

Greenhouse Gas Inventory Report

1993 to 2007

Published January 2009



University of



North Dakota

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EXECUTIVE SUMMARY

This report summarizes the findings of an inventory of the University of North Dakota's greenhouse gas (GHG) emissions. The inventory, which was performed in the fall of 2008, measures heat-trapping GHGs released by human activity that lead to climate change. The inventory was required as part of UND's pledge to the American Colleges and University Presidents Climate Commitment (ACUPCC), which former President Charles Kupchella signed in January, 2008. Signatories to the commitment pledge to eliminate their campuses' GHG emissions in a reasonable period of time as determined by each institution. This long-term commitment is broken into steps, of which the GHG emissions inventory is the third step:

- Step 1 – Sign the ACUPCC
- Step 2 – Identify tangible actions
- Step 3 – Inventory GHG emissions
- Step 4 – Design climate action plan
- Step 5 – Execute climate action plan
- Step 6 – Measure and verify actions

University presidents also commit their institutions to several action items (step 2), including the development of a comprehensive plan to achieve climate neutrality, which is known as a climate action plan (step 4). The climate action plan is dependent on the results of this inventory and will be in development in 2009.

GHG emissions of fiscal years (FY) 1993 to 2007 were calculated based on data collected in 2008. UND's emissions were calculated following the procedures outlined for ACUPCC and using the Clean Air-Cool Planet Campus Carbon Calculator program as the primary tool. The program calculates all six greenhouse gases specified by Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). Because carbon dioxide is the greatest GHG, emissions are reported by metric tons of carbon dioxide emissions (MTCDE), unless otherwise stated.

The results of the GHG emissions inventory show that in 2007, the 15,254 campus members and 5.34 million square feet of building space at UND was responsible for the consumption of 2,482,947 MMBtu of energy and the emissions of 138,633 MTCDE (Figure 1). Since 1993, total emissions in 2007 increased by 9 percent while total energy consumption decreased by 0.3 percent in the same time frame. Meanwhile, square footage increased by 8.1 percent. Emissions per campus member grew by 6.7 percent, while emissions per 1000 square feet increased by just 0.4 percent. A potential reason for the increase in emissions is the increase in research activities, which consume more coal-based

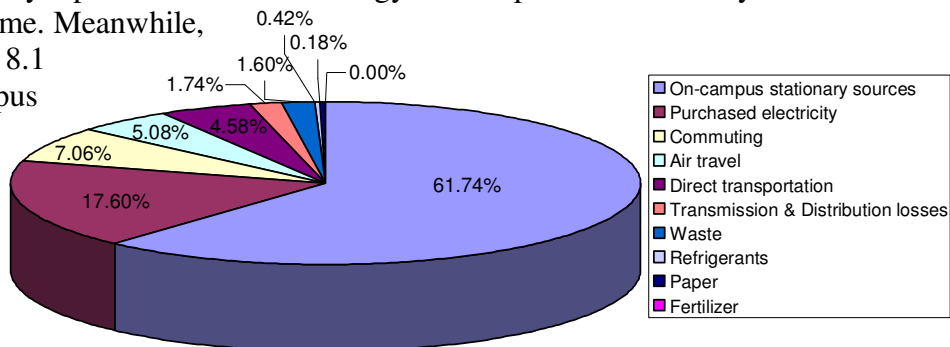


Figure 1: 2007 composition of emissions shows categorical percentage of 2007 total emissions of 138,633 MTCDE

electricity. Energy use per full-student has decreased by 8 percent and energy use per 1000 square feet has also decreased by 8 percent.

The major sources of UND's emissions in 2007 result from on-campus stationary sources (62%), purchased electricity (18%), and transportation (commuting, air travel, direct transportation—17%). The steam plant, which uses coal as its main fuel source, is responsible for 62 percent of total emissions on average from 1993-2007. Electricity has increased its contribution to emissions; emissions from electricity sources have increased by 29 percent since 1993.

When emissions are normalized by gross MTCDE per 1000 square feet and gross MTCDE per full time enrollment, UND's emissions are higher than the average emissions of 16 selected institutions who have reported their emissions to the ACUPCC. The average MTCDE per full time student is 11.0 MTCDE, compared to UND's 13.9 MTCDE. The regional average MTCDE per 1000 square feet is 19.4 MTCDE, compared to UND's 26.0 MTCDE.

This report explains more fully the results of the GHG emissions inventory and details the results by category. It also gives substantial background about UND, detailing its unique sources of emissions and efforts to reduce energy consumption and emissions thus far. Finally, it describes the ACUPCC in detail and the specific responsibilities of UND. Recommendations to reduce GHG emissions will be covered in the climate action plan, which is due to the ACUPCC by January 15, 2010.

PROJECT BACKGROUND

Why address climate change

Climate change is defined by the U.S. Environmental Protection Agency as any significant change in measures of climate, such as temperature, precipitation or wind, lasting for an extended period, meaning decades or longer.⁵ Generally, it is caused by human activities, such as the burning of fossil fuels and deforestation, which have caused the concentrations of heat-trapping greenhouse gases (GHGs) to increase significantly in the atmosphere.⁵ The estimated adverse consequences of the unprecedented scale and speed of the greenhouse effect could reach all sectors of society—health, social, financial and ecological—in all corners of the world.

North Dakota is not immune to changes. According to the National Conference of State Legislatures, which references the most recent climate modeling by the Intergovernmental Panel on Climate Change, the state could experience worsening droughts and an increase in temperature by nearly seven degrees Fahrenheit by 2100.⁶ Extreme weather events in the state, including periods of decreased rainfall and severe drought, and more intense rainfall when precipitation occurs, are projected to increase in frequency.⁶ Agriculture, water resources and tourism may be affected in a variety of ways and could result in significant losses.⁶

To adequately address climate change, an inventory of human-caused GHG emissions must be taken to provide important baseline information of emissions from every source. This report is the results of the GHG emissions inventory for the University of North Dakota (UND).

American College & University Presidents Climate Commitment

Twelve colleges and university presidents who recognized the importance of addressing climate change drafted and signed the American College and University Presidents Climate Commitment (ACUPCC) in October 2006.² The signatories to the commitment, currently numbered at 605 schools in all 50 states, pledge to eliminate their campuses' GHG emissions in a reasonable period of time as determined by each institution.²

The commitment reads: "Colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by reducing global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society. These colleges and universities will be providing students with the knowledge and skills needed to address the critical, systemic challenges faced by the world in this new century and enable them to benefit from the economic opportunities that will arise as a result of solutions they develop. We further believe that colleges and universities that exert leadership in addressing climate change will stabilize and reduce their long-term energy costs, attract excellent students and faculty, attract new sources of funding, and increase the support of alumni and local communities."²

When a president signs the commitment, he commits his institution to develop a comprehensive plan to achieve climate neutrality as soon as possible, initiate two or more actions specified by the commitment while the comprehensive plan is being developed, and make publicly available

the action plan, inventory, and periodic progress reports.² It is expected that the inventory of all greenhouse gas emissions be complete within one year of signing the document, and that an institutional action plan for becoming neutral will be developed within two years.²

Specifically, signatories to the commitment agree to take the following steps in pursuit of climate neutrality:

1. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.
 - a. Within two months of signing the document, create institutional structures to guide the development and implementation of the plan.
 - b. Within one year of signing the document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.
 - c. Within two years of signing the document, develop an institutional action plan for becoming climate neutral
2. Initiate two or more of the following tangible actions to reduce greenhouse gases while the more comprehensive plan is being developed.
 - a. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED [Leadership in Energy and Environmental Design] Silver standard or equivalent.
 - b. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.
 - c. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by the institution.
 - d. Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at the institution.
 - e. Within one year of signing the document, begin purchasing or producing at least 15 percent of the institution's electricity consumption from renewable sources.
 - f. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where other institution's endowment is invested.
 - g. Participate in the Waste Minimization component of the national recycle mania competition, and adopt 3 or more associated measures to reduce waste.
3. Make the action plan, inventory, and periodic progress reports publicly available by providing them to the Association for the Advancement of Sustainability in Higher Education (AASHE) for posting and dissemination.²

UND signs climate commitment

In January 2008, former UND President Charles Kupchella signed the ACUPCC. UND was the first (and only to date) institution in North Dakota to sign the commitment. At the signing, he said it is important to take the step now to set into motion a process by which the university might model positive corporate behavior. In addition to the commitments required by all signatories, Kupchella committed UND to the following steps: 1) Within two months, appoint an institutional standing Council on Environmental Stewardship and Sustainability; 2) Within one year, identify all curricular and academic programs being offered by the university and assess the degree to which each of these courses and programs address the issue of sustainability; 3) Within one year, prepare an inventory of all current, directly environmentally relevant UND research



A summer scene of the English Coulee, which flows through campus.

projects, which will then be kept up-to-date on an ongoing basis. UND will also continue a number of current strategies aimed at increasing efficiency and developing sustainable practices. The president's action in signing onto the climate commitment will supplement these practices, which are outlined later in this section, and accelerate UND's path to sustainability.

To date, UND has fulfilled some requirements of the commitment. Immediately after signing the commitment, Kupchella appointed a core group to sit on the Council on Environmental Stewardship and Sustainability. The next step is the GHG emissions inventory.

Many students, faculty and staff were involved in the preparation of this inventory during the 2008 fall semester. The inventory began in the classroom. The Earth System Science and Policy (ESSP) 501 class performed the first inventory and developed the methodology and protocol that will be used in future inventories. They were assisted in preparation of the inventory by individuals in Facilities

Management and the academic departments of

Chemical Engineering, Technology, and ESSP. The climate action plan is dependent on the results of this inventory.

UND Demographics

UND was founded by the Dakota territorial assembly in 1883 as a public university in Grand Forks, North Dakota (pop. 50,000), which is located on the Minnesota border approximately 75 miles from the Canadian border. UND is one of 11 public colleges and universities within the North Dakota University System. The university employed 790 faculty and 1,905 staff, and had 12,559 students enrolled in FY 2007 (Table 1). North Dakota residents make up 52 percent of the students, while the rest represent 49 states, seven Canadian provinces and more than 50 nations. The campus includes 229 buildings (5.33 million square feet) on 549 acres. UND has a large campus, covering 425 square feet per student in FY 2007.

	1993	2007
Faculty	687	790
Staff	2,294	1,905
Full time students	9,224	9,976
Part time students	2,774	2,583
Campus population (campus members)	14,979	15,254
Square feet	4,905,946	5,339,643
Square feet per student	409	425

Table 1: Summary of institutional data

A significant chapter of UND's history happened in April 1997, when a flood that rose eight feet above street level required the entire city to evacuate. Seventy-two university buildings were

damaged and had to be rebuilt or renovated. This caused enrollment to decline, which the university is still recovering from more than 10 years later.

Research at UND

UND is classified by the Carnegie Foundation as a doctoral/research-intensive institution. It offers 87 undergraduate majors, 64 undergraduate minors, 57 masters programs, 23 doctoral programs, two professional programs (medicine and law), and one specialist diploma program. UND's research portfolio that includes \$315 million in committed and ongoing accounts. Research activity is centered in the Colleges and Schools, which include the College of Arts and Sciences, College of Business & Public Administration, College of Education & Human Development, College of Nursing, Odegaard School of Aerospace Sciences, School of Engineering & Mines, the School of Law, and the School of Medicine & Health Sciences.

The university operates a number of research units, which among others include the Energy and Environmental Research Center (EERC), Center for Rural Health, Center for Innovation, Upper Midwest Aerospace Consortium, Bureau of Governmental Affairs, Bureau of Educational Services and Applied Research, Social Science Research Institute, and Northern Great Plains Center for People and the Environment. The EERC includes the National Alternative Fuels Laboratory and National Center for Hydrogen Technology among other branches of research. One research project of note by the Chemical Engineering Department and the EERC is to discover uses of biofuels and other recognizable projects in aviation. The university works closely with the Grand Forks Human Nutrition Research Center of the U.S. Department of Agriculture and the North Dakota Geological Survey.

The university is an anchor of the Red River Valley Research Corridor. A 55-acre Technology Park, which is adjacent to campus, is operated by the university to host both emerging enterprises and established centers and units. It also facilitates the transfer of university research advances to applications in business and industry. Prominent facilities in this endeavor include the Ina Mae Rude Entrepreneur Center and the Norman Skalicky Technology Incubator.

Energy at UND

Reducing energy and operating costs are continual concerns for the university. UND is situated in an area characterized by warm summers and long, severely cold winters. The cold temperatures have a direct correlation to energy demand for heating purposes. The primary energy sources are on-campus steam production and off-campus electricity. According to data from Facilities Management, approximately 32 percent of UND's energy goes to space heating, 22 percent to water heating, 22 percent to lighting, 5 percent to space cooling and 17 percent to other uses, such as pluggable loads, personal computers, classroom equipment, research equipment, and task lighting.

Heating and cooling, as well as water heating, sterilization, dishwashing, and humidification, are provided by an on-campus steam generating plant. The plant operates continuously to produce and distribute steam through approximately 10 miles of piping to 6.8 million square feet: 5.33 million square feet are campus buildings and the remaining is sold to outlying or surrounding entities. On-campus buildings represent between 70 and 80 percent of demand for steam produced by the plant. The plant burns approximately 55,757 tons of coal, or 587 rail cars per

year of Montana sub-bituminous coal from Westmoreland Coal Company. It produces approximately 680 million pounds of steam each year at the current cost of \$8.98 per 1,000 pounds of steam. It also produces 3,600 tons of ash per year. Three coal-fired boilers provide 213,000 pounds of steam per hour during peak demand. The demand for steam varies from hour to hour. Peak demand can be as great as 250,000 pounds per hour. The plant also has four boilers that can be fired by both natural gas and #2 distillate oil, with a capacity of 210,000 pounds of steam production per hour. They function as additional support to the coal boilers and can be used in the periods of emergency or high demand.



Grand Forks, ND is characterized by long, cold winters with average temperatures in January of 5 degrees Fahrenheit (<http://www.crh.noaa.gov/fgf/climate/gfkf6.php>).

In addition to sub-bituminous coal, the steam plant has also tried to burn lignite coal, wood pellets, sunflower hulls, grass, synthetic coal, and garbage pellets. The burner must be adapted to a specific fuel, so most of these burns were simply test burns, and the burner was not adapted to burn any of these alternative fuels. According to the plant production supervisor, the steam plant increased its emissions capture in 1992. This was achieved by installing side-screen bag houses, which filter out particulates leaving the emissions stack.

The electricity at UND is purchased from three different sources (Figure 2). In FY 2007, UND purchased approximately 79,350,000 kWh from a total of three different sources. Western Area Power Association (WAPA), which is within the U.S. Department of Energy, is the primary

supplier of electricity. It is contracted to provide a firm amount of electricity to UND through 2020

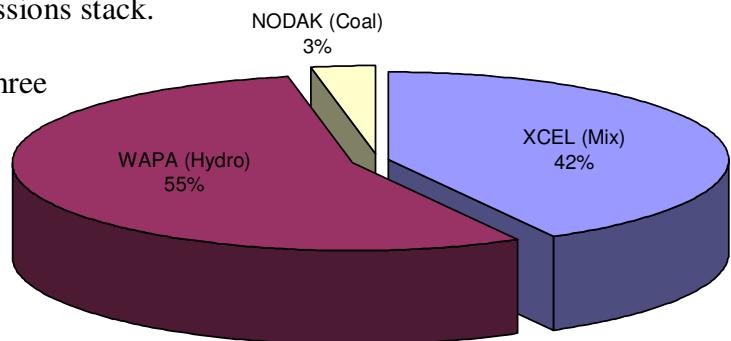


Figure 2: UND electricity providers. Data is based on average percentages of the last 15 years.



Western Area Power Association (WAPA) supplies UND with 44,062,000 kWh of hydroelectricity annually, accounting for 50-60 percent of campus electricity needs (Source: www.wapa.gov).

at a rate of \$0.02426/kWh. WAPA produces electricity via hydropower in western North Dakota. Through WAPA, between 50 and 60 percent of the university's electrical energy is produced by hydropower. Anything above what WAPA provides is supplied by Xcel Energy, which provides electricity to UND at \$0.04971/kWh. Approximately 50 percent of Xcel Energy's electricity is coal-based, and the remaining is from natural gas, nuclear, and oil. Finally, Nodak Electric provides 100 percent coal-fired electricity to UND's off-campus facilities, such as at the Grand Forks International Airport. In addition to these purchased sources of electricity, the campus has diesel-fueled backup generators capable of producing 15 megawatts. According to Facilities Management, the generators are operated approximately 120-140 hours per year.

Strategies for sustainability and efficiency to date

UND has already invested significantly in energy efficiency projects. Beginning in 2000, UND

executed a \$3.9 million comprehensive energy efficiency improvement program reducing electrical and steam usage. This currently generates a savings of about one-half million dollars each year, which is used to pay off the improvement cost. An additional \$2.1 million facility energy improvement program reduced electrical, steam, natural gas and water usage, beginning in 2005. These actions were guided by an effort to reduce energy consumption, but were not based on a campus-wide survey of energy consumption and GHG emissions.

For these efforts, UND received the Administrator Award for Energy Efficiency and Renewable Energy from WAPA in 2001. The award recognized UND's advances in high-tech energy, which has allowed it to heat more buildings with less energy. Prior to that, UND received a National Energy Award in 1994 from the U.S. Department of Energy for the New Dimension in Boiler and Building Technology project.

Research and implementation of efficient energy strategies has allowed the university to cut costs and increase efficiency. UND will continue to look for ways to enhance efficiency in meeting the needs associated with heating and providing electricity for a growing campus.

METHODOLOGY

GHG emissions of fiscal years (FY) 1993 to 2007 were calculated based on the data collected in 2008 from various departments across campus. This report covers July 1, 1992 through June 30, 2007. Data from FY 2008 has been collected but will not be reported until the 2009 GHG inventory. UND's emissions were calculated following the procedures outlined for ACUPCC and using the Clean Air-Cool Planet Campus Carbon Calculator program as the primary tool (Figure 3).⁴ The calculator is a free excel workbook designed to facilitate these tasks. It calculates emissions for the years 1990-2060, and produces charts and graphs that illustrate changes and trends in emissions. The calculator includes all six greenhouse gases specified by Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). It is based on workbooks provided by IPCC on climate change for national-level inventories and is adapted for use at institutions like a college or university.³

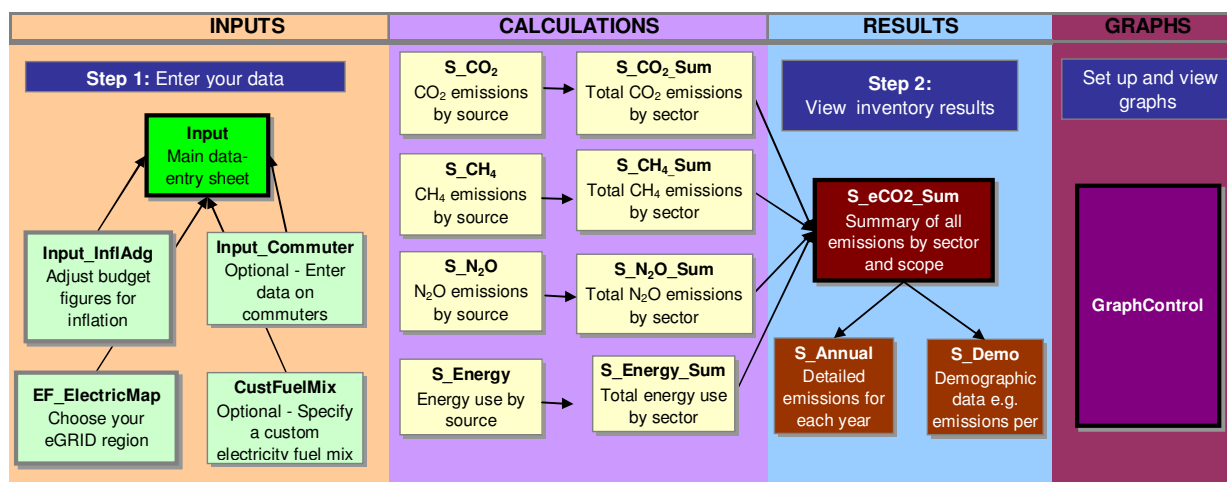


Figure 3: Clean Air-Cool Planet Campus Carbon Calculator spreadsheet map

Because carbon dioxide (CO₂) is the greatest GHG, emissions are reported by metric tons of carbon dioxide emissions (MTCDE), unless otherwise stated. A metric ton is defined by Clean Air-Cool Planet as the common international measurement for the quantity of greenhouse gas emissions.⁴ A metric ton is equal to 2205 lbs or 1.1 short tons (a short ton is the common measurement for a ton in the United States, equal to 2,000 lbs or 0.907 metric tons).⁴

All data collection, calculations, and estimations were done with the goal of inputting the appropriate data in the appropriate category in the carbon calculator. Data was collected across three scopes of emissions, which indicate the level of responsibility and ownership of the emissions:

1. Scope 1: Direct emissions sources
 - a. On-campus stationary sources (steam plant and generators)
 - b. Transportation
 - c. Fugitive emissions from refrigeration and agriculture.
2. Scope 2: Indirect sources owned by UND
 - a. Purchased electricity

-
- b. Transmission and distribution (T&D) losses
 - 3. Scope 3: Sources not owned but financed by UND
 - a. Commuting faculty, staff and students
 - b. Directly financed/study abroad air travel
 - c. Solid waste
 - d. Wastewater
 - e. Paper

As is the case with most GHG emissions inventories, there were data sets for which complete information since 1993 could not be acquired, or did not come in the same form as the calculator required for input. Categories in which this occurred was direct transportation—the state fleet records by miles for gas and hours for diesel, rather than gallons, which the calculator requires as an input; commuting, which was based on a survey of campus members in the fall of 2008; air travel—the calculator asks for miles traveled, which is not recorded by any university department; waste, for which data was missing for one year; paper purchasing, which is not recorded by a central department and thus only one year of data was available; and fertilizer, which was estimated to have remained stagnant by the responsible department.

Presentation of a complete picture of UND's emissions over time was deemed important. Therefore, in cases where data was incomplete, methodology was developed to fill in the most likely numbers, based on trends, averages, or other methodology approved by the ACUPCC. To get accurate numbers for future inventories, some organizational and administrative procedures will need to be adopted or changed.

Once all data was collected and data gaps were filled in, the numbers were entered into the carbon calculator input section. The carbon calculator then processed the data by identifying emissions factors, making calculations, showing detailed results year by year. The results were made into graphs and visuals to demonstrate campus emission trends. The calculator also provided similar results for energy consumption.

This methodology was developed with the goal of organizing different data sources that could be applied in future work. The purpose of this methodology was to provide consistency in data collection and interpretation, therefore, this information was detailed in a protocol document created for this inventory. The 2008 protocol provided a framework for suggestions and recommendations to improve methods of data collection, analysis, and record-keeping, which will make future inventories more efficient and accurate. The expectation is that future inventories will adhere to this protocol.

RESULTS

Overall Emissions and Trends

- UND's total emissions increased from 126,799 MTCDE in 1993 to 138,633 MTCDE in 2007, which is a 9 percent increase (Figure 4). UND's emissions peaked in 1994 at 140,503 MTCDE. UND emits on average 131,738 MTCDE per year.

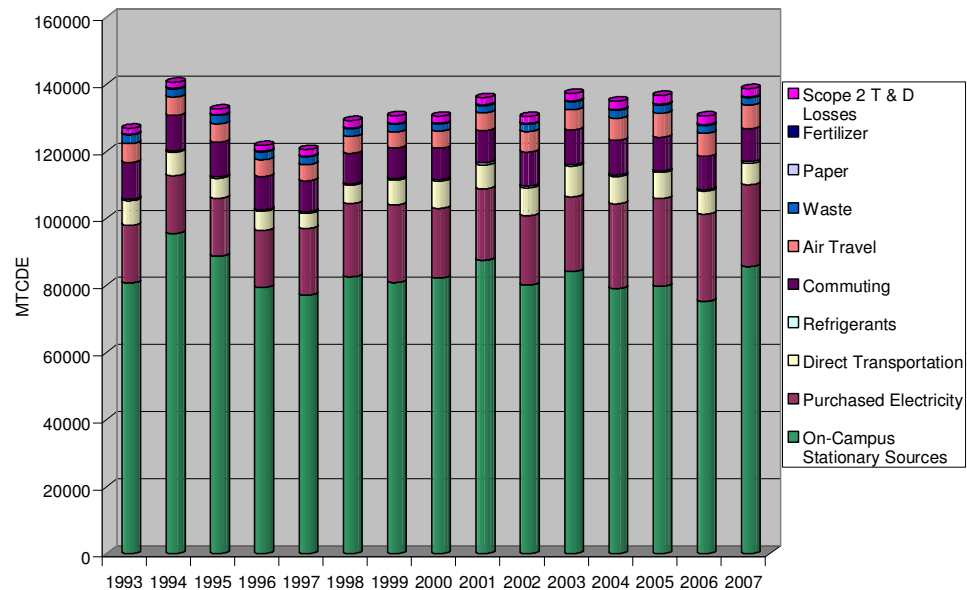


Figure 4: UND campus greenhouse gas emissions 1993-2007

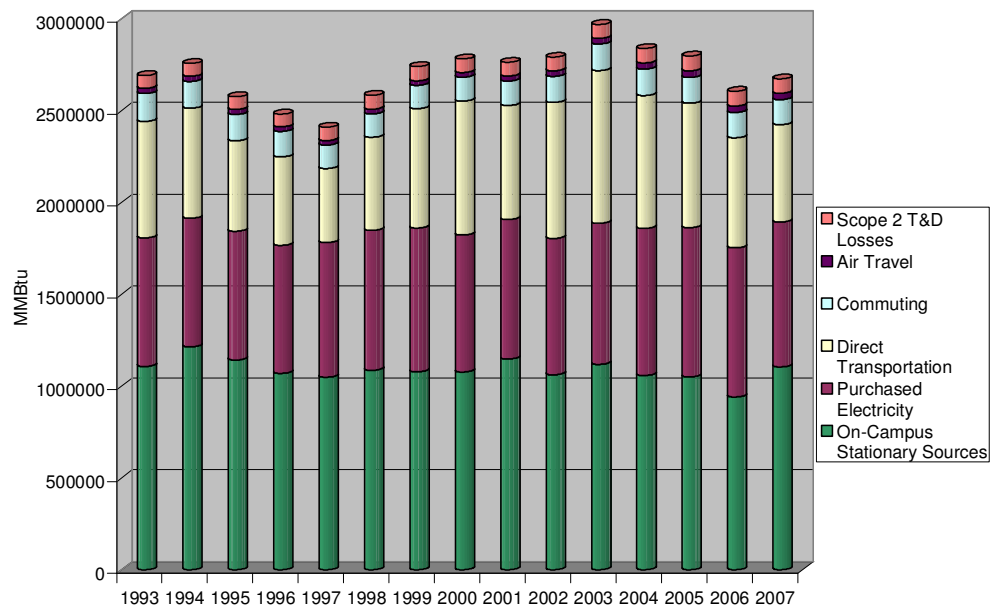


Figure 5: UND energy consumption, 1993-2007

- UND's energy consumption decreased from 2,491,009 MMBtu in 1993 to 2,482,948 MMBtu in 2007, which is a 0.3 percent decrease (Figure 5). UND's energy consumption peaked in 2003 at 2,749,786 MMBtu. On average, UND consumes 2,497,805 MMBtu per year.

- UND relies predominantly on fossil fuels to meet its energy needs. In 2007, 80 percent of overall energy needs were met by using fossil fuels (coal, natural gas, gasoline, diesel, aviation gas, jet fuel, distillate oil). Hydroelectric power production made up 18 percent of energy needs, nuclear was 1.4 percent, and other renewable sources made up 0.1 percent of energy needs. UND transportation reportedly uses a certain amount of biodiesel and ethanol that was not able to be recorded in the inventory.

- UND's student body has grown by 561 students since 1993. The student population in 2007 was 12,559. The campus area has increased by 433,697 square feet since 1993, an increase

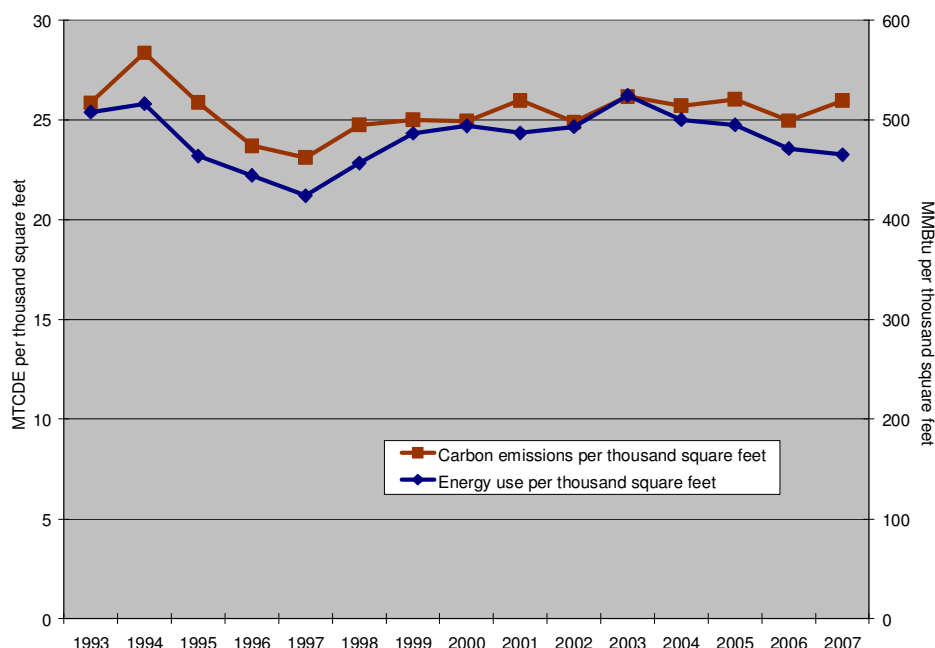
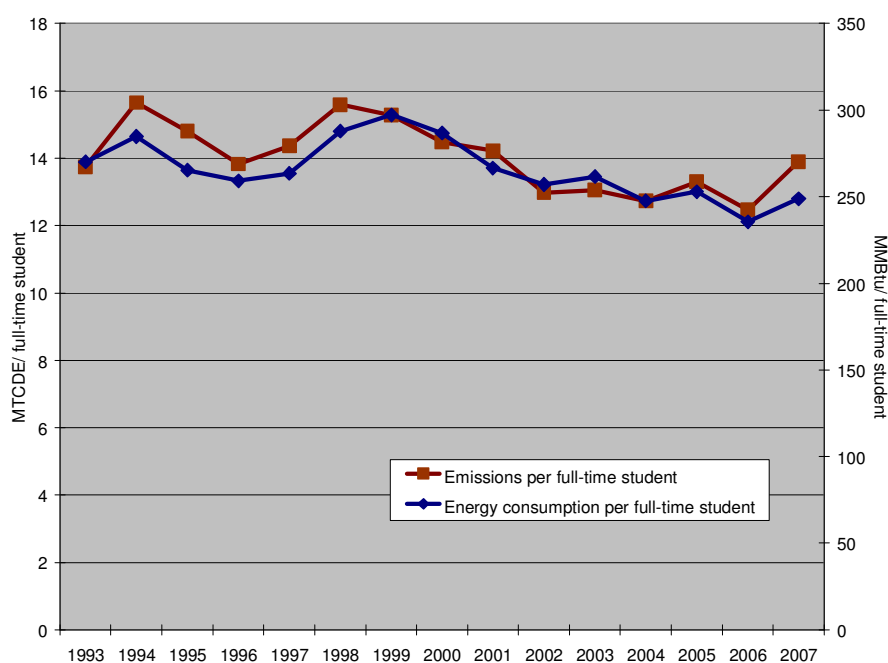


Figure 6: Emissions and energy use per thousand square feet

of 8 percent. Campus area in 2007 covered 5,339,643 square feet.

- UND's emissions per campus member (full and part time students, faculty, and staff) grew from 8.47 MTCDE per person in 1993 to 9.08 MTCDE per person in 2007, which is 6.7 percent. The average over the 15 years reported was 9.11 MTCDE per person. Total emissions per 1000 square feet increased from 25.85 MTCDE in 1993 to 25.96 in 2007, which is a 0.4 percent increase. (Figure 6). The average over the reporting period was 25.41 MTCDE.

- Total energy use has decreased (-0.3%), with energy use per student decreasing by 8 percent and energy use per 100 square feet also decreasing by 8 percent from 1993-2007 (Figure 7).



Composition of Emissions

- The major sources of UND's emissions in 2007 result from on-campus stationary sources (62%), purchased electricity (18%), and transportation (commuting, air travel, direct transportation—17%). Remaining sources (4%) are scope 2 transmission and distribution losses, waste disposal, refrigerants, paper purchasing, and fertilizers (Table 2).

- Major sources of emissions have not changed since 1993, however the ratio has changed. In 1993, the composition of emissions was on-campus stationary sources (64%), purchased electricity (14%), transportation (19%), and remaining sources (3%).

- The campus steam plant is responsible for 62 percent of total emissions on average from 1993-2007.

- Steam plant efficiency is shown to be relatively stable since 1998. Energy use and steam plant emissions from heating vary each year, often depending on the severity of winter. The CA-CP Carbon Calculator does not account for different coal properties used in the plant.

- As UND's electrical needs grow, it must purchase additional supplemental power to meet its needs. This has resulted in rising costs as well as higher emissions. Emissions from electricity sources (and the associated transmission and distribution losses) have increased by 29 percent since 1993, the largest increase in any category (Table 3).

Emissions source	Percent of total 1993 emissions	Percent of total 2007 emissions
On-campus stationary sources	63.64%	61.74%
Purchased electricity	13.57%	17.60%
Commuting	8.63%	7.06%
Air travel	4.46%	5.08%
Direct transportation	5.76%	4.58%
Scope 2 T&D losses	1.34%	1.74%
Waste	2.04%	1.60%
Refrigerants	0.38%	0.42%
Paper	0.19%	0.18%
Fertilizer	0.00%	0.00%

Table 2: Composition of emissions by category in 1993 and 2007

Source	1993 MTCDE	2007 MTCDE	Percent change
On-campus stationary sources	80,691	85,588	6%
Purchased electricity	17,211	24,403	29%
Direct transportation	7,297	6,348	-15%
Commuting	10,937	9,785	-12%
Air travel	5,657	7,042	20%
Waste	2,587	2,219	-17%
Transmission & distribution losses	1,702	2,413	29%
Refrigerants	477	586	19%
Paper	237	246	4%
Fertilizer	3	3	0%
Total emissions	126,799	138,633	9%

Table 3: Percent change in emissions per source for 1993 to 2007

Scopes

The carbon calculator organized data into scopes, which indicate the level and responsibility and ownership of emissions:

1. Scope 1: Direct emissions sources
 - a. On-campus stationary sources (steam plant and generators)
 - b. Transportation (fleet and aviation school)
 - c. Fugitive emissions from refrigeration and agriculture.
2. Scope 2: Indirect sources owned by UND
 - a. Purchased electricity
 - b. Transmission and distribution (T&D) losses
3. Scope 3: Sources not owned but financed by UND
 - a. Commuting faculty, staff and students
 - b. Directly financed/study abroad air travel
 - c. Solid waste
 - d. Wastewater
 - e. Paper

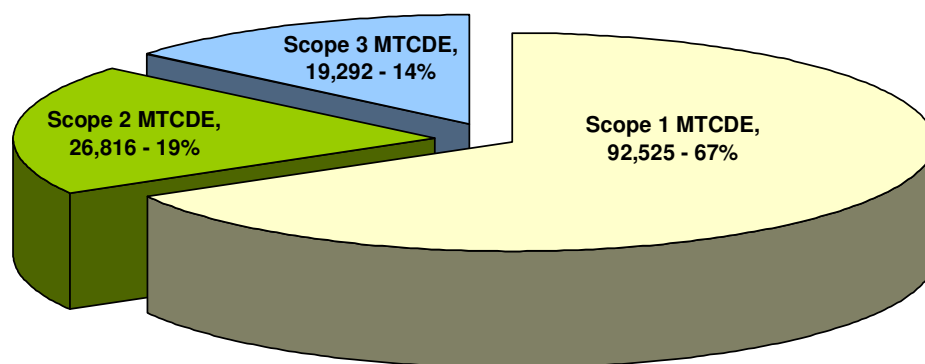


Figure 8: 2007 ratio of contribution of scopes

Figure 8 shows that 67 percent of UND's emissions are Scope 1 sources—produced by the campus, either by stationary power sources such as the steam plant and on-campus generators, or by the campus fleet and the aviation school.

Scope 2 sources, purchased electricity and the losses from the transmission and distribution of the electricity, make up 19 percent of UND's emissions. Even though the university didn't produce the electricity, the emissions are attributed to UND. If UND converted its steam plant to a cogeneration facility (produces both steam and electricity), then the responsibility for the electricity emissions would shift to Scope 1. There would also be a reduction in the T&D losses.

Scope 3 sources, which account for 14 percent of UND's emissions, are attributed to UND because they are occurring as a result of university business. They are neither produced by UND nor owned by UND, so are the least direct sources. Because there is so much room for error in data collection in Scope 3—especially with commuting and directly financed air travel—the ACUPCC has reporting institutions report their emissions with and without Scope 3.

On-Campus Stationary Sources

Campus stationary sources produce the highest percentage of overall emissions, the campus steam plant being the main contributor. In FY 2007, on-campus stationary sources produced approximately 85,600 metric tons of CO₂ emissions (MTCDE) which accounted for 62 percent of total campus emissions (Table 4). The steam plant, which is fueled primarily by coal and secondarily by #2 distillate oil and natural gas, is responsible for approximately 98 percent of on-campus stationary source emissions (Figure 9). Other sources of emissions that contribute to the on-campus stationary source category are eight university-owned fixed generators, as well as natural gas burned at buildings not connected to the campus, such as Ryan Hall, the airport, and Fargo medical buildings.

Year	On Campus Stationary Sources (MTCDE)			Total	Percent of overall emissions
	Steam Plant	Fixed Generators	Natural Gas		
1993	79514	0	1177	80691	64%
1994	94158	85	1177	95421	68%
1995	87334	146	1177	88657	67%
1996	77991	161	1177	79328	65%
1997	75696	206	1177	77079	64%
1998	80945	393	1177	82515	64%
1999	79326	316	1177	80818	62%
2000	80792	216	1177	82186	63%
2001	85998	180	1267	87446	64%
2002	78598	264	1218	80080	61%
2003	82694	153	1284	84132	61%
2004	77504	285	1253	79042	59%
2005	78256	259	1177	79692	58%
2006	74053	307	829	75190	58%
2007	84088	381	1119	85588	62%

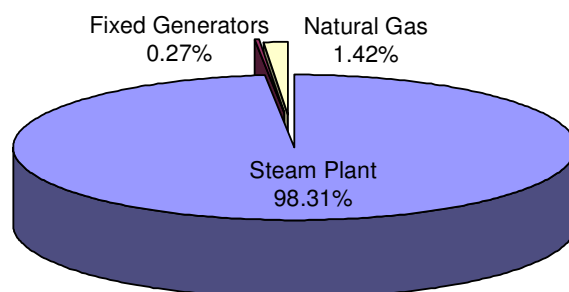


Figure 9: Percent contributions to overall emissions per stationary source category.
Data is based on percent totals over 15 years.

Table 4: UND on-campus stationary sources, 1993-2007



The campus steam plant is the largest consumer of energy and the greatest source of emissions on campus.

Steam Plant

UND's steam plant is the largest consumer of energy and the greatest source of emissions on campus. In FY 2007, the steam plant used approximately 887,600 MMBtu and 84,000 MTCDE. Steam plant emissions have been relatively stable since base year 1993 with little overall change. The highest emissions (63%) were seen in 1994, while 2006 marked the lowest point (58%). Efficiency improvements contributed to a trend of decreasing emissions from 2001 to 2006, however, system failures and a cold winter caused emissions to increase again in 2007. Emissions from the steam plant largely depend on the severity of winter, with the general trend being higher emissions associated with colder winters and more heating degree days. Heating degree days are a quantitative index designed to reflect the demand for energy needed to heat a building.

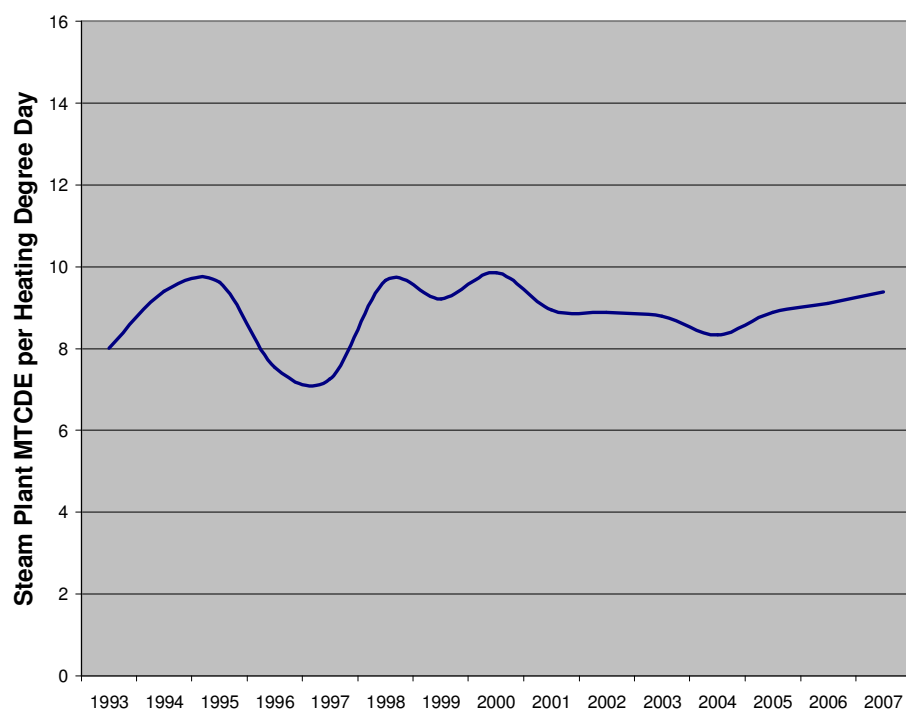


Figure 10: Steam plant emissions per heating degree day, 1993-2007. This shows the efficiency of the steam plant over time.

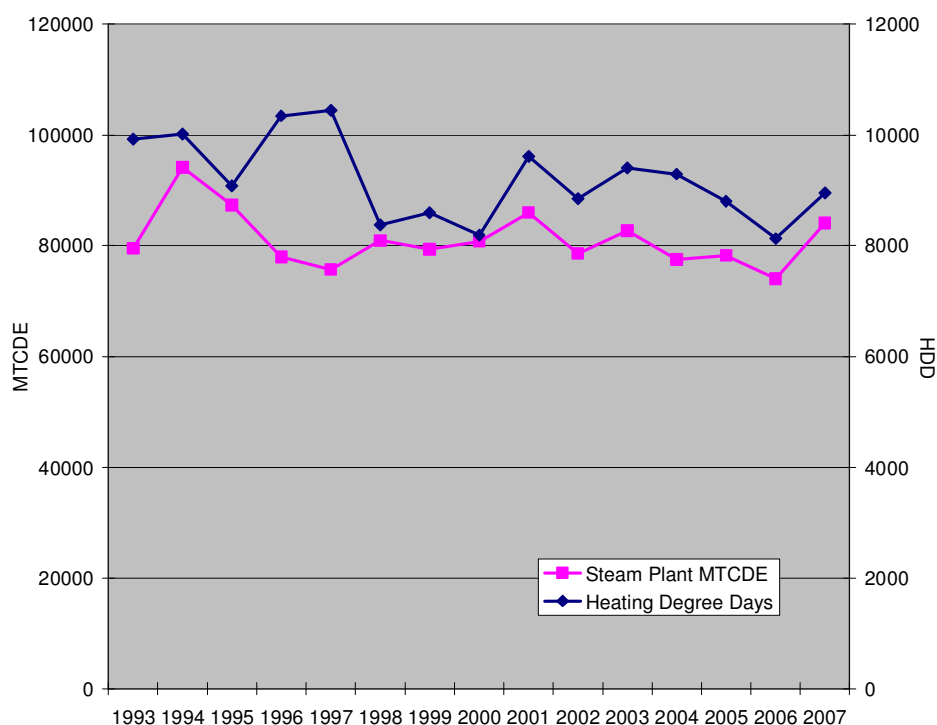


Figure 11: Steam plant emissions and heating degree days, 1993-2007. This shows the relationship between steam plant emissions and heating degree days.

Figure 10 shows the steam plant's emissions per heating degree day, which provides a graphical representation of the plant's efficiency. Figure 11 shows the relationship between steam plant emissions and heating degree days. Discrepancies for the years 1996 and 1997 are likely caused by inconsistent data resulting from disaster-related occurrences. Above average numbers of heating degree days combined with power outages associated with blizzards and flooding could explain the disturbance in the trend seen in other years. Differences in the fuel mix used in the boilers from year to year can also explain some of the variation. Higher quantities of natural gas and lower amounts of coal were used in years 1993, 1996, 1997, and 1999, which correspond with lower emission years.

Electricity Sources

The second largest contributor to campus emissions comes from purchased electricity. UND campus electrical usage for FY 2007 was responsible for approximately 790,000 MMBtu and 24,400 MTCDE, which is 18 percent of total emissions (Figure 12). Overall usage has increased since base year 1993, which can be attributed to campus growth, higher student numbers, and a greater amount of intensive electricity uses, such as research. However, energy use per thousand square feet of building space decreased in 2007, which may be attributed to campus lighting efficiency projects (Figure 13). Energy consumption has increased by 11 percent from 1993-2007, while emissions from electricity have increased by 30 percent. The higher increase in emissions is due to the declining percentage of hydroelectricity as a source.

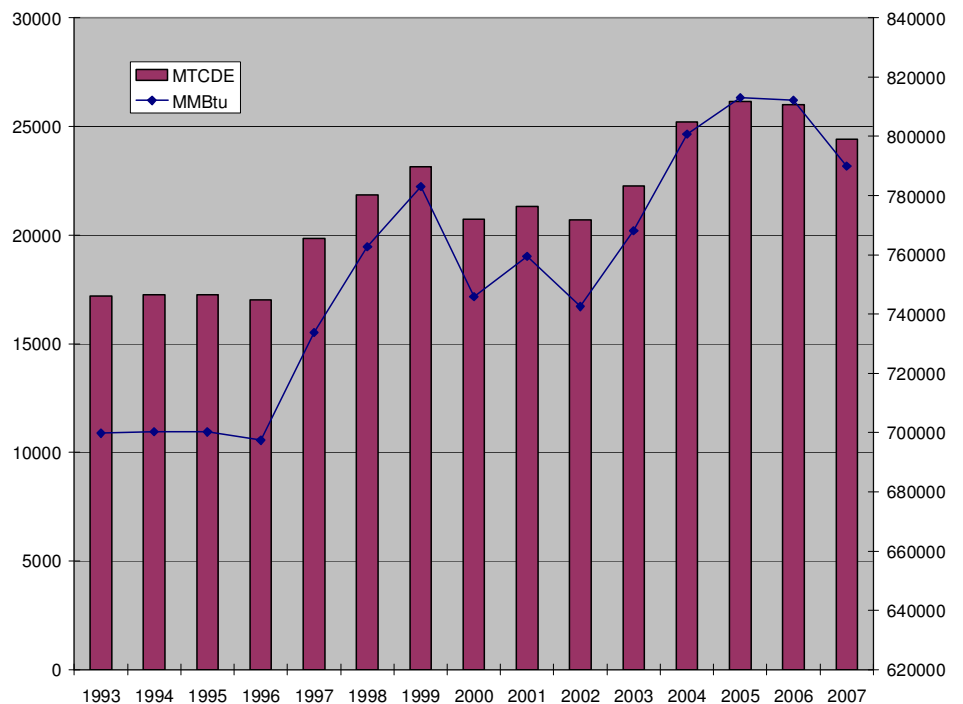


Figure 12: Emissions and energy consumption from electricity, 1993-2007

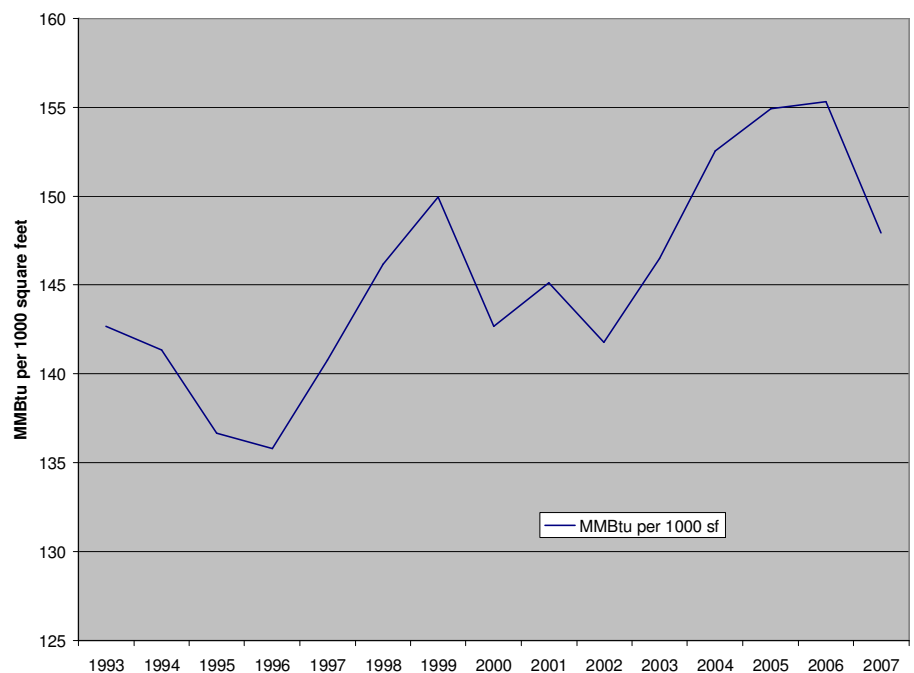


Figure 13: Energy units (MMBtu) from electricity, per thousand square feet of building space

	Total Electricity Purchased (kWh)	Hydro-Electric (%)	Coal (%)	Natural Gas (%)	Nuclear (%)	Distillate Oil (#1-#4) (%)	Waste to Energy (%)	Renewable (wind, solar) (%)	Residual Oil (#5-#6) (%)	Biomass (%)
1993	68,002,458	65.8%	19.9%	9.9%	3.3%	0.9%	0.1%	0.1%	0.0%	0.0%
1994	68,002,458	65.8%	19.9%	9.9%	3.3%	0.9%	0.1%	0.1%	0.0%	0.0%
1995	68,002,458	65.8%	19.9%	9.9%	3.3%	0.9%	0.1%	0.1%	0.0%	0.0%
1996	67,643,321	66.1%	19.7%	9.8%	3.2%	0.9%	0.1%	0.1%	0.0%	0.0%
1997	71,688,972	62.6%	21.5%	11.0%	3.6%	1.0%	0.1%	0.1%	0.0%	0.0%
1998	74,506,187	60.3%	22.7%	11.8%	3.9%	1.1%	0.2%	0.1%	0.0%	0.0%
1999	76,417,176	58.9%	23.4%	12.2%	4.0%	1.1%	0.2%	0.1%	0.0%	0.0%
2000	72,977,198	61.5%	22.1%	11.4%	3.7%	1.1%	0.1%	0.1%	0.0%	0.0%
2001	73,993,925	60.7%	22.5%	11.6%	3.8%	1.1%	0.1%	0.1%	0.0%	0.0%
2002	73,492,361	61.1%	22.3%	11.5%	3.8%	1.1%	0.1%	0.1%	0.0%	0.0%
2003	76,040,977	59.2%	23.3%	12.1%	4.0%	1.1%	0.2%	0.1%	0.0%	0.0%
2004	80,388,100	56.2%	24.9%	13.1%	4.3%	1.2%	0.2%	0.1%	0.0%	0.0%
2005	81,739,406	55.3%	25.3%	13.4%	4.4%	1.3%	0.2%	0.1%	0.0%	0.0%
2006	81,557,146	55.4%	25.1%	13.5%	4.4%	1.3%	0.2%	0.1%	0.0%	0.0%
2007	79,351,339	56.9%	24.4%	13.0%	4.3%	1.2%	0.2%	0.1%	0.0%	0.0%

Table 5: Fuel sources of electricity purchased by UND, 1993-2007

Table 5 shows UND's fuel sources from 1993-2007. UND's contract with WAPA covers over half of campus electricity demand and contributes clean hydroelectricity to UND's purchased electricity fuel mix. The remainder of campus demand is met by Xcel Energy, which uses a variety of sources (Table 6). Nodak Electric provides UND's airport facilities with electricity, which accounts for 2 to 3 percent of annual usage.

Because UND has a fixed contract with WAPA, increasing demand for electricity must be met by increased amounts purchased from Xcel Energy, which relies more on coal as a fuel source. The results are more emissions from fossil fuel sources. This trend will likely continue until UND's contract with WAPA changes or the campus develops alternative energy projects.

Electricity Supplier	Generation Type	Percentage
WAPA	Hydro	100%
Xcel Energy	Coal	51.9%
Xcel Energy	Natural Gas	31.1%
Xcel Energy	Nuclear	10.2%
Xcel Energy	Hydro	3.2%
Xcel Energy	Oil	2.9%
Xcel Energy	Refuse	0.4%
Xcel Energy	Wind	0.2%
Nodak	Coal	100%

Table 6: Fuel sources for UND purchased electricity

Transportation

Transportation rivals electricity as the second or third largest source of emissions on campus. Transportation sources are categorized from most direct sources to least direct. Direct transportation covers the university fleet and the aviation school pilot training program. Indirect transportation sources are directly financed outsourced travel, study abroad air travel, and commuters. In FY 2007, all categories of campus transportation combined for total energy use of 701,000 MMBtu, which is 28 percent of overall energy use, and 23,000 MTCDE, which is 17 percent of campus emissions (Figure 14).

Transportation is a key aspect of UND's overall emissions. Commuting is the largest source of emissions—student, faculty and staff commuting make up 42 percent of transportation emissions (Figure 15). Many campus members (students, faculty, and staff) travel long distances to campus from rural locations. UND also supports air travel for business purposes and for students interested in studying abroad, together they make up 30 percent of transportation emissions. It is important to note that transportation emissions at UND are likely to be higher than at most institutions because of the aviation school, which makes up 21 percent of the transportation emissions. Finally, the university fleet makes up 7 percent of transportation emissions.

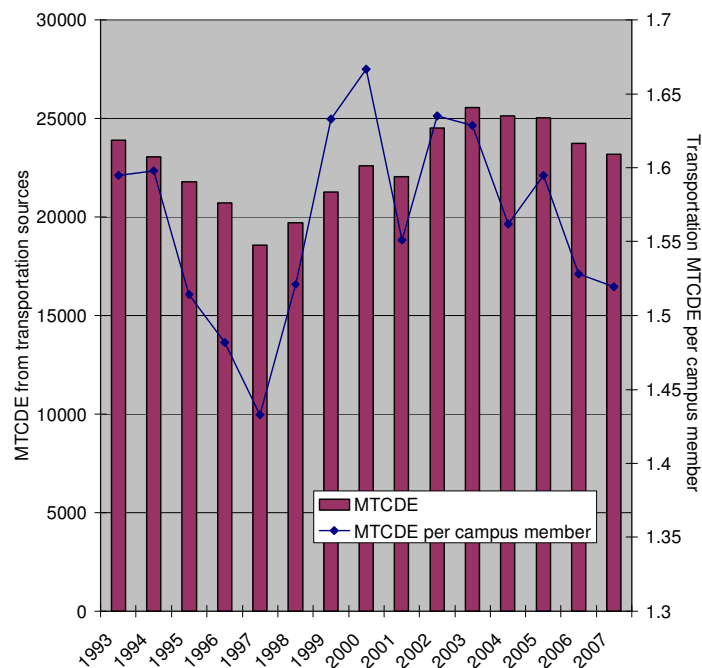


Figure 14: Transportation emissions, 1993-2007

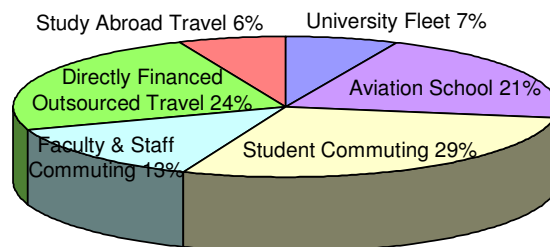


Figure 15: Percent contributions of each transportation source to overall transportation emissions

Emissions from transportation have remained relatively stable over the last 15 years. The lowest point was 1997, which was likely due to the flood that shut down UND for the end of the spring semester (Figure 14). The high point was 2003, which corresponds with growth in numbers of campus members. Lower numbers of campus members correspond with lower transportation emissions.

University Fleet

The university fleet consists of all state-owned vehicles, including all campus shuttle buses, motor coaches, and utility operators. Data was based on the university's Department of Transportation annual reports, which supplied mileage and gallon usage for the gasoline vehicles, and hourly totals for the diesel vehicles. Because total gallon data was not available for the diesel fleet,

estimations were made based on an hour per gallon ratio for campus shuttles and motor coaches. Based on all available information, the university fleet consumed approximately 93,000 gallons of gasoline and 69,500 gallons of diesel fuel in FY 2007.

Emissions from the university fleet totaled 1,532 MTCDE, or about 1 percent of all campus emissions.



UND operates a system of shuttle buses, giving students an alternative to walking or driving when on campus.

Aviation School

UND Aerospace offers flight training opportunities to students as part of the institutions' well-known aviation program. UND operates a fleet of over 100 aircraft, which is the world's largest non-military fleet of training aircraft, within its training complex at the Grand Forks International Airport. The jet fuel and aviation fuel used in flight training contributes significantly to campus emissions and is categorized as a direct transportation source. In FY 2007, UND Aerospace used approximately 16,000 gallons of jet fuel and 508,000 gallons of aviation fuel, which make up 20 percent of the energy used by UND. This use emitted 4,815 MTCDE, or 3 percent of all campus emissions.



UND Aerospace offers flight training with a fleet of 100+ aircraft.

Commuting

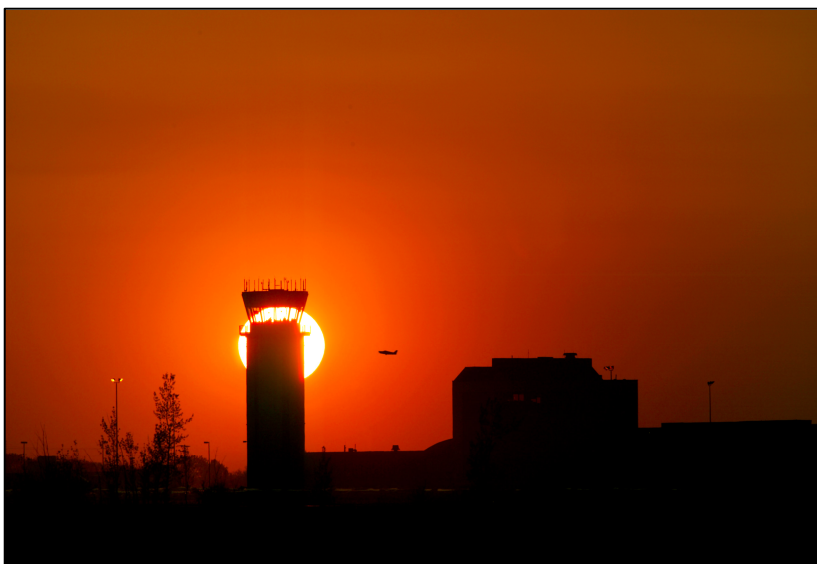
With a population of over 15,000 campus members, the commute to campus for students, faculty, and staff produces a considerable amount of emissions. The data gathered for commuting was based on the returns of an email survey sent out to all UND students and employees in October 2008. The survey was designed to sample commuting habits across campus and determine an estimate of miles traveled per year per member. From the results of the survey, the estimated fuel consumption for the student community was 716,000 gallons of gasoline and 29,000 gallons of diesel in FY 2007. Faculty and staff consumed approximately 347,000 gallons of gasoline and 725 gallons of diesel. Emissions from commuting estimates totaled 9,800 MTCDE, or 7 percent of total campus emissions in FY 2007. Commuting consumed 136,080 MMBtu, or 5 percent of total energy usage.

Directly Financed Outsourced Travel

Emissions from UND financed travel were estimated using records of airline tickets and spending on faculty and staff trips from 2005-2007. Air travel miles were calculated using a conversion method approved by the ACUPCC. According to the results, faculty and staff totaled over 7.1 million air miles in FY 2007 which used 28,000 MMBtu and produced 5,537 MTCDE, or 4 percent of total emissions.

Study Abroad Air Travel

Emissions from study abroad travel were calculated based on data of the number of students studying abroad each year and the air miles to each destination. Estimates on study abroad travel showed students traveled more than 1.9 million miles in FY 2007, which consumed 7,600 MMBtu of energy and produced 1,505 MTCDE. These numbers represent less than 1 percent of overall energy usage and about 1 percent of total campus emissions.



Air travel miles from faculty and staff trips combined with students studying abroad accounted for about 5% of UND's total emissions in FY 2007.

Waste Management

Waste management at UND consists of the disposal of solid waste and wastewater, which accounts for about 2 percent of campus CO₂ emissions per year. Landfilled waste is the primary source of methane emissions on campus, while wastewater releases a significant amount of nitrous oxide. Carbon dioxide emissions from waste have decreased slightly since base year 1993 (Figure 16). Data is not available for the flood year 1997. Though all trends are shown assuming it was a normal year, it is likely that if data were available, 1997 would be characterized by a much higher amount of waste disposal than other years due to the amount of materials damaged by flooding.

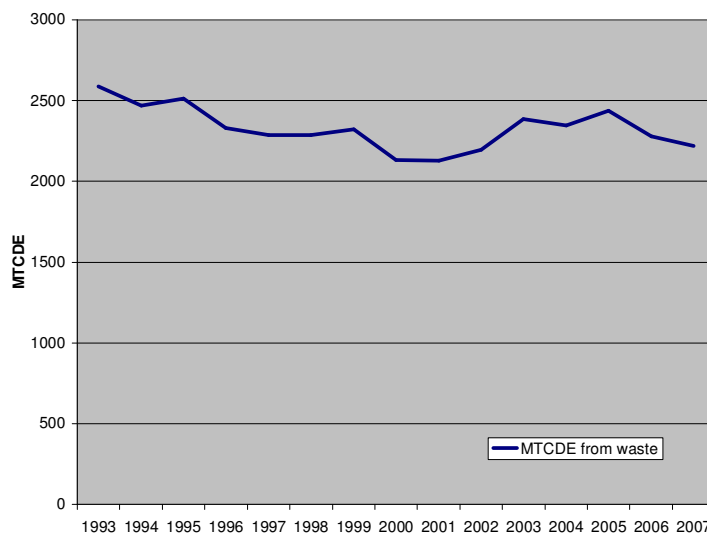


Figure 16: CO₂ emissions from waste, 1993-2007 (Assuming 1997 was average year)

Solid Waste Disposal

UND's campus maintains an aggressive recycling program aimed at reducing the amount of solid waste that goes into the local landfill. UND recycles 15 to 20 percent of its waste each year and sells scrap metal, which accounts for a small percentage of overall waste. These numbers increased from the early 1990's, when only about 5 percent of all waste was recycled or sold. In FY 2007, UND recycled 484 short tons of waste, sold 50 tons of scrap metal, and landfilled 2,159 tons of waste (Figure 17). Solid waste disposal has stayed relatively stable from 1998 through 2007. There are a few years of data that are not available for this category, such as 1997. Flood cleanup and restoration efforts caused waste disposal to be abnormally high that year, but data could not be found.

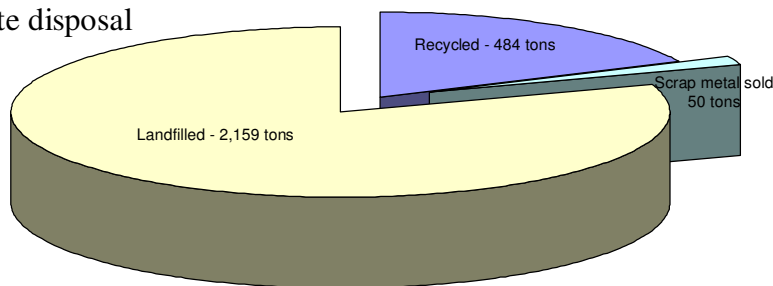


Figure 17: Breakdown of 2007 solid waste disposal in short tons

Solid waste disposal accounts for a small percentage of campus CO₂ emissions and is the primary source of methane (CH₄) emissions, which has 21 times the global warming potential of CO₂.⁴ The city landfill that takes the waste does not currently have CH₄ recovery capabilities. Landfilled waste contributed 2,145 MTCDE, or 2 percent of total campus CO₂

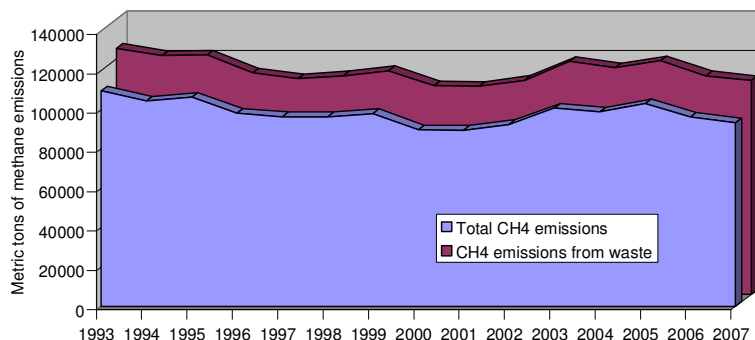


Figure 18: CH₄ emissions in kg, 1993-2007

emissions in FY 2007. More significantly, solid waste was responsible for approximately 93,000 kg of CH₄ emissions, or 86 percent of overall campus CH₄ emissions (Figure 18). Methane emissions from waste have decreased by 15 percent from 1993-2007.

Wastewater

UND's wastewater is another small contributor to campus emissions. Water waste from campus generally gets sent to a local water treatment plant. While CO₂ emissions from wastewater are less than 1 percent of total emissions (74 MTCDE in FY 2007), nitrous oxide (N₂O) emissions are more significant. Wastewater was responsible for 250 kg of N₂O emissions, or 8 percent of campus N₂O emissions in FY 2007.

Other Sources of Emissions

Refrigerants

The release of chemical refrigerants is a very small source of CO₂ emissions for UND. The primary chemical sources of refrigerant emissions at UND are chlorofluorocarbons (CFC's). There were 760 pounds of CFC-22's lost in FY 2007, accounting for 586 MTCDE (Figure 19). Less than 1 percent of total campus emissions can be traced to refrigerants.

Paper

UND purchases approximately 200,000 pounds of paper each year. It is estimated that 20 percent of paper purchased has a recycled content of 30 percent, while the rest does not have any recycled content. The paper purchased in FY 2007 produced 246 MTCDE, less than 1 percent of total emissions.

Fertilizer

UND does not practice agriculture, but it does apply fertilizer to practice fields and flower beds. 2,400 pounds of synthetic fertilizer was used on campus. The fertilizer used contained 28 percent nitrogen. This amount of fertilizer is responsible for no more than 3 MTCDE per year.

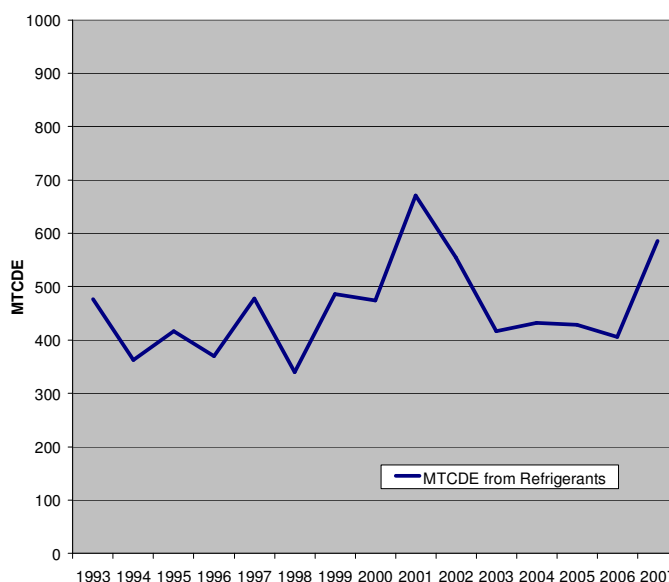


Figure 19: CO₂ emissions from chemical refrigerants, 1993-2007

COMPARISON WITH OTHER INSTITUTIONS

A comparison of emissions profiles with other institutions explains the significance of numbers. Figure 20 and Table 7 compares reporting institutions in Idaho, Minnesota, Montana, North Dakota, South Dakota, and Wyoming, as well as two reporting aviation schools—Cornell University, New York and University of Cincinnati, Ohio—and the University of Maryland at Baltimore. The emissions data, which includes all three scopes of emissions and no offsets, was reported by the institutions to the ACUPCC and posted online by the Advancement of Sustainability in Higher Education (AASHE).¹ Figure 20 shows how the institutions compare when emissions are normalized by gross MTCDE per 1000 square feet and gross MTCDE per full time enrollment.

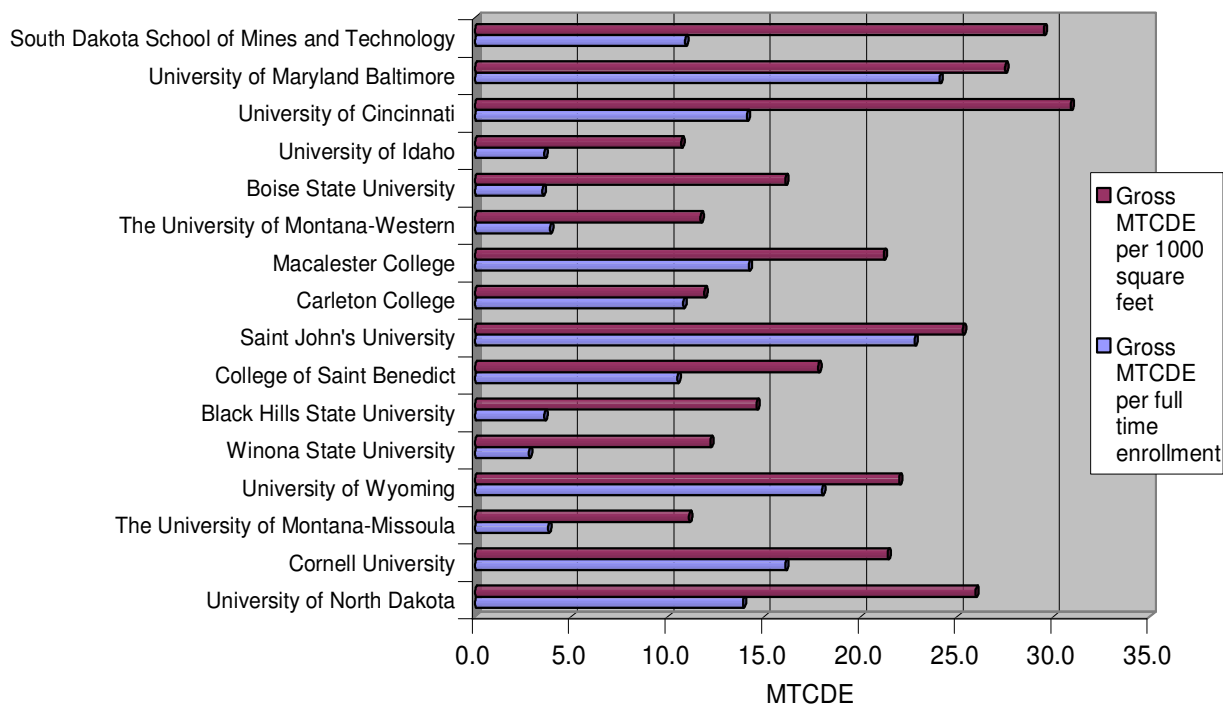


Figure 20: Comparison of emissions of other institutions, as reported to the Association for the Advancement of Sustainability in Higher Education.¹

Table 7 includes these numbers, as well as total emissions, enrollment, and U.S. Department of Energy climate zone. It is ordered by climate zone—from warmest to coldest—and then by enrollment size. UND is the only reporting institution located in climate zone 7. Climate zones are used by the Department of Energy to determine building standards. Of the 16 institutions listed below, the average MTCDE per full time student is 11.0 MTCDE, and the average MTCDE per 1000 square feet is 19.4 MTCDE. UND's emissions are above average.

Institution	State	USDOE Climate Zone	Enrollment	Total MTCDE Emissions	MTCDE per FT student	MTCDE per 1000 sf
South Dakota School of Mines and Technology	SD	4	1,734	18,984	10.9	29.5
University of Maryland Baltimore	MD	4	6,681	160,783	24.1	27.5
University of Cincinnati	OH	4	26,393	372,310	14.1	30.9
University of Idaho	ID	5	10,855	39,594	3.6	10.7
Boise State University	ID	5	14,314	49,884	3.5	16.1
The University of Montana-Western	MT	6	1,084	4,265	3.9	11.7
Macalester College	MN	6	1,889	26,824	14.2	21.2
Carleton College	MN	6	1,986	21,533	10.8	11.9
Saint John's University	MN	6	2,080	47,376	22.8	25.3
College of Saint Benedict	MN	6	2,087	21,823	10.5	17.8
Black Hills State University	SD	6	2,950	10,698	3.6	14.6
Winona State University	MN	6	7,792	2,097	2.8	12.2
University of Wyoming	WY	6	8,659	155,634	18.0	22.0
The University of Montana-Missoula	MT	6	11,186	42,687	3.8	11.1
Cornell University	NY	6	19,800	319,000	16.1	21.4
University of North Dakota	ND	7	9,976	138,633	13.9	26.0

Table 7: Comparison of emissions of other institutions, as reported to AASHE.¹ UND is the only institution in zone 7 that has reported its emissions.

SUMMARY

This report entails a comprehensive review of the GHG emissions of UND from 1993 to 2007. It is the third step of a long-term commitment to become climate neutral:

- Step 1 – Sign the ACUPCC
- Step 2 – Identify tangible actions
- Step 3 – Inventory GHG emissions
- Step 4 – Design climate action plan
- Step 5 – Execute climate action plan
- Step 6 – Measure and verify actions

The ACUPCC defines climate neutrality as having no net GHG emissions, to be achieved by minimizing GHG emissions as much as possible, and using carbon offsets or other measures to mitigate the remaining emissions.² The path to reach climate neutrality will be defined in UND's climate action plan, which is due to the ACUPCC in January 2010. To reach climate neutrality, UND will need to focus on reducing its major emissions.

In 2007, UND emitted 138,633 MTCDE per year. The major sources of UND's emissions in 2007 result from on-campus stationary sources (62%), purchased electricity (18%), and transportation (commuting, air travel, direct transportation—17%). The campus steam plant is responsible for 99 percent of on-campus stationary sources each year, and has accounted for 62 percent of total emissions on average from 1993-2007.

The results of this inventory can provide the emissions information necessary for setting climate action priorities and can also be used to demonstrate cost-benefit analyses of proposed projects. The climate action plan will include project recommendations such as energy efficiency projects and will address the financial obligations of the projects. It will project a target date for climate neutrality along with interim milestones and timeframes for specific projects. It will also show projections of what emissions would have been with no changes and what emissions would be with proposed changes.

In addition to the climate action plan, there will likely be changes proposed to certain areas of record keeping based on the methodology and protocol developed during this inventory. Because the GHG emissions inventory will be updated annually, some organizational and administrative procedures will need to be adopted to enable data collection.

This GHG inventory is an example of how student and academic involvement can be integrated into planning for climate neutrality. In cooperation with Facilities Management, which is the implementation liaison for the university, a large portion of this inventory was performed by the 2008 Earth System Science and Policy 501 class and a graduate student in the Department of Technology. Plans are in place to involve students throughout all steps of this process.

The ACUPCC is based on the concept that universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. As the first institution in North Dakota to sign the commitment, UND has already taken leadership to

address the pressing issue of climate change. The actions necessary to bring UND to climate neutrality will require commitment of personnel and financial support. Such commitments will ensure that UND will lead the university, its community, graduates and state towards mitigating society's greatest crisis.

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 - Santosh Rijal
 - Navin Thapa
 - Junyu Yang
- Facilities Management, Department of
 - Larry Zitzow, Director
 - Randy Bohlman, Technology Advancement Coordinator
 - Janice Troitte, Assistant to Director
 - Juli Reismour, Utility Accountant
 - Larry Evenson, Steam Plant Manager
 - Craig Berntsen, Space Manager
- John D. Odegard School of Aerospace Science
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- North Dakota Department of Transportation/State Fleet Services
 - Karen Bagenstoss, Fleet Operations Manager
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- Technology, Department of
 - David Yearwood, Chair
 - Tushar Deo, Graduate Study Student
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Implementation Liaison: Larry Zitzow
Director of Facilities Management
larryzitzow@mail.und.nodak.edu
701.777.2594

Technical Coordinator: Randall Bohlman; CEM, CMVP, CDSM
Technical Author: Technology Advancement Coordinator
Dept. of Facilities
randybohlman@mail.und.nodak.edu
701.777.2333

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University of North Dakota
Facilities Management
3791 Campus Road
Stop 9032
Grand Forks, ND 58202
Phone: (701) 777-2591

Implementation Liaison

Larry Zitzow
Director of Facilities Managemet
larryzitow@mail.und.nodak.edu
701.777.2594'



Technical Coordinator

Technical Author

Randall Bohlman; CEM, CMVP, CDSM
Technology Advancement Coordinator
randallbohlman@mail.und.nodak.edu
701.777.2333