. Jones, P. A. Marquet, K. C. Weathers, and J. J. Armesto. 2008. "Regeneration patterns and persistence of the fog-dependent Fray Jorge forest in semiarid Chile during the past two centuries." *Global Change Biology* 14: 161–176.
- **Beverly J. Johnson, Associate Professor of Geology**
  Bourque, B. J., Johnson, B. J., and Steneck, R., 2008. "Pos¬sible prehistoric fishing effects on coastal marine food webs in the Gulf of Maine." *Human Impacts on Ancient Marine Ecosystems* (eds., T.C. Rick and J.M. Erlandson), University of California Press, Berkeley, p. 165–85.
- **Lynne Y. Lewis, Associate Professor of Economics**
  "Dams, Dam Removal and River Restoration: A Hedonic Property Value Analysis," with Curtis Bohlen and Sarah Wilson. *Contemporary Economic Policy*, April 2008.

Engaging faculty in small-scale research projects that pertain more directly to Bates' climate commitment and sustainability efforts is an area that deserves greater attention. Several faculty members have undertaken these types of projects, e.g., production of biodiesel from the Bates dining hall post-production cooking oil, but we need to engage more faculty in this effort and to prioritize projects.

Campus Life Educational Initiatives

Bates offers a number of ways student, faculty and staff can get involved in and learn about climate change and sustainability outside the classroom. Formal and less formal opportunities occur through invited lectures, movies, panel discussions, community-based projects and committee/club participation.

Each year the Environmental Studies Program, Sustainability Coordinator and other offices and departments at Bates host talks or events with a theme of climate change or sustainability. Recent public lecturers include authors Bill McKibben and Michael Pollan. Frequently academic departments host academicians who specialize in climate change research to present lectures and seminars. For example, Nathan Lewis, an internationally known alternative energy expert and chemistry professor at the California Institute of Technology, presented a lecture entitled "Where in the World Will Our Energy Come From?" in the fall of 2009.

The Environmental Studies Program and the Sustainability Coordinator also host an informal weekly lunch gathering called the "EnviroLunch Series." Open to the entire Bates community, these lunches are a chance to hear about a range of current environmental issues. Guest speakers, students, faculty and staff give presentations on topics relevant to Maine, including sustainability work going on at the College. Topics that have been covered recently include:

- **community-supported agriculture**
- **single-stream recycling**
- **state environmental legislation**
- **Lewiston/Auburn food assessment**
- **Bates' greenhouse gas emissions inventory**
- **Bates' energy use and conservation goals**
- **land use planning and sprawl**

In addition to speaker events and special lectures, Bates makes sustainability part of campus life. Each year at fall orientation, students receive a *Sustainable Bates* canvas bag, information about how to sign up for Zipcars (hybrids) and a newsletter about getting involved with sustainability initiatives on campus.

Whenever possible, the Dean of Students Office works to create a yearlong theme around sustainability connecting orientation with a prominent event and/or speaker later in the year. For example, the 2009–2010 theme is *Changing the Climate Through Art and Action*. Beginning with the first year common reading, students were introduced to "Project 350," foreshadowing a semester's worth of campus and community action around climate change.

Additional opportunities for involvement and learning about sustainability and climate change are woven into campus life in many ways throughout the year.

- **Student residential life staff (JAs and RCs) are trained to be a resource on sustainability (how to recycle, use campus transportation, conserve energy, etc.) and they often focus their educational programs on sustainability.**
- **Bates sponsors an environmental residential theme house on campus.**
- **The Sustainability Coordinator runs a series of outreach programs with a team of student EcoReps on peer-to-peer education.**
- **Two student-run environmental clubs actively engage students.**
- **Two faculty/staff/student committees work on environmental issues: the Energy Task Force (ETF) and the Committee on Environmental Responsibility (CER).**

Community Outreach

A new upper level ES capstone seminar requires the ES majors to use and expand their "expertise" by addressing community issues. In the fall of 2009 students worked on four different projects that centered on assessing local food production, its distribution and deficiencies, i.e., the sustainability of urban food. We anticipate that topics for future capstone seminars will continue to focus on local environmental sustainability and/or climate change.

The Sustainability Coordinator partners with local organizations and groups whenever possible to collaborate on energy and climate change projects including:

- **Project 350, an international effort encouraging local communities to call attention to climate change**
- **The Lewiston/Auburn Winterization program to improve energy efficiency in low-income homes throughout Androscoggin County**

Bates also assists students with placement in environmental internships. The ES Program in particular requires all of its majors to complete a minimum of a 200-hour internship with an environmentally focused government agency, business or nonprofit organization. Examples of internships that have been completed and focused specifically on sustainability and/or climate change include:

- **City of Lewiston — Greenhouse Gas Emissions Inventory**
- **Maine Preservation — Green Building Conference**
- **Appalachian Mountain Club — Atmospheric Deposition Study**
- **Natural Resources Council of Maine — Clean Energy Campaign**

Additional efforts are under way to prepare students to work with communities wanting to complete greenhouse gas emission inventories and implement weatherization programs. We hope these internship opportunities will continue to expand, allowing more students to work directly on climate change issues.

Financing //

Business as Usual

Together the strategies of energy conservation, using natural gas to fuel the central heat plant, the continued purchase of green electricity, implementation of energy efficiency projects and green building practices represent “business as usual” (BAU) at Bates College. This is far from a “do-nothing” scenario BAU typically suggests. In many ways this is an acknowledgement of the best practices already in place and the work already under way. In most cases, these strategies are cost-saving measures, already funded through the College’s operating budget.

Reducing the amount of energy consumed by the College through conservation measures such as engaging the school community in behavioral changes and/or making changes to College operations has a zero cost of implementation. These efforts can be implemented immediately. The payback on these efforts is instantaneous and easily sustained. It is estimated that implementation of energy conservation strategies could provide annual energy savings of $134,000.

One operational strategy that has the potential to be a future expense (and will be re-evaluated if the cost rises above No. 2 fuel oil) is our commitment to the use of natural gas in the central plant where economically feasible. Our central heating plant has the capacity to burn both oil and natural gas, and the College has traditionally used the lowest cost fuel (which at present is natural gas). This is beneficial because on both a per unit (gallons and therms) and heat content (British thermal units) basis natural gas has a smaller carbon footprint.

Related to this is the College’s current practice of purchasing of green power. The cost for this is currently around $73,000 annually.

Concurrent with the development of this Climate Action Plan, Bates’ Energy Task Force (ETF) developed an inventory of more than 230 energy efficiency projects. These projects have a total estimated capital cost of more than $1,305,000. The ETF is working to implement these projects over time, using an existing operating budget of $250,000 per year. The ETF will continue to develop additional energy savings projects and pursue those with a beneficial simple payback.

The energy efficiency projects developed by the Energy Task Force address the need to improve efficiency of existing buildings. In order to address the need for energy efficiency in future College facilities, Bates will continue to develop its green building practices.

We estimate it would cost $4,100,000 for incremental energy efficiency measures in the renovations and new construction planned under the Campus Facilities Master Plan Update. This represents just over $4/gross square foot of built space for additions and renovations contained in the Campus Facilities Master Plan Update. This cost is roughly 1.5 percent of the baseline cost of building new and 3 percent for renovation, with paybacks usually in the 5 to 10-year range.

Business as usual costs are largely incorporated into existing operating budgets. Below is a summary of costs associated with each of the three options we analyzed for achieving climate neutrality.

Option 1: Climate Neutral Now

The climate neutral now scenario proposes offsetting all emissions remaining starting in 2010 after the purchase of green power. Emissions reductions from energy conservation and efficiency measures as well as green building design under business as usual would incrementally reduce the need for offsets as the campus grows, but no additional mitigation strategies would be pursued on-site.

The only capital cost to Bates for achieving climate neutrality now through offsets would be the cost of purchasing offsets. Net emissions in FY 2010 total 10,383 MTCDE (after the purchase of RECs). Assuming a cost of $5/MTCDE for offsets, the annual capital cost would be approximately $51,915. This need would grow as the campus grows. Table 7-1 shows the costs associated with Option 1:

Table 7-1 Climate Neutral Now - Option 1

Mitigation Strategy	Capital Cost ($ 2009)	Annual Energy Savings ($ 2009)	Simple Payback (Years)	Emissions Reduction (MTCDE)	Reduction Cost ($ 2009/ MTCDE)
Energy Conservation	-	-	-	-	-
Green Electricity	-	-	-	8,569[1]	-
Energy Efficiency	-	-	-	-	-
Green Building	-	-	-	-	-
Offsets	$51,915	-	-	10,383	$5

[1] *No capital cost for green electricity is carried as it is currently budgeted as an annual operating expense.*

Option 2: Climate Neutral in 2020* [Planned]

By 2020, the new construction and renovations planned under the Campus Facilities Master Plan are expected to produce emissions reductions from conservation, efficiency, green building design and the continued purchase of green electricity. *Climate Neutral in 2020* Option 2* goes beyond these BAU reductions with the replacement of fossil fuel boilers at the main steam plant with a biomass cogeneration system. Together, these two mitigation strategies will reduce emissions by more than 8,300 MTCDE, bringing on-site reductions to 60 percent of gross emissions.

The incremental capital cost to convert the main steam plant to biomass is estimated at $5,500,000 and will provide an estimated annual savings of $700,000. In addition to biomass boilers a steam cogeneration turbine would cost $1,500,000. This will provide an estimated energy savings of $183,302 while further reducing emissions by 816 MTCDE. These strategies are summarized in the Table 7-2.

Table 7-2 Climate Neutral in 2020* - Option 2

Mitigation Strategy	Capital Cost ($ 2009)	Annual Energy Savings ($ 2009)	Simple Payback[1] (Years)	Emissions Reduction (MTCDE)	Reduction Cost ($2009/ MTCDE)
Energy Conservation	-	$134,215	Immediate	1,430	-
Energy Efficiency	-	$150,922	8.65	1,610	-
Green Building	-	$266,006	6	1,092	$1,464
Green Electricity	-	-	-	5,585	-
Biomass	$7,500,000	$560,000	13.4	7,279	$1,030
Cogeneration	$1,500,000	$183,302	10.6	816	$1,838
Offsets	$13,700	-	-	2,740	$5

[1] Simple payback is based on total annual benefit & not solely upon annual energy savings. Total energy benefit takes into account increased maintenance, etc.

Through the implementation of biomass and cogeneration, Bates will reduce the emissions reduced through the purchase of RECs (from 8,569 to 5,585 MTCDE) and offsets (from 10,392 to 2,740 MTCDE) needed to achieve climate neutrality.

Costs associated with this plan have been built into the Campus Facilities Master Plan Update and are currently being evaluated to determine what portion could be financed and what portion could be fundraised.

Option 3: Climate Neutral in 2020*

Option 3 builds on Option 2, adding wind and photovoltaic renewable energy generation systems to campus. These additions would not reduce gross emissions because Bates' electricity is already mitigated through the purchase of RECs. They would reduce the amount of RECs we purchase.

The Wind Energy Generation System has an anticipated capital cost of $2,700,000, with an annual electric energy benefit of $221,680 exclusive of demand savings. Photovoltaic (PV) energy systems include several systems anticipated to be placed at various locations across campus. The cost for the implementation of the PV projects included in this plan is estimated to be $7,900,000, with an annual electrical energy savings of $178,822. The total need for the implementation of Climate Neutral 2020 – Option 3 is $17,612,090, as is shown in Table 7-3 Below:

Table 7-3 Climate Neutral in 2020* - Option 3

Mitigation Strategy	Capital Cost ($ 2009)	Annual Energy Savings ($ 2009)	Simple Payback[1] (Years)	Emissions Reduction (MTCDE)	Reduction Cost ($2009/ MTCDE)
Energy Conservation	-	$134,215	Immediate	1,430	-
Energy Efficiency	-	$150,922	8.65	1,610	-
Green Building	-	$266,006	6	1,092	$1,464
Biomass	$7,500,000	$700,000	13.4	7,279	$1,030
Cogeneration	$1,500,000	$183,302	10.6	816	$1,838
Wind	$2,700,000	$221,680	10.8	1,085	$2,488
Photovoltaic	$7,900,000	$178,822	36.7	797	$9,903
Green Electricity	-	-	-	4,025	-
Offsets	$12,090	-	-	2,418	$5

[1] Simple payback is based on total annual benefit & not solely upon annual energy savings. Total energy benefit takes into account increased maintenance, etc.

For financing purposes each of the major mitigation strategies are estimated at full cost, inclusive of design and construction fees. The fees are fully burdened, not including incentives that are available from state and federal governments, local utilities, the regional grid operator and the sale of various environmental attributes (e.g., RECs, NOx, CO2). No escalation has been included with costs and savings estimated in 2009 dollars.

The CAP As A Dynamic Plan //

Policy & Technical Changes

Bates anticipates that the future will bring changes that will affect not only how we use energy, but how it is generated and distributed. One area where we foresee future change is the establishment of a nationwide Renewable Portfolio Standard (RPS). The federal government will likely require electrical generation utilities to ensure that a certain percentage of their generation assets are from renewable sources such as wind, solar or hydropower facilities. This RPS is a means to encourage the development and use of renewable energy technologies on a commercial scale, and will help reduce the carbon intensity of our electrical grid. As of today, many states have established a RPS, and have targets that require greater percentages of renewable energy generation assets over a given time period.

Another anticipated development is the move toward distributed generation systems and the development of a "smart grid." Distributed generation incorporates smaller, more numerous, yet closer to end user sources of electrical generation. Because these systems effectively put the generation asset closer to the end user, associated transmission and distribution losses are reduced compared to our current grid system. Smart grid technologies are currently being researched and developed. The goal of the smart grid is to better allocate the use and availability of grid-based assets by providing intercommunication among generation and distribution points and creating greater efficiencies and economy of use.

Additional technological changes will likely have a great impact in the future. Bio-based photovoltaic cells and fuels, carbon capture and sequestration technologies, advanced fuel cell technologies, and efficiency improvements of heating, cooling, electrical and transportation equipment are likely to provide sustainable alternatives to our energy needs. What form or within what time frame these technological changes will occur is a matter for great anticipation and speculation.

Tracking Progress

The purpose of this section is to define, subsequent to the adoption of this Climate Action Plan (CAP), a process by which we can track progress toward our goal of achieving climate neutrality. Assessment of progress toward this goal is not limited to the achievement of climate neutrality alone; it also includes a method by which we can determine our success integrating sustainability into the fabric of the College and the community's collective knowledge.

As conventional wisdom dictates: What gets measured gets managed, and this holds true for our campus emissions. Therefore we endeavor to update our greenhouse gas emissions inventory every two years. Along with the updated inventory, the Sustainability Coordinator along with the Committee on Environmental Responsibility will prepare a simple narrative summary reporting:

- **Mitigation strategies undertaken for the fiscal year**
- **Campus emissions**
- **A comparison of emissions with emission projections contained in the CAP**
- **Explanations for significant difference between emissions and projections, and possible remedies**

Every five years the CAP will be reviewed and revised to reflect changes in the Campus Facilities Master Plan. This revision will also provide an opportunity for a review of changes in technology, energy and markets for environmental offsets, and financing mechanisms. Most importantly this review will allow us to consistently re-evaluate our progress in achieving milestones and our target date for climate neutrality.

Appendix A Methodology, Boundaries & Assumptions //

Methodology

In order to calculate the greenhouse gas emissions, the Campus Carbon Calculator, developed by Clean Air-Cool Planet (CACP), was used. The calculator contains a series of spreadsheets created by Clean Air-Cool Planet in collaboration with many others, and contains data and calculations, including but not limited to the Intergovernmental Panel on Climate Change (IPCC) Third Assessment, the U.S. Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID), Energy Information Administration (EIA) and the World Resources Institute (WRI). Following IPCC and WRI guidelines, the emissions calculated for Bates have been converted to metric tons carbon dioxide equivalent (MTCDE). This unit is used to report total releases by Scope (Sector) and summarize the Bates greenhouse gas inventory. A copy of the input into and summary information from the CACP calculator are provided in Appendix A, Greenhouse Gas Emissions Inventory. During the process of assessing our emissions the CACP calculator has undergone several revisions. The emissions inventory information presented in Appendix A was entered into and calculated with version 6.4, the most current calculator available from CACP at the time this report was prepared.

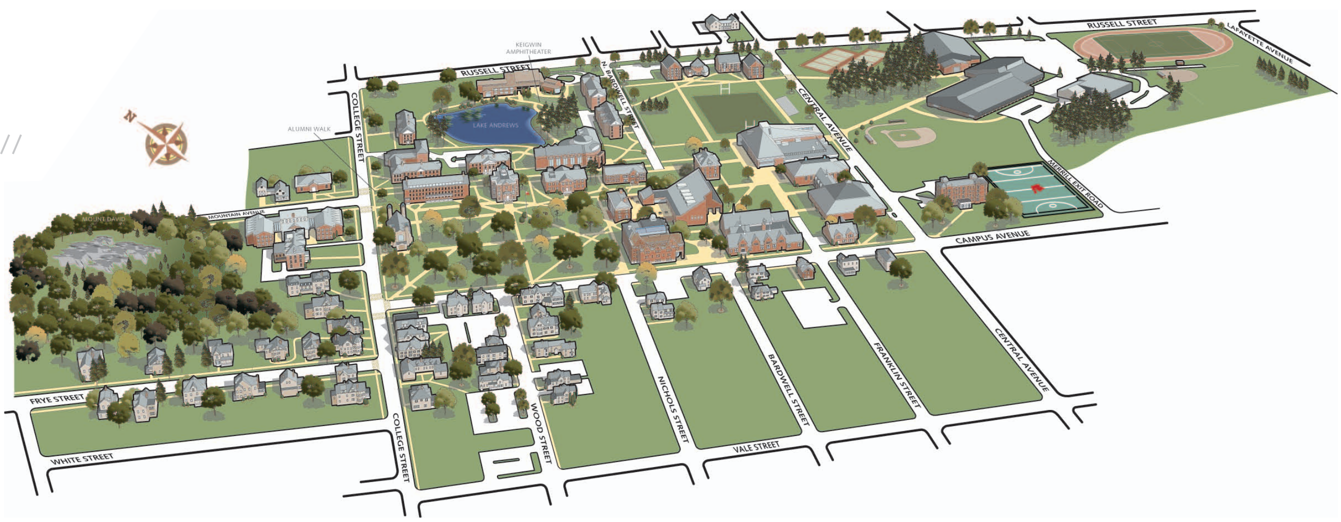
Data were obtained from offices at Bates including Physical Plant, Dining Services, Human Resources and Institutional Research. The annual data reflect a period from July 1 through June 30, the Bates fiscal year (July to July), not the calendar year. As is typical of any data-gathering undertaking, data were not available for every year of the study for each sector. However, the data obtained were sufficient to interpolate and thereby complete a comprehensive emissions inventory. The available data were entered into the appropriate spreadsheets and emissions output determined. Bates has now calculated greenhouse gas emissions for multiple years and the quality of the input data has grown with each subsequent year. Remaining assumptions are included in Section 7 of this report. The emission estimates for on-site energy generation and purchased energy are based on regional and national average emission factors for the various fuels used. Included in the waste section are emissions associated with the incineration of solid waste generated by the College. The refrigeration section examines the release of HFC and PFC refrigerants that are primarily from the on-campus chilled water plants.

As would be expected, there are several sources of emissions that are not included in this inventory. For example, the emissions generated by the production and transportation of materials purchased by Bates are not included in the inventory, as they would fall outside of the "boundaries" of Bates control. In addition, the emissions resulting from students/faculty/staff off-campus activities and student commuting/transportation are not estimated. Bates has elected to omit data for student commuting based upon the fact that 96 percent of students live on-campus and the remaining 4 percent are located within walking distance to campus, rendering an analysis of commuting mileage and habits ineffectual. These omissions do not imply that these sources of greenhouse gases are insignificant. Rather the inventory focuses on emission sources that are, for the most part, directly under the control of Bates. The intent of the inventory is to provide a basis on which to develop an environmentally and economically sound greenhouse gas reduction policy for Bates College.

Boundaries

As with any benchmarking or measurement activity, there must be limits or boundaries on what data, activities or time frame within which we will work. The physical boundaries for Bates' GHG inventory were limited to the on-campus buildings, generation assets, the electrical energy consumed by on-campus buildings, activities that occur on-campus, faculty and staff commuting, waste generation and disposal, and College-sponsored air travel and study abroad. With the exception of the last two items, the boundaries for the inventory are limited to the main Lewiston, Maine, campus, and do not include any of our satellite campus/educational locations.

The temporal boundaries for the inventory span the fiscal years 2000 to 2009 for the CAP. The FY2009 data was collected for the main campus buildings, and for those small buildings/rental properties located south of Campus Avenue along Campus Avenue, Wood Street, Frye Street, Nichols Street, Bardwell Street, Franklin Street, College Street, Mountain Avenue and Russell Street, as shown on the map below:



Assumptions

The following is a listing of assumptions and *a priori* conclusions that were used in the collection of data, analysis of data, projection of future campus greenhouse gas emissions and effects of mitigation strategies, all of which have been included in the preceding Climate Action Plan. Assumptions are organized by section of this report.

Campus Emissions

- Students were not included in the baseline GHG calculations for commuting. As 96 percent of the student body lives on campus, and the remaining 4 percent are located within walking distance, we felt that they had no significant impact on the emissions associated with commuting.

- Campus fleet fuel usage was obtained in either of two methods, depending on the year in which the data was collected: 1) Actual fuel purchases were tracked/collected or, 2) mileage was tracked and the estimated fuel economy for each make and model of vehicle was applied to determine fuel usage for the campus fleet.
- It is assumed that our Central Heating Plant will use natural gas as its fuel for the years 2010 and beyond, until the end of its useful life or until it is replaced by another technology.
- It is assumed that we will not connect our "small housing" to the central plant at campus.
- It is assumed that when we renovate our small housing, the furnaces installed will be natural gas fired if natural gas is available nearby.
- It is assumed that the "green power" purchased by Bates is for that electrical energy purchased for our large and medium service accounts, and not by the small housing we own.
- Emissions attributed to purchased electricity and shown on the distribution graph in Section 2 contain the transmission and distribution losses associated with the electrical use on-campus. The T&D losses have been broken out in subsequent sections.

Mitigation Strategies

- Feasibility and costs used in evaluation and implementation of mitigation technologies are based upon current costs of utilities, equipment and supplies (2009 dollars).
- No provisions have been made for future policy changes and regulatory action or initiatives. It is assumed that all potential mitigation strategies will remain viable alternative going forward.
- Bates evaluated ground source heat pumps using calculation methodology set forth by J. Hanova and H. Dowlatabadi in their study entitled "Strategic GHG reduction through the use of ground source heat pump technology" and published by the Institute of Physics in its Environmental Research Letters (Environ. Res. Lett. 2 (2007) 044001 (8pp)).

Other/Miscellaneous

- The Business as Usual Case set forth in Section Two utilizes the 2009 national fuel mix and electrical grid region as default values. The associated emissions values for these two items were subsequently normalized to MBTU per gross square foot for each of the two commodities, and projected growth in square footage and year was then applied to generate the emissions growth model/projection of both on-campus stationary sources and purchased electricity.
- The Business as Usual Case as set forth in Section Two and the associated projection that shows the effects of mitigation strategies has not been normalized for student and faculty/staff growth. These numbers remain constant as we do not anticipate growing the institution in term of these items. The default values used are 1,700 students and 700 faculty and staff.

Climate Action Plan

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