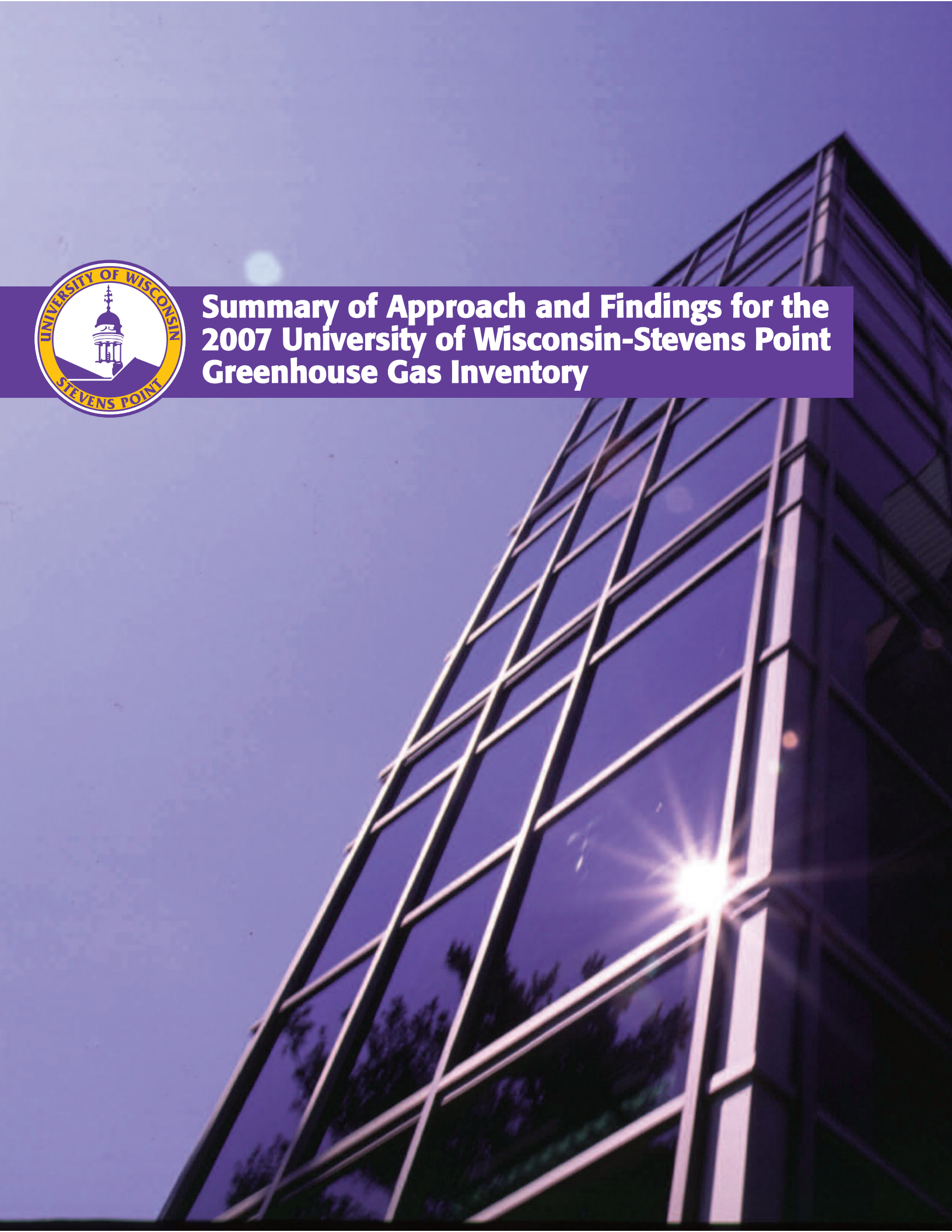
Summary of Approach and Findings for the 2007 University of Wisconsin-Stevens Point Greenhouse Gas Inventory



2007 UW-Stevens Point Greenhouse Gas Inventory

Submitted by the University of Wisconsin-Stevens Point Sustainability Task Force

with special thanks to Shelly Janowski, Paul McGinley, Bob Oehler and Michael Demchik for their contributions to this effort

August 2008

Background

The University of Wisconsin-Stevens Point is developing plans for moving toward climate neutrality. In the fall of 2007, Chancellor Bunnell created the UWSP Sustainability Task Force to achieve the goals set forth in the Chancellor's Climate Commitment. This followed UWSP joining the American College and University Presidents Climate Commitment (ACUPCC). Short term goals of the Sustainability Task Force include completing a greenhouse gas inventory, selecting actions to reduce greenhouse gas emissions, and establishing a climate neutrality action plan (future- Fall 2009). The greenhouse gas inventory described in this report is an important step towards developing the strategy for reducing greenhouse gas emissions.

The principal greenhouse gases emitted by UWSP are carbon dioxide, methane, nitrous oxide and fluorinated gases. These gases absorb and trap heat at the earth's surface. These gases can be released from many activities. Carbon dioxide is released when fuels such as coal, oil, wood and natural gas are burned. Methane is released in the production of fossil fuels and by decomposing waste in landfills. Nitrous oxide is also released during fuel consumption and from fertilizers. Fluorinated gases such as hydrofluorocarbons and perfluorocarbons can be released through operation and maintenance of refrigeration equipment. Many activities at UWSP can lead to the release of these greenhouse gases.

The climate neutrality plan includes the main UW-Stevens Point campus and several off campus, non-contiguous properties. The main campus occupies 400 acres and contains thirty-five different buildings. Thirteen of the buildings are residence halls that house approximately 3,100 students. Several of the main campus buildings, such as the Dreyfus University Center and the Noel Fine Arts Center have been built in the last five years. Others, such as Old Main and Nelson Hall are more than ninety years old.

Approach

The inventory of greenhouse gas emissions was developed using the Clean Air-Cool Planet Campus Carbon Calculator (Version 5.0). Data from a variety of campus sources was combined with utility information to estimate the emissions from 1996 through 2007. The Campus Carbon Calculator follows protocols developed by the Intergovernmental Panel on Climate Change (IPCC) and reports the impact of all the gases in terms of an equivalent amount of carbon dioxide based on their relative global warming potential. The emission calculations are based on worksheets developed by IPCC.

Institutional data that was collected and entered includes budget figures for operating expenses, research dollars and energy costs, population data for students, faculty and staff, and building space. Energy data entered includes purchased electricity and on-campus stationary sources of emissions, which include oil, natural gas, coal and paper pellets used in the heating plant (UWSP does not operate a co-generation plant). Transportation data includes (or was extrapolated from, in the case of commuter data) statistics from the university fleet vehicles, air travel miles, and faculty/staff and student commuter data. Fertilizer application is included under the agriculture section; UWSP does not have any animal agriculture information to report. Under the solid waste section, the quantity of waste sent to the landfill was reported. Chemical and refrigerants replaced, due to maintenance and leaks were estimated. The emissions associated with fertilizers, solid waste and refrigerants were very small compared to all other emissions. Lastly, actions taken to offset greenhouse gas emissions are reported in the offsets section of the input sheet. UWSP offsets include renewable energy credits, which are purchased through Wisconsin Public Service, composting efforts, and carbon sequestered due to forest preservation.

The collection of data was accomplished through the contribution of many people from many departments across campus, including budgeting, admissions, transportation, fleet services, facility services, payment services, parking services, international student travel and academic departments. Off-campus contacts were also made to acquire information –landfill representatives, Wisconsin Public Service, the Department of Administration and the City of Stevens Point. Because UWSP has accumulated utility and energy data for many years, heating plant reports could be used to retrieve stationary energy sources. The figures were adjusted to account for the steam that UWSP sells to St. Michael's Hospital. The calculated greenhouse gas emissions also include estimates for commuter and air travel, and forest preservation that will need to be updated as new information becomes available. There are minor sources of stationary energy that were not captured, such as LP gas, wood and oil used at some of the campus' field stations.

The carbon calculator is an Excel-based spreadsheet which has six modules. The Input Module contains data sheets for input of Campus data. The Summary Module uses summary sheets to analyze and display the data. Data from the summary sheets are displayed as graphs in the Graphs Module. The Emission Factors Module contains reference data from numerous sources and is used for calculations and no input is necessary. The Advanced Energy Demand and Cost Module allows for a customized fuel mix to be entered and calculates projections of future demand and costs. The Project Module estimates greenhouse gas reductions from campus initiatives.

Although the inventory is a detailed estimate of UWSP emissions, it does not include emissions associated with products that are manufactured elsewhere and then used on the UWSP campus. Examples include the energy used to pump water that is provided by the Stevens Point Water Utility or the energy used in manufacturing white board markers that are purchased by the University. These "embedded" or "embodied" emissions represent a portion of the campus carbon footprint, and may be included in the future, but they are not part of the Carbon Calculator nor are they required components of the ACUPCC inventory.

Greenhouse Gas Emission by Sector

UWSP greenhouse gas emissions were calculated in six different sectors: 1) purchased electricity; 2) stationary on-campus emissions from heating and cooling; 3) transportation; 4) emissions from agriculture and fertilizer application; 5) emissions associated with decomposition of landfilled waste; and, 6) emissions associated with the loss of refrigerants on campus.

Figure 1 shows the total carbon dioxide equivalent (eCO2) emissions for UWSP since 1996 in these six sectors. The carbon dioxide equivalent or eCO2 is a measure used to compare emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "metric tons of carbon dioxide equivalents (MTCDE). Total emissions for UWSP for 2007 were 43,572 metric tons of eCO2. Based on these estimates, the largest carbon sources are the purchased electricity at 44% of the total emissions (19,071 metric tons), stationary on-campus fuel use for steam generation for heating and cooling at 44% (18,962 metric tons), and transportation at 12% (5,283 metric tons). Agriculture, solid waste and refrigerant emissions total less than 1%. The preliminary emissions estimates are useful for assigning this general ranking to the different sources. Because the data used to make these estimates were not uniform across all of the years, some caution must be exercised in using these estimates to examine trends over time. For example, air travel was included in the transportation sector, but data was only available for the last two years. That is one reason for the apparent increase in emissions from transportation in 2006 and 2007.

Figure 1. Total greenhouse gas emissions by sector (see Table 1 and text for discussion of assumptions)

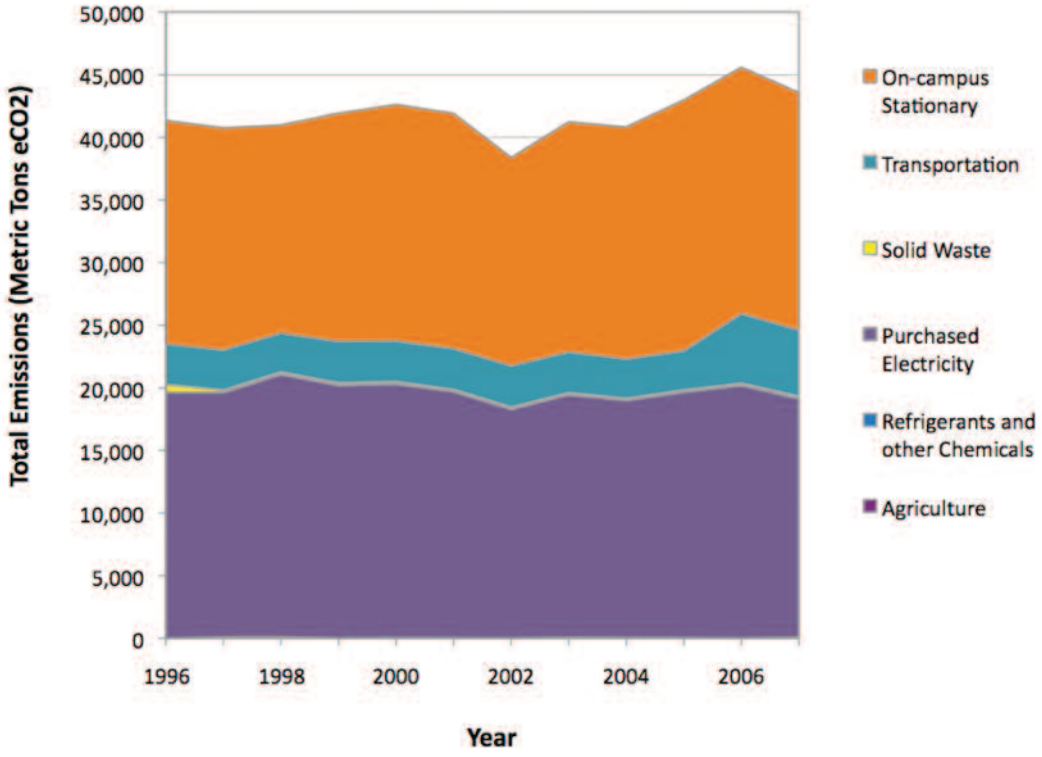


Table 1. shows the total carbon dioxide equivalent emission for 2007 by sector category. The emission estimates are described in more detail in the sector discussions that follow.

Table 1. Annual Greenhouse Gas Emissions for the University of Wisconsin-Stevens Point in 2007

Sector	Category	Energy Consumption (MMBtu)	Carbon Dioxide (kg CO2)	Methane (kg CH4)	Nitrous Oxide (kg N2O)	Total by Category Equivalent Carbon Dioxide (metric tons)	Total by Sector Equivalent Carbon Dioxide (metric tons)
EMISSIONS							
Energy (Electricity & Steam)	Electricity (Purchased)	201,899	19,025,644	77	146	19,071	38,033
	Heating and Cooling (Generated On-Campus)	246,466	18,849,885	2,041	219	18,962	
Transportation	University Fleet	5,036	354,782	65	23	363	5,283
	Student Commuters	15,179	1,067,966	202	70	1,093	
	Faculty/Staff Commuters	23,916	1,679,032	335	115	1,721	
	Air Travel	10,677	2,097,790	21	24	2,105	
Agriculture					60	18	18
Solid Waste				7,745		178	178
Refrigeration						61	61
TOTAL EMISSIONS		**503,174**	**43,075,100**	**10,486**	**657**		**43,572**
OFFSETS							
Green Electric Credits							(9,218)
Composting							(7)
Forest Preservation							(6,919)
NET EMISSIONS							**34,354**

Carbon Offsets

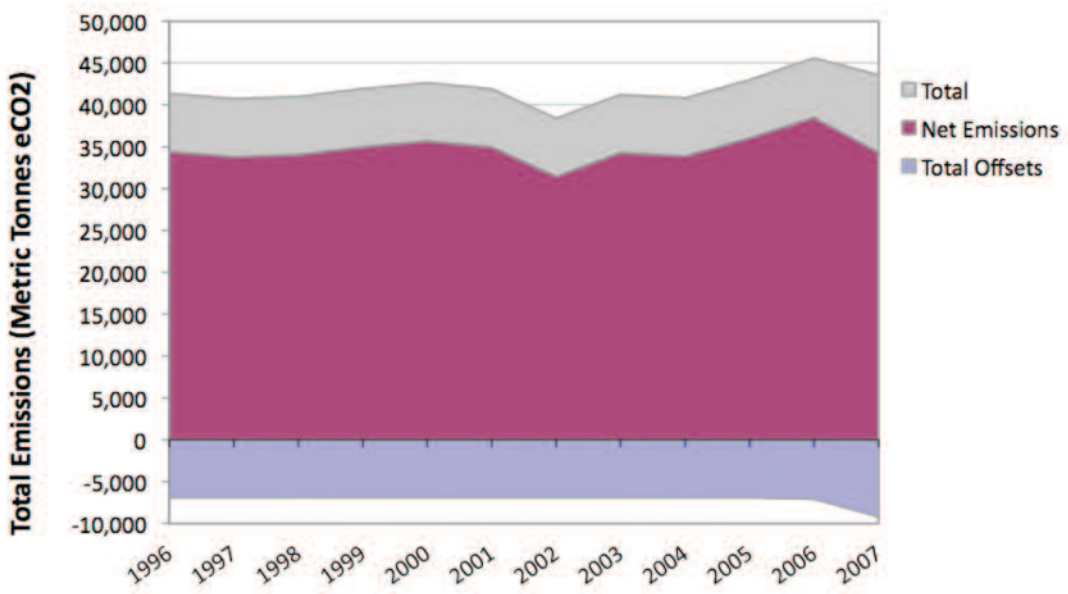
Note that on Table 1 there are "Offsets" that reduce the total emissions. UWSP offsets its emissions in several ways. First, UWSP purchases Naturewise renewable energy from Wisconsin Public Service that was produced using renewable energy sources, such as wind, solar or hydroelectric. Because the electricity associated with the renewable sources may not actually be produced near the university nor specifically used by the university, it is reported as an offset to our emissions, rather than a reduction of our emissions from electric purchases. UWSP reported Naturewise purchase offsets in 2006 and 2007, thus those years had larger credits.

Another offset is from composting. When properly done, composting does not generate methane emissions, but results in carbon storage.

Preservation of forest land is another way to offset emissions because the forest functions as a carbon sink. A large portion of our emission offsets are from forest preservation, which is a very approximate calculation for carbon storage. The UWSP estimate was based on an annual volume yield for a mixed forest of pine and hardwood and does not include herbaceous vegetation and soil carbon. The estimate also generalizes the growth versus loss at 0.5 cord/acre for all forested land although some of the forests are likely near or past their pathological rotation (i.e., they lose more volume to mortality than they gain by growth).

In the following figure, total emissions, net emissions and total offsets are represented. Note that on the graph that offsets are negative values. 2007 net emissions were 34,354 metric tons C02.

Figure 2. Total emissions, total offsets and net emissions



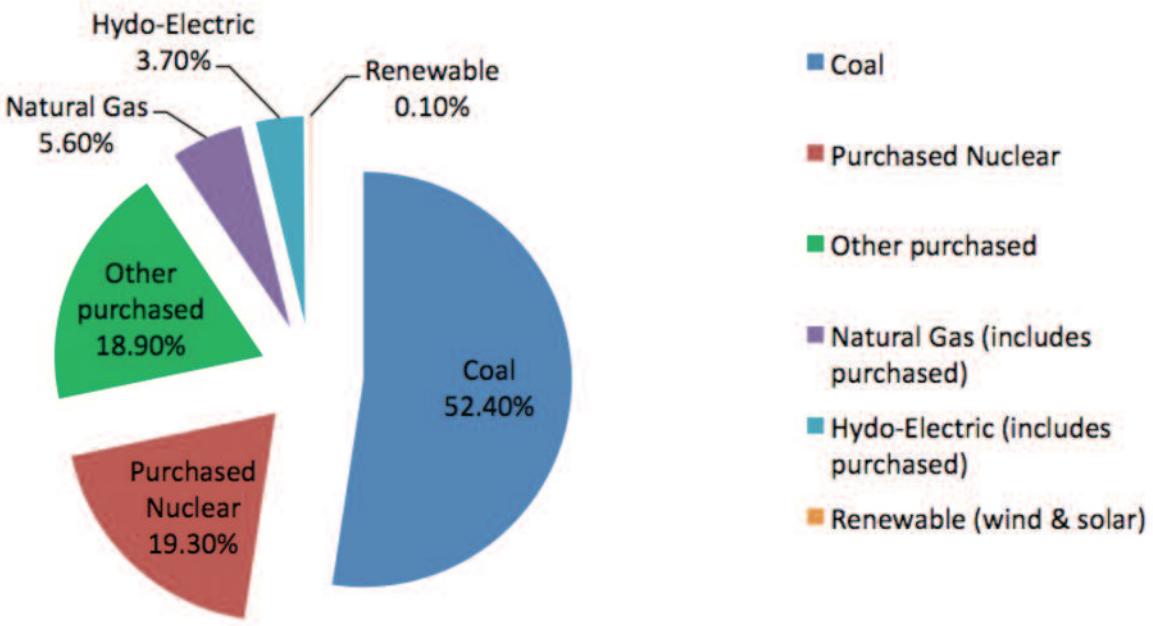
Energy Sector

The energy sector is the largest source of greenhouse gas emissions at UWSP and includes both purchased electricity and steam generated on-campus. The on-campus energy use is largely from the combustion of coal and natural gas at the UWSP central heating plant. The heating plant provides the majority of heating and cooling needs for 30 buildings on the main campus with 2,460,000 square feet of conditioned space. The heating plant has the capacity to generate all steam needed for the campus' current needs, as well as the needs of St. Michael's Hospital in Stevens Point.

The University purchases electricity from Wisconsin Public Service (WPS). The electricity is produced through combined sources of burning coal and natural gas, renewable sources of wind generation and solar, nuclear power, hydro-electric and "purchased power". The source of generation for their purchased power could include a combination of any of the above sources. The percentage of purchased power reported by WPS has increased from 17% in 1999 to 44% in 2007. The offset is a decrease in nuclear and coal. The carbon calculator includes efficiency factors for the net purchased portion of electricity production, but it may not be the same as if the actual sources were known and entered.

WPS supplied us with their custom fuel mix for 1999-2007. For years 2005-2007 they also supplied a further breakdown of their purchased power. The 2007 source mixture assumed in this inventory is shown in Figure 3.

Figure 3. Approximate Fuel Mixture for Purchased Electricity in 2007



(Wisconsin Public Service Data)

Changes in the WPS fuel mix will affect the results of our carbon emissions. For example, in 1999, WPS was using 64% coal as a source of electricity production, whereas in 2007, coal was at 52% of the mix. The WPS custom fuel mix for 1996, 1997 and 1998 were not supplied, therefore, those years may not be comparable to other years.

Table 2 summarizes all campus energy use since 1997 in millions of BTUs. Variation in energy use may be due to changes in building space, as in fiscal year 2007, where there was a decline in purchased electricity when the university center was offline due to remodeling. Variations may not always correspond to changes in total greenhouse gas emissions because of energy efficiencies of new construction or coincident changes in the fuel mix used. The type of fuel source used will make a difference in emissions. For example, in 2002, the majority of our on-campus fuel source was natural gas. UWSP did not use oil that year and coal use was relatively low compared to other years. Referring back to Figure 1 shows a dip in the emissions that year because the heating plant consumed more of a cleaner source of fuel.

Table 2. UWSP Energy Use (MMBtu)

Fiscal Year	Purchased Electricity	Campus Distillate Oil (#1 - #4)	Campus Natural Gas	Campus Coal	Other Paper Pellets & Solar	Transportation	Fleet Gasoline and Diesel	Total
1997	212,704	21	146,130	105,067	11,829	39,437	5,021	520,209
1998	228,253	251	143,504	94,633	9,773	39,148	4,119	519,681
1999	215,304	5	143,435	111,689	8,892	40,381	5,688	525,394
2000	215,597	25	144,407	118,095	7,886	39,687	5,581	531,278
2001	209,117	1,056	104,112	138,702	16,228	39,783	5,621	514,619
2002	200,925	-	155,270	88,491	8,938	40,417	5,320	499,361
2003	209,882	493	119,345	126,338	14,642	39,997	5,292	515,989
2004	203,423	497	100,972	138,181	1,131	38,663	5,160	488,027
2005	205,948	119	87,741	161,721	960	38,596	4,978	500,063
2006	211,227	134	105,094	148,197	942	50,888	4,900	521,382
2007	201,899	-	105,965	140,452	49	49,773	5,036	503,174

Transportation Sector

The transportation sector includes fuel used by the University fleet, faculty/staff and student commuting, and air travel. It is estimated that this sector contributes approximately 12% of the total greenhouse gas emissions, although the numerous assumptions necessary to make this calculation suggest it is probably also the least certain portion of the inventory.

The greenhouse gas emission estimate for the University fleet and commuting is based on records of fuel usage when available, and estimates of mileage and fuel efficiency for other travel. In this initial inventory, estimates of faculty/staff and student commuting were based on the size of these groups and a review of available parking records. Bus usage by students was estimated by student pass accounting provided by the bus system. The commuting estimate does not include off-campus travel to their permanent addresses by students before, after and during the semester

Air travel is another important component of greenhouse gas emissions in the transportation sector. Records for air travel were available for those trips purchased through the purchase card system. These records included origination, intermediate and final airport locations that were used to estimate overall trip mileage. The calculator was used to convert air travel mileage to an equivalent carbon dioxide emission for air travel. Because the air travel records were only available for the last few years, this component of the travel sector was not estimated for all years.

There are many areas where the greenhouse gas emission from the transportation sector could be refined. Because it is an important component of the overall UWSP greenhouse gas emission, efforts to continue to refine these estimates are warranted.

Agriculture Sector

Greenhouse gas emissions from the agricultural sector were associated with the nitrous oxide emission from nitrogen fertilizer. Records of fertilizer use provided by the Buildings and Grounds Departments were used with conversion factors from the calculator to estimate the equivalent carbon dioxide emission. Overall, these emissions were a very small portion of the total UWSP greenhouse gas emission (less than 0.1% and do not require additional refinement).

Solid Waste Sector

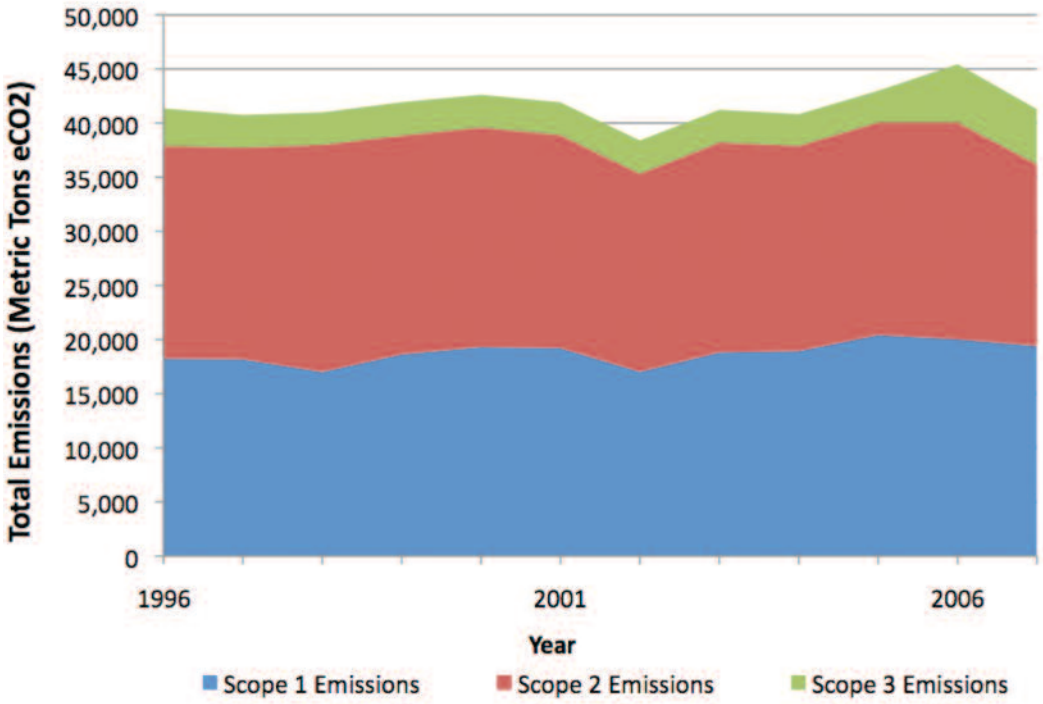
Greenhouse gas emissions from the solid waste sector are largely due to methane generation from landfilled solid waste. This methane is generated during the anaerobic decomposition of the waste in the landfill. The methane emissions are converted to an equivalent amount of carbon dioxide in the calculator. Because methane has a much larger warming potential than carbon dioxide, landfills that burn the methane to carbon dioxide either through flaring or to produce electricity reduce the equivalent quantity of carbon dioxide that is produced.

The greenhouse gas emissions from the solid waste sector were estimated from the quantity of landfilled solid waste and conversion factors provided in the calculator. In 1996, the first year of reported data, the landfill had no methane recovery. Beginning in 1997, calculations included the flaring of methane at the landfill. Overall, the solid waste sector accounted for less than 0.5% of the total UWSP greenhouse gas emissions.

Total Emissions by Scope

The emissions can be divided into three "scopes" or categories. Scope 1 includes direct sources of greenhouse gases that are owned or controlled by UWSP, including the production of heat, fleet transportation, fertilizer application and refrigerants. Scope 2 includes indirect sources of emissions associated with purchased electricity, and purchased steam if it pertains. Scope 3 includes all other indirect sources of emissions from activities of the institution. For UWSP, Scope 3 would include emissions from commuting, air travel and emissions associated with landfilling solid waste. Figure 5 shows the emissions by scope. For UWSP, Scope 1 emissions, those sources we own or directly control, equal 47% of the total emissions. Purchased electricity, Scope 2, is 41% of the emissions and all other indirect sources, Scope 3, equates to 12% of the total emissions.

Figure 5. Emissions by Scope



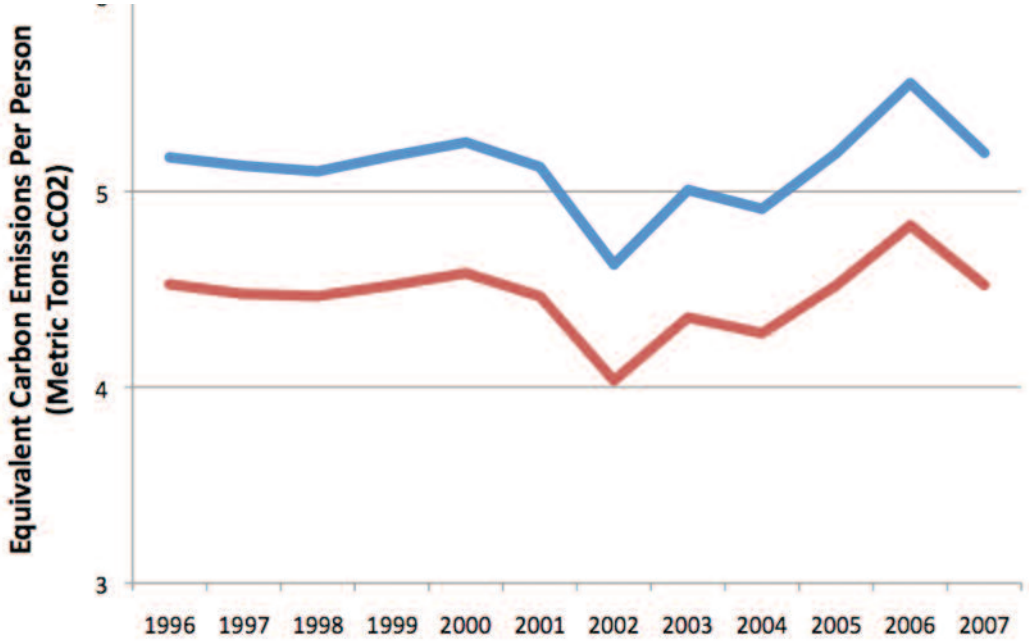
Greenhouse Gas Emissions per Student

The preliminary estimate of UWSP greenhouse gas emissions was used to estimate the emissions per student and the emissions per campus community, which includes combined students, faculty and staff. The estimate is summarized in Figure 6 and shows that the UWSP emissions range is between 5 and 6 metric tons of carbon dioxide equivalents per student per year.

The equivalent carbon dioxide emission of 5 to 6 metric tons per student per year is comparable to that reported by some other institutions. Other Universities report higher and lower emissions depending on fuel mixes assumed, variations in commuting distances and percentages, and whether they include air travel, commuting or other components of the inventory.

The variation in eCO2 emissions per student over time reflects a variety of factors including the above average student population in 2002, 2004 and 2007; above average use of natural gas compared to coal in 2002; and, the inclusion of air travel into the total emissions only in 2006 and 2007. Overall, however, the variation over time is relatively small as would be expected for a carbon emission that is dominated by energy use.

Figure 6. The total UWSP eC02 emissions per student and community member



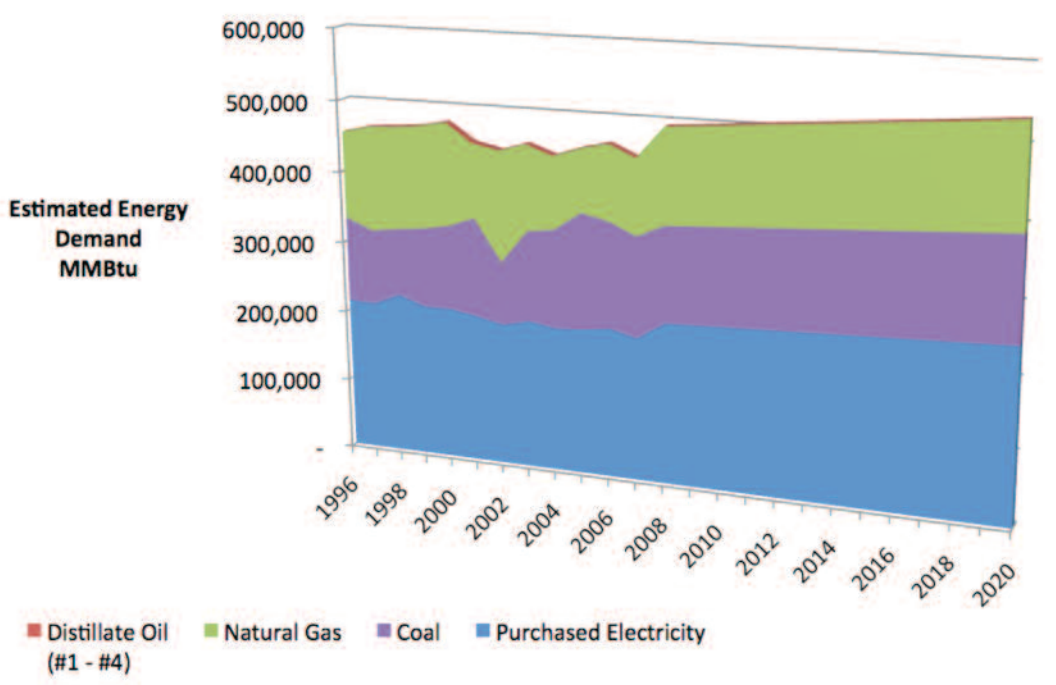
Projected Energy Demand

The Advanced Energy Demand and Cost Module of the calculator summarizes all historical energy use by fossil fuel type and uses forecasted energy prices published in the U.S. Department of Energy *Annual Energy Outlook* to estimate future demand and costs. Based on the summary of historical fossil fuel energy data entered, the percentage of each fossil fuel type is determined and an average percent is then calculated with the assumption that data will remain constant going forward.

Future fossil energy demand for the campus is estimated using 1) the historical energy data entered for 1996 to 2007, 2) UWSP's average building efficiency and 3) our built space growth expectations.

The following figure shows UWSP's projected demand for fossil fuels in MMBtu. Although this is a simplified projection of future energy demand, because it is estimating the change in energy demand as a function of institutional growth, it does provide a general estimate of the likely future energy requirements in the absence of institutional change.

Figure 7 Estimated energy demand based on FY2007 average building efficiencies and institutional growth rate from 1996-2007



Summary and Conclusions

The greenhouse gas emissions calculations provide a framework for establishing baselines and identifying and prioritizing actions to approach climate neutrality. Although the data entered is accurate to the best of our knowledge, some assumptions and estimates were made. Therefore, this baseline may change with further analysis and adjustment.

Greenhouse gas emissions from UWSP are largely due to energy and transportation. Changes over time are likely to be relatively small unless there are changes to energy use and fuel sources. The Sustainability Task Force will continue to evaluate renewable fuel source options to reduce dependence on fossil fuels and mitigate greenhouse gases, while considering other environmental impacts as well. It will be necessary to evaluate funding options and other considerations related to new energy options for providing electric power, heating and cooling of the UWSP campus. The importance of energy to the total greenhouse gas emissions suggests it is critical that UWSP maintain an active and continual energy management program.

Where do we go from here?

The UWSP Sustainability Task Force will:

- Continue to refine the carbon calculations to improve the estimate of greenhouse gas emissions.
- Incorporate these estimates into sub-committee efforts to reduce greenhouse gas emissions.
- Identify opportunities for emission reductions (Green Energy and Power Sub-committee), such as improving efficiency of energy use and developing more renewable fuel source options.
- Create a communication plan to raise awareness, educate students, faculty and staff on the greenhouse gas emissions and opportunities for reduction.