2009

Carbon Neutral Plan

Prepared by the
Presidential Task Force on the Environment

http://www.holycross.edu/sustainability

Holy Cross

College of the Holy Cross

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Published September 2009

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Executive Summary

Rev. Michael C. McFarland, S.J., president, signed the American College and University Presidents Climate Commitment on Sept. 15, 2007, earning Holy Cross charter member status. This visionary commitment has energized the campus to move in a new direction with the greater good of the community and environment as a priority.

The College-wide commitment in this area is rooted in the College's Jesuit values. When the 35th General Congregation of the Society of Jesus met in January 2008, it reaffirmed the call of the former Superior General, Fr. Peter-Hans Kolvenbach, to all "Jesuits and those who share our mission to show ever more effective ecological solidarity in our spiritual, communal, and apostolic lives … to move beyond doubts and indifference to take responsibility for our home, the earth."

In that spirit, numerous changes have taken place on the Holy Cross campus including:

- Inventory of campus emissions
- Very active environmental task force with methods for any community member to submit a sustainability suggestion, idea, concept or project utilizing a newly developed environmental Web site
- Community garden that will produce food for the main dining hall as well as the less fortunate members of surrounding communities
- Trayless dining that has significantly reduced food consumption, waste, water and energy usage
- Increased activity among student environmental organizations
- Student-run Eco-Action group organized a "Trash for Treasure" end of year event where unwanted student clothing, food and furniture donations were collected and distributed to local charities
- Student initiated wind power feasibility study in progress utilizing a grant from the Massachusetts Technology Collaborative

The environmental education and community outreach efforts are achieving new levels of success each year. The Environmental Studies program is a runaway success. A new sustainability Web site is up and running at http://www.holycross.edu/sustainability, task force members have been making classroom presentations and, starting September 2009, there will be two student environmental positions in each residence hall.

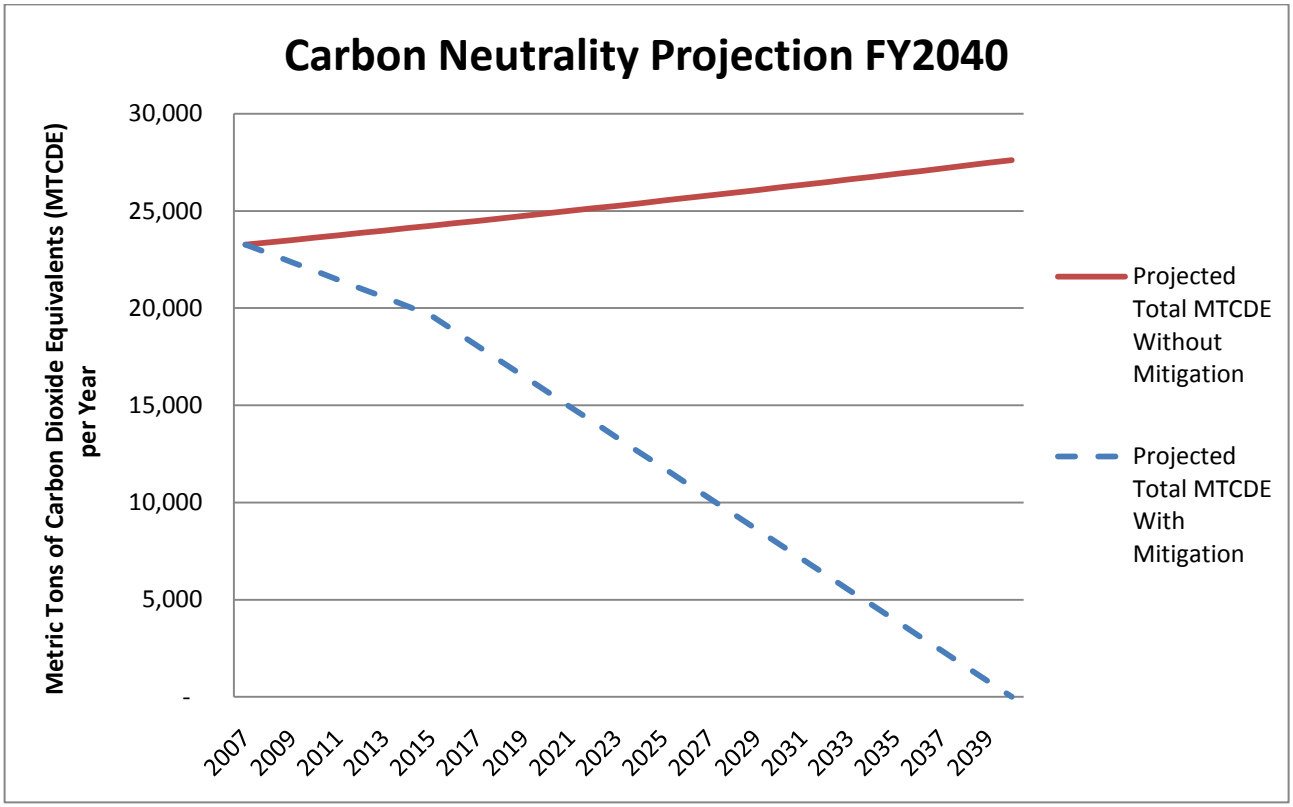
The task force has established a first milestone goal of 20 percent carbon reduction by the year 2015. This is a challenging but achievable goal. The College has already demonstrated a significant drop in greenhouse gas emissions since 2007 with the procurement of electricity from a source with a large hydro-electric component. Numerous capital projects have taken place to reduce energy consumption, and a new energy policy has been developed and implemented to reduce energy consumption on campus.

Three key mitigation strategies to achieve this goal include:

- Fuel switching in the campus boiler plant;
- Electricity conservation measures and selective energy purchasing; and
- Behavioral changes which will affect both fuel and electricity use.

A long range goal of climate neutrality by fiscal years 2030 to 2040 is more challenging and relies on future technology development. However, these dates are consistent with longer range goals which are being set on a global scale. For example, the United Kingdom is contemplating a goal of removal of all petroleum fueled vehicles from the roads by 2040; the countries of Cost Rica and Norway aim to be fully carbon neutral by 2030; and the Commonwealth of Massachusetts is targeting 2050 for an 80 percent reduction in carbon dioxide equivalents relative to 1990 baseline levels.

The following chart represents a projection of carbon output without mitigation and with mitigation on campus. :



The College is making campus related carbon reduction a priority and is not considering the purchase of carbon credits until all other options are exhausted. It is likely that there will be significant technological developments to produce clean energy and make equipment much more energy efficient long before the year 2040. This should provide many cost effective opportunities to achieve this challenging goal. It would be impossible to have a clear path to the long term goal at this time. However, the environmental task force is now in place to evaluate and implement new technologies and spearhead efforts to make this goal a reality.

Funding to achieve these goals will be a challenge. The College has always invested wisely in infrastructure and plans to continue doing so. Considering the difficult current economic climate in which limited funds are available, the College is still keeping a long range outlook and investing significant capital repair and renovation funds wisely by replacing inefficient equipment with modern, highly efficient ones. In addition

to this funding, the Development Office has been asked to consider seeking specific donations toward sustainability initiatives.

Project Participants

The Presidential Task Force on the Environment at the College of the Holy Cross consists of members from many different areas of the campus community. There are regular monthly meetings with participation of all members.

Current Task Force Members

- Scott Merrill (Co-Chair), Director of Physical Plant
- Katherine Kiel (Co-Chair), Associate Professor, Economics
- John Cannon, Associate Director of Physical Plant
- Loren Cass, Associate Professor, Political Science
- Eileen Cravedi, Access Services Librarian
- Marty Dudek, Assistant Director of Dining Services
- Kristine Goodwin, Associate Dean for Student Life
- Harold Knapp, Associate Director, ITS
- Art Korandanis, Director of Auxiliary Services
- John Lapomardo, Assistant Director of Physical Plant
- Nikolas Markantonatos, Managing Editor/Web Communications, Public Affairs

The task force also has two student positions to represent a student-run environmental group and the student body. Sarah Bolthrunis represented Eco-Action until her graduation in 2009. Maria de la Motte will represent Eco-Action starting September 2009. Melissa Ogonowski represented the Student Government Association in her role as the director of environmental concerns until her graduation in 2009. Elena Rogliano will represent the SGA starting in September 2009.

Jane Van Doren, a chemistry professor and original task force co-chair, was a driving force behind the task force. She has since moved on to another institution, and her contributions are greatly appreciated.

The task force is also supported with four subcommittees with a specific focus. The subcommittees and the membership include:

1. Task Force Communications
   Subcommittee Charge: Develop and implement a communications plan for the task force.

   John Cannon (chair)
   Nancy Costello
   Nikolas Markantonatos
   James Walsh
   Sarah Bolthrunis
   Joyce O'Connor Davidson
   Terence McCoy '10

2. Recycling/Waste Reduction
   Subcommittee Charge: *Assess and improve recycling/waste minimization on campus.*

   Jesse Baptista
   Eileen Cravedi (chair)
   Selina Carter
   Cathleen Doane

Margaretmary Gilroy
Kristen Gleason
James Pinkerton

3. Sustainability Projects

Subcommittee Charge - Review and evaluate suggestions and projects submitted to the task force.

Rory Banim
Harold Knapp (chair)
Linda Nardella
Rebecca Riopel
John Tardiff

4. Educational Initiatives

The Environmental Studies (ENVS) Committee, composed of representatives of the faculty teaching in the Environmental Studies program, has served as the task force's Academic Subcommittee.

Loren Cass (chair)
Robert Bertin
Sarah Bolthrunis
Katherine Kiel
Catherine Roberts

Project Background

The College of the Holy Cross is a residential college with approximately 2,800 students and 1,100 faculty and staff. Rev. Michael C. McFarland, S.J., is the president and a charter signatory of the American College and University Presidents Climate Commitment (ACUPCC). The official signatory date for Holy Cross was Sept. 15, 2007. As a signatory the College committed to:

- Selection and implementation of two "tangible early actions";
- Development of a comprehensive plan to achieve climate neutrality, including work on supporting greenhouse gas inventories; and
- Publicly disseminate action plans, inventories, and periodic progress reports.

In order to accomplish development and implementation of early actions and plans, Fr. McFarland appointed an environmental task force composed of faculty, staff and students. The task force has been working on climate change initiatives at Holy Cross beginning in the fall of 2007. Since that time, Holy Cross has completed the following climate related activities:

- Selected and implemented two "tangible early actions"[1];
- Developed a baseline greenhouse gas inventory for fiscal year 2007 and a subsequent inventory for fiscal year 2008;
- Developed projected detailed greenhouse gas inventories for future fiscal years 2009, 2010 and 2015;
- Developed a conceptual greenhouse gas inventory for fiscal year 2030 – 2040; and
- Publicly disseminated the greenhouse gas inventory for fiscal year 2007 through both the ACUPCC program and the recently developed Holy Cross sustainability Web site.

[1] The tangible early actions selected by Holy Cross were preferred specification of Energy Star equipment and adoption of a Green Building policy.

This document, the "College of the Holy Cross 2009 Carbon Neutral Plan" is intended to serve as a first step toward a comprehensive plan to achieve climate neutrality. Holy Cross anticipates that further planning will be necessary as technology and mitigation measures evolve and mature. Measures that can be implemented to reduce direct and indirect greenhouse gas emissions generated by the campus activities are not currently available to the extent needed to achieve true carbon neutrality. Thus, an iterative planning process will be necessary.

Education and Outreach

2008-2009 Climate Education and Outreach Activities

The Presidential Task Force on the Environment has taken the lead in the past year in raising awareness of the American College & University Presidents Climate Commitment and creating opportunities to educate the campus community about the College's plans to achieve carbon neutrality in the future. The Environmental Studies (ENVS) committee, composed of representatives of the faculty teaching in the Environmental Studies program, has served as the Task Force's academic subcommittee. During the 2008-2009 academic year, the ENVS Committee was composed of chair Loren Cass (director of Environmental Studies, political science), Robert Bertin (biology), Sarah Bolthrunis '09, Katherine Kiel (economics), and Catherine Roberts (computer science and mathematics). A list of the most important educational and outreach activities is included below along with a set of priorities for the 2009-2010 academic year.

- John Cannon, associate director for planning and operations in Physical Plant, has developed a presentation which he has made to four groups on campus involving approximately 50 participants in discussions of how to reduce Holy Cross' carbon footprint.
- Nikolas Markantonatos in Public Affairs has developed a Web site (http://www.holycross.edu/sustainability/) dedicated to the College's environmental initiatives with an emphasis on the College's climate commitment. The site has become an excellent communication tool as well as a central location to solicit ideas from the campus community for improving the College's environmental performance.
- The student-led Environmental Concerns Organizations (Eco-Action) has taken the lead in educational efforts directed at students on campus to promote conservation and recycling. Eco-Action's Web site (http://sites.google.com/a/holycross.edu/eco-action/) provides useful links for students and information about student led environmental initiatives. Eco-Action has contributed frequently to environmental debates on campus through op-eds to the *Crusader* (the campus newspaper). Eco-Action is also a part of the national "Campus Climate Challenge" and has been working to educate students about renewable and clean energy options.
- The Environmental Studies Program (ENVS) has also been active in seeking to provide students with the information and skills that they need to understand the complex environmental and energy challenges that society faces today. The ENVS program has provided courses in biology (fresh water ecology, general ecology, global change biology, and conservation biology), economics (environmental economics and energy economics), geology (environmental geology and global climate change), mathematics (environmental math), physics (energy and the world citizen), political science (comparative environmental policy, global environmental politics, public policy, and politics of development), as well as in the humanities (environmental philosophy, religion and ecology, ecology and theology, memory and landscape, and environmental history).

2009-2010 Climate Education and Outreach Priorities:

- The Presidential Task Force on the Environment will continue to lead efforts to educate and inform the campus community about the College's climate commitment. It will also act as a central clearing house for ideas for improving waste reduction, energy conservation, and recycling.
- Eco-Action will continue to pursue its environmental education agenda.
- The task force, Eco-Action, and the Environmental Studies program intend to more closely coordinate their efforts with a particular emphasis on educating the incoming freshman class on environmental and sustainability issues. There is a specific effort to integrate environmental concerns into Montserrat, a program designed to help first-year students enhance their academic and campus experiences.
- The task force is considering hiring work study and/or academic interns to help gather and organize information to improve the College's environmental performance.
- The Environmental Studies program will seek to increase the number of course offerings as well as environmental internship and research positions to continue to expand the opportunities available to students and prepare them for future work related to energy and the environment.

Greenhouse Gas Inventories

Holy Cross prepared the baseline inventory for fiscal year 2007, and subsequent inventories for fiscal year 2008 and fiscal year 2009. Due to the timing of publication of this report, the fiscal year 2009 inventory represents a blend of actual and projected emissions. In addition to the current inventories, projections have been made for fiscal year 2015 as well as the fiscal year 2030 to fiscal year 2040 timeframe. These projections reflect expected emissions if no mitigation measures are implemented. Greenhouse gas emissions are expressed in Metric Tons of Carbon Dioxide Equivalents (MTCDE). This is a common metric used to express the global warming potential of emissions of six greenhouse gases regulated under the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Inventory Methodologies

The methodology used to prepare the Holy Cross greenhouse gas emission inventories generally follows the recommendations of the ACUPCC, as published in their Implementation Guide (September 2007, v. 1). The ACUPCC Implementation Guide recommends use of detailed methodologies published as the Greenhouse Gas Protocol (http://www.ghgprotocol.org/) and Clean Air-Cool Planet (http://www.cleanair-coolplanet.org/).

In general, Holy Cross used the Greenhouse Gas Protocol, supplemented by the U.S. Environmental Protection Agency (EPA) methodologies for sources which are not addressed by the Greenhouse Gas Protocol. For quality assurance purposes, and to further understand the estimating process, results from the Greenhouse Gas/EPA Protocols were cross-checked against results from the Clean Air-Cool Planet protocol.

During the development of the Holy Cross greenhouse gas emissions inventory, it was found that there was agreement between results between the Greenhouse Gas Protocol and the Clean Air-Cool Planet protocol for the following sources:

- On-campus stationary source fuel use
- Institution owned/controlled vehicles
- Purchased electricity
- Commuting

For air transportation there was a significant difference between the Greenhouse Gas Protocol and the Clean Air-Cool Planet protocol results. The difference was traced to the use by the Clean Air-Cool Planet protocol of a "radiative forcing factor".

The Greenhouse Gas Protocol did not provide guidance regarding methodologies for emission estimating of refrigerant use, waste disposal or recycling credits generation. Holy Cross used methodologies published by the EPA for these sources of emissions and credits.

It was found that there was agreement of results between EPA methodologies and the Clean Air-Cool Planet protocol for refrigerant use.

For waste disposal there was a significant difference between the EPA methodology (as modified for local relevance by Holy Cross) and the Clean Air-Cool Planet protocol. The difference was traced to the use by Holy Cross of a regional mix offset of electric generation (primarily natural gas) versus use by EPA and Clean Air-Cool Planet of a national mix offset of electric generation (primarily coal). The emission estimating methodology is discussed in more detail in the following section which addresses Waste Disposal.

EPA references used in the development of the inventories are:

1. Greenhouse Gases and Global Warming Potential Values – Excerpt from the Inventory of U.S. Greenhouse Emissions and Sinks: 1990-2000. April 2002.
2. Solid Waste Management and Greenhouse Gases, A Life-Cycle Analysis. 3rd edition, 2006.

The following sections present specific information regarding Holy Cross inventory methodologies.

On Campus Stationary Source Fuel Use

Stationary combustion sources on campus include dual-fueled boilers (residual oil and natural gas) for the production of steam used campus-wide, diesel generators[2], natural gas fueled generators[2], and miscellaneous natural gas sources[3]. Greenhouse gas emission estimating methodologies for these sources were straightforward and required no exceptions to the Greenhouse Gas Protocol assumptions and methods. For these sources, as recommended in the Greenhouse Gas Protocol, emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are included in the estimates.

[2] Including reciprocating internal combustion engines.
[3] Including hot water heaters, furnaces, cooking and Bunsen burners.

Raw data sources used to estimate the greenhouse gas emissions include campus fuel purchasing and use records for boilers, hot water heaters, furnaces, and other miscellaneous combustion sources such as cooking and use of Bunsen burners. Raw data sources used for engine emissions are engine operating hours and engine maximum fueling rates. Engines are not typically operated at maximum fueling rates; therefore emission estimates for the engines may be conservatively high. However, engine operation accounts for less than 1 percent of the total for the stationary combustion source greenhouse gas emissions; thus the overestimate is not considered significant.

Institution Owned/Controlled Vehicles

Holy Cross owns a fleet of vehicles which includes trucks, cars and vans. Also included in this inventory category are various sources such as lawnmowers, weed-eaters and miscellaneous mobile equipment such as an excavator and a tractor. Greenhouse gas emission estimating methodologies for these sources were straightforward and required no exceptions to the Greenhouse Gas Protocol assumptions and methods.

Raw data sources used include campus fuel purchasing and records and vehicle mileage data. When mileage data were used, an average fuel economy for each vehicle had to be obtained. The source used for vehicular fuel economy was http://www.fueleconomy.gov. For one make and model of vehicle, fuel economy data were not available at that site and a generalized web search was conducted to obtain it.

Refrigerant Use and Reclamation

Ozone depleting refrigerants are used at Holy Cross in air conditioning units, hockey rink chillers, refrigerators and freezers in fiscal year 2007. Specific refrigerants used are R-22 and R-134a.

Estimation of greenhouse gas emissions of ozone depleting refrigerants is straightforward. The raw data source referenced for the estimates is the College's Refrigerant Use Log. It is assumed that if makeup refrigerant is required when servicing equipment, then losses must have occurred (fugitive leaks) to the atmosphere. By accounting for makeup refrigerant, fugitive leaks are therefore determined.

In order to calculate the MTCDE associated with ozone depleting refrigerants, their individual global warming potentials (GWPs) must be established. The appropriate GWPs were established using the ACUPCC *Implementation Guide*, in conjunction with EPA's *Greenhouse Gases and Global Warming Potential Values – Excerpt from the Inventory of U.S. Greenhouse Emissions and Sinks: 1990-2000*, (April 2002).

Purchased Electricity

Estimates of greenhouse gas emissions per kilowatt-hour (kWh) of electricity purchased may be generic to a region, accounting for the mix of generating capacity in the region, or may be specific to a supplier, accounting for the sources of electric generation or purchase by that supplier.

Holy Cross purchased electricity from two different suppliers during fiscal year 2007. One supplier (Supplier 1) was used early in the fiscal year, and then a second supplier (Supplier 2) was used in the second part of the fiscal year. Supplier 2 used a large percentage of carbon neutral resources to generate electricity (primarily hydroelectric power). Supplier specific emission factors for the timeframe of interest were available from Supplier 2, but not Supplier 1. Therefore, a supplier specific emission factor was used for Supplier 2, and a regional mix emission factor was used for Supplier 1. Holy Cross has continued with the use of Supplier 2 in fiscal years 2008 and 2009, and the supplier specific emission factor has been used for those years.

In addition to electric generation emission factors, losses occur during transmission and distribution to the site. Typical New England transmission and distribution loss percentages were obtained from an environmental report by the local electric distribution company.

Raw data used, in conjunction with the emission factors and the transmission & distribution losses, consisted of purchased electricity records (kWh).

Commuting

Gathering data regarding student, faculty and staff commuting habits can be extremely resource intensive and, depending on community participation, may not result in a representative snapshot of actual activity. Holy Cross used a simplified approach to approximate greenhouse gas emissions from commuting activity, in conjunction with a number of assumptions.

Given a fuel use amount associated with commuting, greenhouse gas emission estimating methodologies for this source were straightforward and required no exceptions to the Greenhouse Gas Protocol assumptions and methods.

In order to approximate the total gallons of gasoline used by students, faculty and staff for commuting, the following assumptions were made:

1. For all those with off-campus residences on record, daily round trip mileage was estimated using a residence zip code to Holy Cross' zip code estimate from http://www.mapquest.com.

2. All off-campus residents were assumed to travel in a single occupancy vehicle with an average fleet mileage from http://www.bts.gov/publications/national_transportation_statistics.
3. All off-campus residents were assumed to travel round trip to campus five (5) days per week and forty-five (45) weeks per fiscal year.
4. All vehicles use gasoline fuel.

A small percentage of Holy Cross students are commuters.

Air Travel

Greenhouse gas emission estimating methodologies for air travel were straightforward and required no exceptions to the Greenhouse Gas Protocol assumptions and methods[4]. In order to use the Greenhouse Gas protocol emission factors, air miles traveled needed to be established and classified by short, medium and long haul trip length.

Holy Cross obtained a compilation of air travel destinations and number of passengers from its travel agents[5]. In order to establish the mileage for each trip, the following assumptions were made:

1. Each flight was round trip.
2. The originating flight and the return flight did not involve multiple take-offs and landings.
3. The originating and return airport for each trip was Boston, Logan Airport.
4. The largest hub airport was selected if there were multiple airports at a destination city.
5. Airport to airport mileage was obtained from http://www.webflyer.com.

[4] The Greenhouse Gas Protocol does not use a "radiative forcing factor" for the purpose of estimating emissions from air travel. Holy Cross accepted this methodology.

[5] Air travel may be purchased by individual faculty and staff members and expensed without the use of the travel agents. Expense reimbursement forms are not readily searchable for air travel destination data at Holy Cross. Therefore, trip miles based on these data are not included in the inventory.

Summary of Current Inventories (FY2007, FY2008 and FY2009)

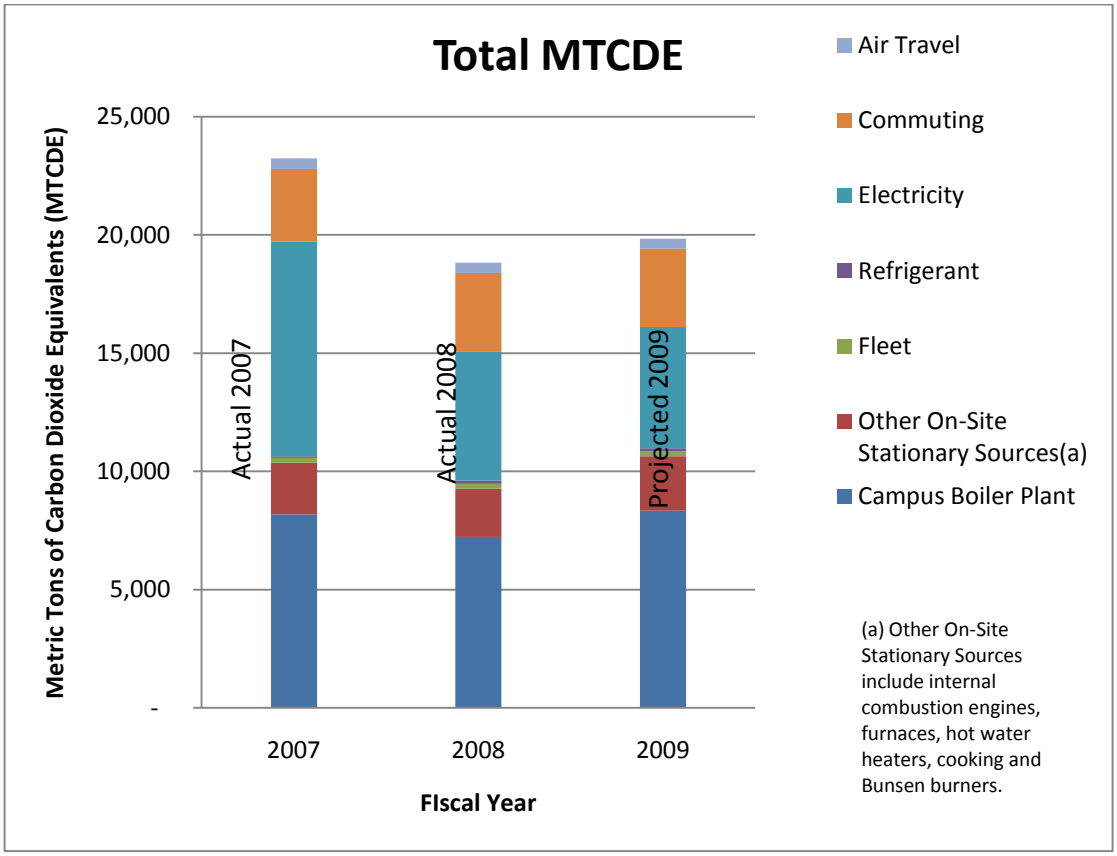
The fiscal year greenhouse gas footprints for fiscal years 2007, 2008 and 2009 are 23,261 MTCDE, 19,020 MTCDE and 20,262 MTCDE, respectively. Mitigation measures have been used at Holy Cross since the baseline year of fiscal year 2007. Specifically, direct emissions from the boilers have been reduced due to fuel switching (increased use of natural gas and decreased use of residual oil) and due to use of an electricity supplier with a significant renewable energy portfolio (primarily hydropower). The sources that contribute to the total greenhouse gas footprint associated with the campus are enumerated in the following table.

Greenhouse Gas Emissions (Metric Tons of Carbon Dioxide Equivalents, MTCDE)

Fiscal Year	2007	2008	2009 Projected
Scope 1 Emissions			
Campus Boiler Plant	8,181	7,227	8,340
Other On-Site Stationary Sources[(a)]	2,189	2,042	2,299
Fleet	199	210	210
Refrigerant	74	129	129
Total Scope 1 Emissions	***10,643***	***9,608***	***10,978***
Scope 2 Emissions			
Electricity	***9,077***	***5,473***	***5,127***
Scope 3 Emissions			
Commuting	3,064	3,316	3,316
Air Travel	458	424	424
Total Scope 3 Emissions	***3,522***	***3,740***	***3,740***
TOTAL FISCAL YEAR FOOTPRINT	**23,242**	**18,821**	**19,845**

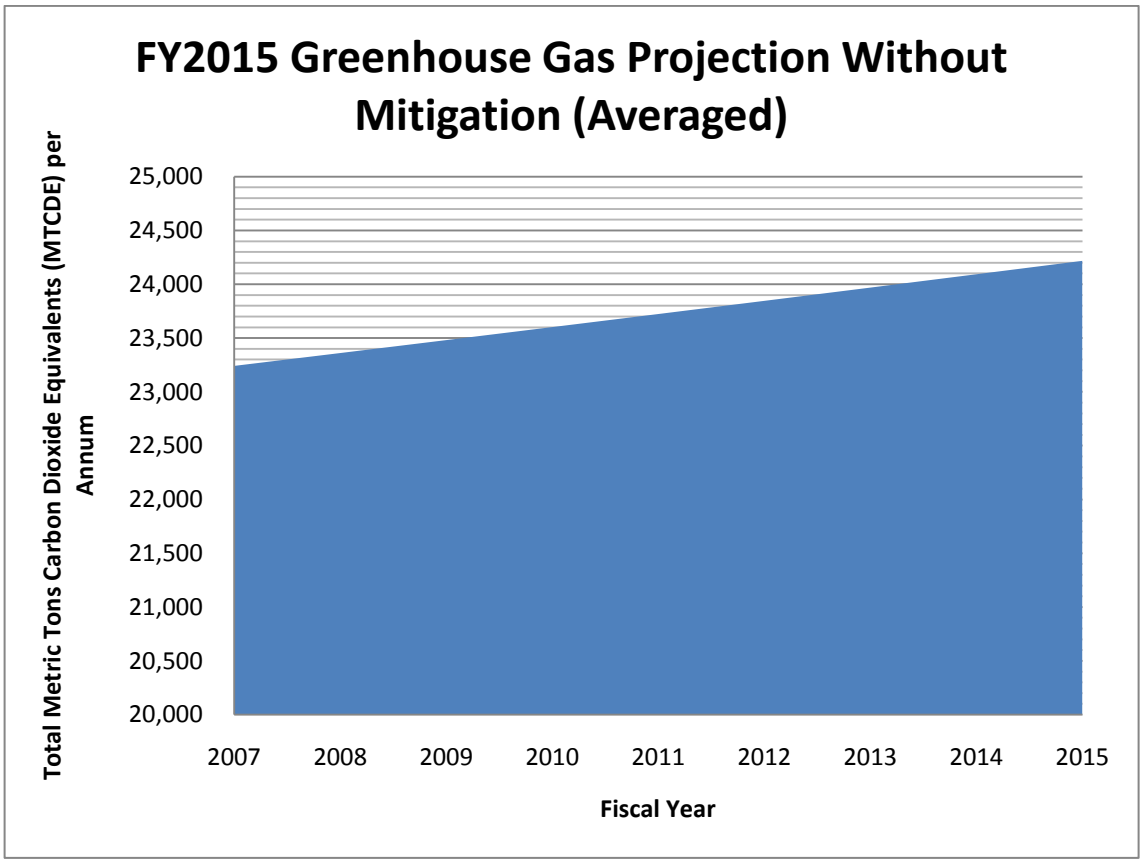
[(a)] Other On-Site Stationary Sources include internal combustion engines, furnaces, hot water heaters, cooking and Bunsen burners.

Relative contributors to the total carbon footprint are shown in the following graph.



Projection for FY2015 Without Mitigation

The Holy Cross student population is not expected to grow in the future. Between fiscal year 2007 and fiscal year 2015, two buildings totaling 101,846 square feet will have been added to the already 2,036,155 square foot campus. This represents approximately 5 percent growth, on a square foot basis, or 0.6117 percent escalation per annum smoothed over 8 years. If boiler, other on-site stationary source, refrigerant and electricity use are escalated relative to fiscal year 2007 at a rate of 0.6117 percent per annum, then greenhouse gas emissions, without mitigation, would be expected to increase to 24,238 MTCDE by fiscal year 2015. For calculation purposes, fleet, commuting and air travel use are considered constant, since they are dependent on student, faculty and staff population which is not expected to grow significantly. The projected growth in greenhouse gas emissions of 4.3 percent over a period of 8 years is depicted in the following graph.



Projection for fiscal years 2030 to 2040 Timeframe Without Mitigation

Additional growth after fiscal year 2015 has been projected at a rate of 0.6117 percent per annum. Although the campus is constrained in size due to a limited parcel of land in an urban area and there are no plans at this time to increase the student population, additional building is anticipated. For purposes of this plan, the greenhouse gas emissions increase projected for the fiscal year 2030 to 2040 timeframe is escalated at a rate consistent with recent campus growth in building square footage. Greenhouse gas emissions at Holy Cross in fiscal years 2030 to 2040, without mitigation, are projected to be approximately 27,600 MTCDE per year.

Greenhouse Gas Emission Reduction Strategies

Holy Cross is committed to reducing GHG emissions by 20 percent on or before fiscal year 2015, relative to the fiscal year 2007 baseline. Holy Cross has tracked energy savings initiatives starting in fiscal year 2006. A list of energy reduction achievements pre-fiscal year 2007 through fiscal year 2010 is provided in Appendix A. Every energy reduction measure implemented reduces Holy Cross' GHG emissions.

Formally Analyzed Strategies for Achieving Fiscal Year 2015 Target

Holy Cross has accounted for campus growth (population and building area) and identified and quantified the results of mitigation measures for projection of GHG emissions in fiscal year 2015. In order to achieve an absolute 20 percent reduction in GHG emissions, the College plans to implement the following measures:

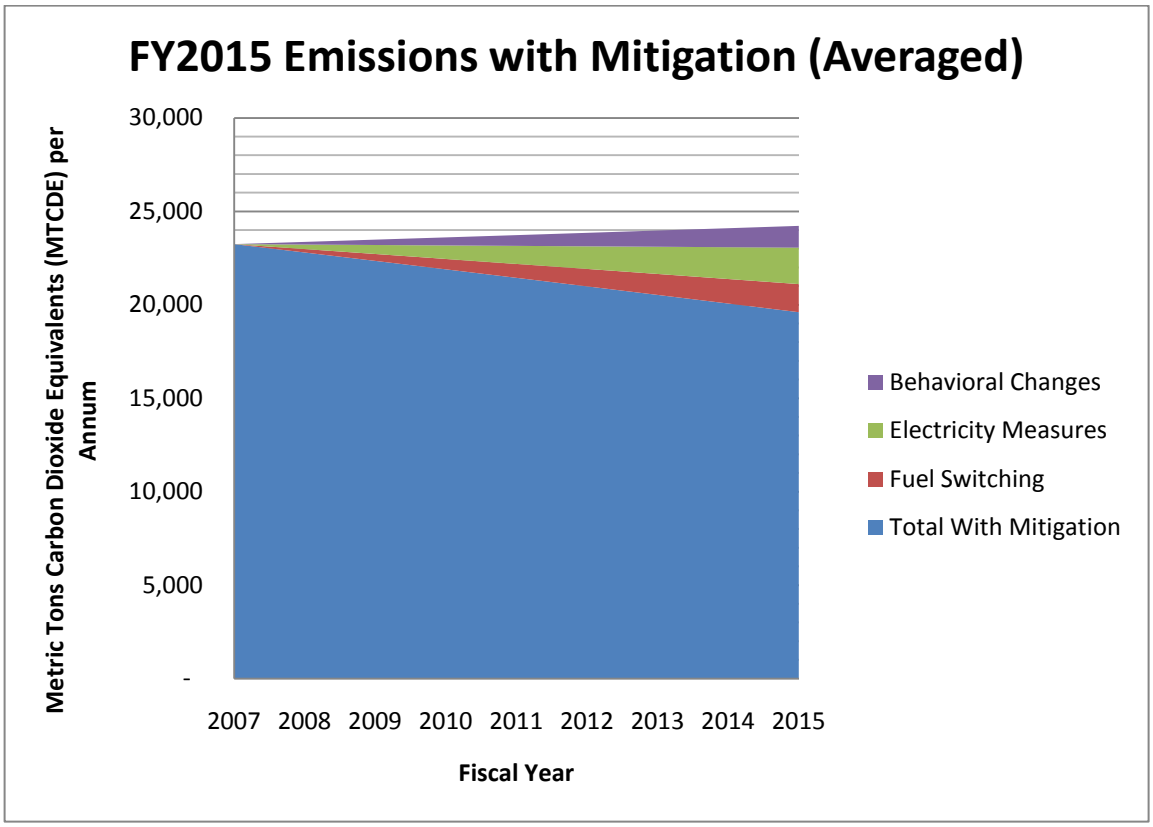
- Fuel switching in the campus boiler plant;
- Electricity conservation measures and selective energy purchasing; and
- Behavioral changes which will affect both fuel and electricity use.

Historically, Holy Cross has saved money on fuel to the campus boiler plant by using dual fueled boilers and switching between natural gas and residual oil as cost dictates. Natural gas pricing is more affordable when a firm supply is not required and interruptible gas can be procured. As a measure to help the College achieve the fiscal year 2015 target, the planned fuel to the campus boiler plant is now from natural gas. That is, no residual oil fueling is planned for the boilers. Fuel switching is estimated to result in a decrease of 10 percent in greenhouse gas emissions on campus.

In order to conserve electricity, a variety of ventilation optimization projects, energy efficient lighting projects and occupancy sensor projects are underway. These projects are expected to decrease electricity use by 5 percent, even considering campus growth in building square footage.

Behavioral changes to be implemented at Holy Cross are anticipated to afford combined fuel and electricity use mitigation resulting in a decrease of 5 percent in greenhouse gas emissions on campus. Behavioral changes can include, but are not limited to, improved utilization of lighting, heating and hot water through reduction of unnecessary or wasteful use.

The following figure shows a projection of the effect of the mitigation measures on the total Holy Cross carbon footprint, averaged over the fiscal year 2007 to fiscal year 2015 timeframe.



Additional Strategies for Achieving Fiscal Year 2015 Target

In addition to the fuel switching and electricity conservation measures described above, other energy conservation measures are underway to help achieve the fiscal year 2015 target. The GHG reduction potential of these additional measures has not been quantified. The measures include gradual replacement of appliances (e.g., hot water heaters, furnaces, air conditioners, etc.) that have reached end of life with more energy efficient units. During this time period, Holy Cross also plans to continue to analyze on-site renewable energy generation technologies, such as wind power, solar photovoltaic and solar thermal technologies. For example, students initiated a wind power feasibility study, from which results are pending.

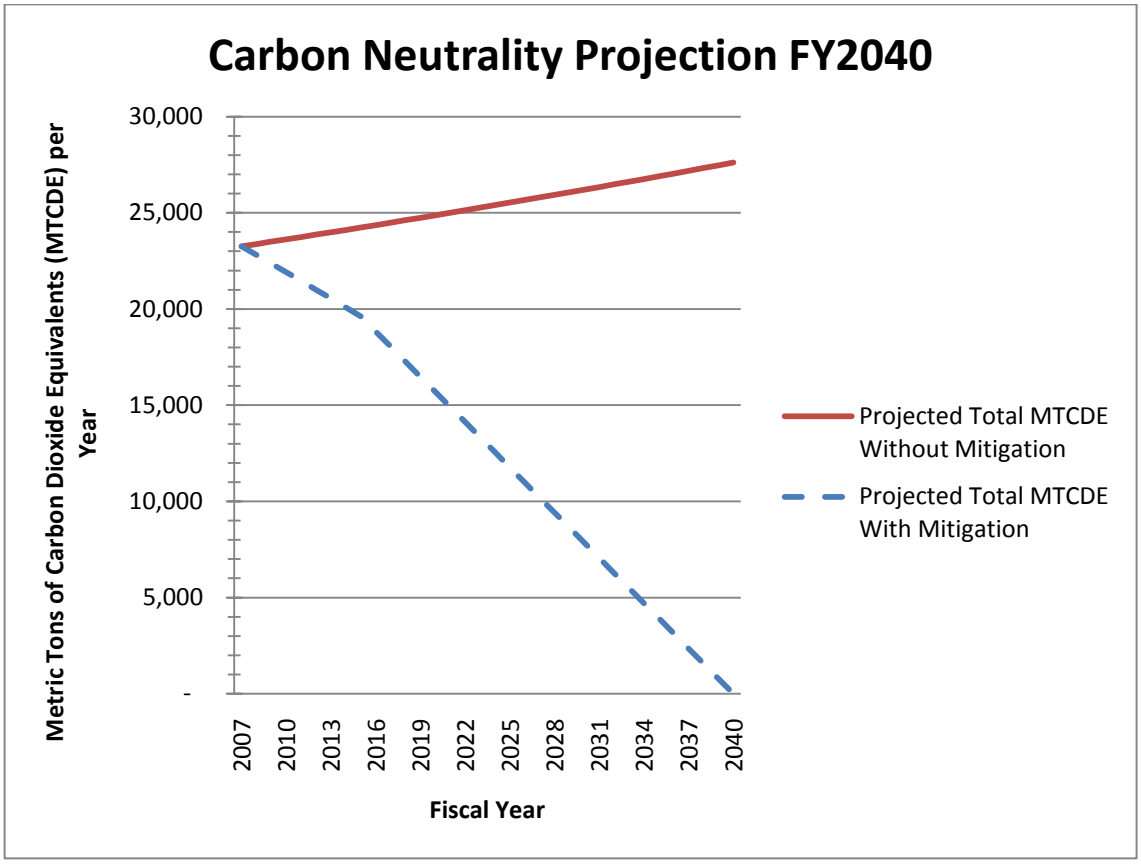
Goals for FY2030 to FY2040 Timeframe - Climate Neutrality

Holy Cross signed on to the ACUPCC commitment to initiate a plan for carbon neutrality by September 15, 2009. The College currently defines carbon neutrality as net zero GHG emissions given the inventory scope addressed to date (i.e., Scope 1, Scope 2 and selected Scope 3 emissions). Net zero emissions may be achieved by a combination of measures, including reduction of GHG emissions attributable to Holy Cross activities and purchase of carbon offsets for reduction of emissions which are not directly attributable to College activities. Holy Cross ranks the purchase

of carbon offsets as less valuable than actual reductions due to equipment, operational, purchasing and behavioral change by the campus community (faculty, staff and students).

A longer range goal of climate neutrality by fiscal years 2030 to 2040 is established in this plan by Holy Cross. These dates are consistent with longer range goals which are being set on a global scale. For example, the United Kingdom is contemplating a goal of removal of all petroleum fueled vehicles from the roads by 2040; the countries of Cost Rica and Norway aim to be fully carbon neutral by 2030; and the Commonwealth of Massachusetts is targeting 2050 for an 80 percent reduction in carbon dioxide equivalents relative to 1990 baseline levels.

A graphic approximation of a pathway to achieve the climate neutrality goal for Holy Cross is shown here.



Along with the numerous systems replacements and energy reduction projects that are likely to take place in the future, the college is investigating major renovations for many of the residence halls during the next 5 to 10 years however the scope and details are not yet defined. It is anticipated that these renovations will include significant carbon reduction strategies with new HVAC systems that will be a large step towards the long range goal of carbon neutrality however the actual reduction cannot be calculated at this time.

Current technology does not point to a clear path for achievement of the carbon neutrality goal without the use of carbon offsets. It is presumed that newer technology and management

techniques will be developed as knowledge advances in the field of GHG reduction. Therefore, this GHG reduction plan is viewed as a living document which will be subject to periodic update and revision as Holy Cross works toward the ultimate goal of carbon neutrality.

Funding Mechanisms for GHG Reduction Strategies

The College has invested significant capital funds for many years into energy reduction through equipment installation and replacement. Examples of the improvements include a computerized energy management system, boiler plant replacement, ice rink chiller replacement, numerous lighting changes, underground steam line replacement, steam trap replacements and air conditioning chiller replacements. These funds are part of the overall capital repair and replacement budget utilized to properly maintain the campus buildings and to keep the maintenance backlog to a minimum.

Mechanisms for Achieving FY2015 Target

The three primary carbon mitigation strategies to achieve the 2015 carbon reduction target involve capital improvements, utilization of natural gas versus fuel oil for the campus boiler plant and behavioral changes by the campus community. The required funds will involve capital investment through the annual capital repair and replacement budget to continue with energy efficient equipment replacement and upgrades. The utilization of gas in the campus boiler plant is not projected to be a cost increase in comparison with oil at this time. Contracts are currently under negotiations. The purchase of the current level of renewable electricity is also projected to be cost neutral at this time and a contract is in place through 2012. However, this market has the potential to change during contract negotiations.

The purchase of renewable energy equipment will be considered to achieve additional carbon reductions if funding is available. The Development Office has been asked to explore options for donors who might want to fund these opportunities. The Office of Grants and Corporate and Foundation Giving is actively pursuing funding opportunities to help achieve carbon reduction goals.

Funding Strategies for the FY2040 Goal

It is much more difficult to determine the funding sources for the mitigation strategies to reach the 2040 goal since there is heavy reliance on technological developments for carbon reduction. Therefore the cost is impossible to estimate. The College has a strong history of supporting the capital repair and renovation needs on campus and this is expected to continue. Assuming this is the case, energy efficient upgrades will continue as long as the funds are available. The use of operating funds to achieve carbon neutrality will be explored each year depending on the savings from energy reduction due to energy efficient upgrades.

Appendix A
Energy Saving Measures Undertaken

Year	Reduction Category	Project
Pre-FY2007	Purchased Electricity	Several National Grid lighting upgrades at various campus locations
		Occupancy sensors installed in Dinand library
		Several motors were outfitted with Variable Frequency Drives (VFDs)
	Boiler Fuel Use	Steam trap replacement program for every building on a five year cycle
FY2007	Boiler Fuel Use	St. Joseph steam line tunnel upgraded and several line leaks identified and repaired
		Upgraded 2 of 4 boilers with new Hawk control panels for improved control of combustion efficiency and nitrogen oxides (NO_x) emissions
FY2008	Purchased Electricity	Replaced Swords cooling tower and added VFD drive on the fan
		Replaced all Cathode Ray Tube (CRT) computer screens with flat screens
	Boiler Fuel Use	Wheeler & Haberlin steam tunnel upgraded and several line leaks identified and repaired
		Upgraded remaining 2 of 4 boilers with new Hawk control panels for improved control of combustion efficiency and NO_x emissions
		Added automatic blowdown to 4 boilers, reducing makeup water heating demand
		Steam traps replaced in Fenwick/O'Kane
	Other On-Site Stationary Source Fuel Use	Replaced Gym Heating Ventilation and Air Conditioning (HVAC) units and reduced outdoor air intake using carbon monoxide (CO) sensor controls
FY2009	Purchased Electricity	Upgraded lighting in Swords library
		Provided occupancy sensors in new Wheeler dorm rooms
		Replaced ice rink chillers with an energy efficient ammonia refrigeration system
	Boiler Fuel Use	Clark to Mulledy & Hanselman to Hogan steam lines upgraded and several line leaks identified and repaired
		Steam traps replaced in Kimball
	Other On-Site Stationary Source Fuel Use	Replaced Clark hot water heater (plumbing) with 96 percent efficient equipment
FY2010	Purchased Electricity	Lighting upgrades for Gym, Ice Rink, Fieldhouse, Hart Center
		Upgraded temperature controls in Swords and in the Library
		Replacement of Stein Chiller with a Turbocooler
	Boiler Fuel Use	Steam traps replaced for Alumni, steam line upgrade St. Joseph's to Hanselman
	Other On-Site Stationare Source Fuel Use	Replaced Ice Rink HVAC units and reduced outdoor air intake using CO sensor controls