Greenhouse Gas Inventory Compilation for Wentworth Institute of Technology's President's Climate Commitment

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Abstract
In June 2007 the President of Wentworth Institute of Technology (WIT) signed the American College and University Presidents' Climate Commitment (ACUPCC). The support activities of the environmental club, now called the Green team, were the key factors in getting the President to sign this commitment.

The Green Team, first established 15 years ago, has been very involved on campus promoting and carrying out a wide variety of sustainability efforts. The Green Team is structured into two committees. One focuses on recycling and one focuses on sustainability. Both committees develop new, innovative ideas to help improve campus wide sustainability efforts. The Green Team received the award for the Best Student Organization Executive Board in 2008.

Within three years of signing the ACUPCC, WIT is required to create a Comprehensive Action Plan (CAP) with a future completion date and interim milestone dates for becoming carbon neutral. The starting point for this plan is the completion of a comprehensive greenhouse gas (GHG) emissions inventory of the Wentworth Campus. The Green Team was recruited to complete this inventory and conduct other support activities such as Recyclemania to facilitate the completion of the CAP. Recyclemania is a national recycling competition with the goal of raising student awareness of sustainability issues and increasing campus recycling efforts.

Introduction
In October 2006, after planning sessions among a group of college and university presidents and their representatives at the Association for the Advancement of Sustainability in Higher Education (AASHE) conference at Arizona State University, 12 Presidents agreed to become founding members of the ACUPCC. In December the same year, those presidents sent a letter to nearly 400 of their peers inviting them to join the initiative. By March 31, 2007, 152 schools became charter signatories of the ACUPCC. This new group of signatories sent a packet of information to their peers at over 3,500 institutions. By September 15, 2007, 400 institutions had joined the initiative as signatories. To date, there are 677 signatories of the ACUPCC.[1]

Recyclemania was founded by Ed Newman of Ohio University and Stacy Edmonds Wheeler of Miami University in February 2001 because both schools wanted to increase recycling in their residence and dining halls on their campuses. A 10 week competition between Ohio State and Miami University was staged. This was the beginning of Recyclemania. The competition gained momentum and approximately doubled the number of participants the first two years. In 2004 Recyclemania teamed up with the U.S. Environmental Protection Agency's Waste Wise Program to enhance and expand the competition and the competition won the National Recycling Coalition's Outstanding Recycling Innovation Award. Today over 600 colleges and universities participate in some division of the Recyclemania competition.[2]

Greenhouse Gas Inventory Overview

Clean Air Cool Planet (CA-CP) software was used to complete the GHG inventory for fiscal year 2007. This software was user friendly and easy to work with. The link was taken from the ACUPCC website. The software combines all the sources of greenhouse gas emissions from the campus and turns them into carbon dioxide (CO_2) equivalent emissions. This software is capable of graphically representing the amount of CO_2 and CO_2 equivalent GHG released by the campus. It also pinpoints sources that emit the most CO_2 so those areas can be targeted in the climate action plan.

Data Collection

Data for the Greenhouse Gas Inventory was collected from many different departments on the WIT campus. The first input to the CA-CP carbon calculator was Institutional Data. The budget numbers, such as the operating budget, research budget, and energy budget were obtained from Chief Financial Operator. Population figures, such as, full time, part time, and summer school students were acquired from the Student Service Center. Human Resources provided the number of faculty and staff. The physical size of the campus and buildings was provided by Physical Plant.

The second input to the greenhouse gas inventory was On-Campus Stationary Sources of CO_2 emissions. This includes on campus cogeneration plants and other on campus stationary sources of emissions. Data for cogeneration plants included the type and amount of fuels used and the electrical output, steam output, electrical efficiency and steam efficiency of the units. Because WIT has multiple cogeneration units and there was only input space for one, the co-generator data had to be combined. The figures for the co-generators and other on campus stationary sources were provided by the Physical Plant. The outputs of the different units were totaled. From the total output, a percentage was given to each individual unit and this percentage was used to combine the efficiencies and outputs of the different units into one number to be put into the carbon calculator.

The next category for input was Direct Transportation Sources. This included the amount of fuel and type of fuel (gasoline, diesel, E85 Ethanol, and Hydrogen) used by the WIT fleet. Physical Plant provided this information.

Refrigerants and Chemicals was the next category of the Inventory. The amounts of each were obtained from the Physical Plant. Agricultural Sources, such as Animal Husbandry and Fertilizer Application are included on the inventory. WIT has no Animal Husbandry but the pounds of fertilizer used by the campus were obtained from physical plant. This part of the Inventory also asked for the type of fertilizers used, synthetic or organic, and the percent nitrogen of each. Because this category has only one input space and WIT uses various types of fertilizer, an average of the percent nitrogen was used based on the amount of each of the various types of fertilizers used on campus.

Next on the Inventory were Purchased Electricity, Purchased Steam and Purchased Chilled Water. These figures were given by Physical Plant. Purchased electricity required input of how WIT's energy is generated by the utility company. This information was given to Physical Plant by the utility company.

The miles that commuters traveled to WIT everyday also had to be calculated. It had to be determined how commuters got to school (automobile, bus, light rail, commuter rail) and how

many miles they travel per day for both students and faculty and staff. This was done by putting together a survey which was emailed to all commuter students. The survey asked students how they get to school every day and approximately how many miles they traveled. Since not everyone replied to the survey, the data was compiled and extrapolated to represent all commuting students.

Also included in the survey was Directly Financed Outsourced Travel. This included all institute funded air travel by faculty and students.

Last on the inventory was Solid Waste. This category included how many tons of solid waste is generated by WIT and what is done with it once it leaves campus, for instance, if it is waste-to-energy incinerated, just incinerated, if it is put in a landfill with CH_4 recovery, or put in a landfill without CH_4 recovery. This information was given by physical plant and WIT's waste removal company.

Results

Table 1- Emissions by Category

Source	**Amount (Tons eCO_2)**
Purchased Electricity	3,000
On-Campus Stationary	8,000
Transportation	3,000
Solid Waste	2,000
Refrigerants	1,000
Total	**17,000**

The results of the Greenhouse Gas Inventory showed that Wentworth Institute of Technology emitted about 17,000 metric tons of carbon dioxide equivalents (eCO_2) for the fiscal year 2007. About 3,000 metric tons of eCO_2 came from purchased electricity. About 8,000 metric tons of eCO_2 were emitted from on campus stationary sources such as cogeneration units and heating boilers. Transportation was responsible for about 3,000 metric tons. Solid waste emitted about 2,000 metric tons of eCO_2 and refrigerants emitted less than 1,000 metric ton of eCO_2.

Per capita, WIT uses about 75 MMBtu's of energy per student and releases about 5 metric tons of eCO_2 per student.

It is evident from this data that on-campus stationary sources are the biggest contributor to the total emissions of the school. This is expected because WIT generates a lot of its own power using co-generators and has three central heating plant boilers. The next two biggest contributors to WIT's greenhouse gas emissions were purchased electricity and transportation. 3,000 metric tons of eCO_2 were emitted from each. Emissions from purchased electricity are slightly higher because WIT was purchasing electricity while replacing its largest cogeneration unit.

Since the completion of the first greenhouse gas inventory, WIT has already made many strides in reducing its CO_2 emissions. The new 600kW cogeneration unit is now on line and WIT has started competing in Recyclemania, a national recycling competition between colleges and universities. WIT has also started composting its food waste and the Green Team and physical plant actively search for new ways that WIT can save on energy and reduce its carbon footprint.

Recyclemania

Recyclemania is a 10 week, national recycling competition between colleges and universities. Over 600 schools including over 5 million students and 1.3 million faculty and staff are participating in 2010. WIT is participating in the Benchmark Division for its first year in the competition. By participating in the Waste Minimization Category, WIT is pledging to implement an active program to sell or donate campus surplus property, offer discounts or other incentives for using reusable mugs in campus dining facilities, and creating and promoting a system for the campus community to report wasteful practices and offer suggestions for waste minimization.

Participating in Recyclemania is a key component to WIT's Climate Action Plan. Recycling reduces the amount of land-filled waste and reduces greenhouse gas emissions. WIT Green Team and physical plant worked together to create a planning committee trying to involve as many departments as possible. Getting a high participation rate was one of the main goals. A high participation rate increases the amount of material being recycled and increases student awareness of the need for sustainable efforts on campus. Participation by faculty and staff shows students that WIT is serious about sustainability on campus. By participating in the Benchmark Division WIT can comparatively see how they are doing against other schools. Starting next year, WIT plans on entering the official competition.

The Physical Plant and Green team took on the responsibility of carrying out and publicizing the 2010 Recyclemania competition. Students, Faculty, and Staff formed a planning committee to work out the logistics of the competition such as developing a strategy to report the amount of material recycled each week and reporting that information to the competition, developing a system of displaying results in residents halls, creating awareness of the competition through advertising and events such as raffles, and developing a competition between residence halls to encourage recycling. A "Mt. Trashmore" was also created to physically show how much trash is generated on campus in a week.

In the first week of competition WIT recycled 11.31% of its waste. In weeks 2, 3, 4, 5, 6, 7 and 8 WIT recycled 20.71%, 14.02%, 10.22%, 12.59%, 11.01%, 13.92% and 5.95% consecutively for an eight week average of 12.47%. Week eight had a much lower recycle rate because of spring break. WIT is working to increase its recycling rate in the final weeks by increasing awareness of the competition to get students to participate. As of week 8, WIT ranks 67 out of 302 schools for the bottles and cans category of the competition. The next focus will be on improving WIT's ranking for paper and cardboard recycling.

Table 2- Weekly Recycling Rates

Week	Rate
1	11.31%
2	20.71%
3	14.02%
4	10.22%
5	12.59%
6	11.01%
7	13.92%
8	5.95%
Average	**12.47%**

Conclusion

A greenhouse gas inventory for fiscal year 2009 is now being completed. The inventories from 2008 and 2009 will provide the basis for completing the comprehensive action plan to greatly reduce WIT's greenhouse gas emissions and increase sustainability efforts on campus. With the completion of the third greenhouse gas inventory WIT will be able to see the progress they are making in reducing emissions. WIT will also be able to target their biggest contributors of eCO_2 emissions and address them in their Climate Action Plan.

The goal of participating in the Benchmard Division of Recyclemania was to familiarize the students with Recyclemania. After participating in Recyclemania, there is a greater awareness on campus of the need to both recycle and act sustainably. By taking part in the Benchmark division, WIT has learned there is room for improving the recycling rates in all categories. WIT looks forward to participating in the official competition in 2011 and hopes to see an improvement in overall recycle on campus.

Author Biography

Peter Salvatore is currently a senior in the Civil Engineering Technology Program at Wentworth Institute of Technology. He has been a member of the Green Team since 2007. Through Green Team, he has gotten involved with many extracurricular activities and sustainability efforts such as compiling WIT's first greenhouse gas inventory and being a student member of the 2010 Recyclemania Planning Committee.

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[1] "Frequently asked Questions." *American College & University Presidents' Climate Commitment*. 20 March 2010. <http://www.presidentsclimatecommitment.org/about/faqs#5>

[2] "History of Recyclemania." *General Overview* . n.d. 20 March 2010. <http://www.recyclemaniacs.org/overview.htm>