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EXECUTIVE SUMMARY

This report summarizes the findings of an updated inventory of the University of North Dakota’s greenhouse gas (GHG) emissions through 2010. This inventory measures heat-trapping GHGs released by human activity that lead to climate change. The updated inventory is 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 was dependent on the results of the first inventory and was released in May 2010.

GHG emissions of fiscal years (FY) 1993 to 2010 were calculated based on data collected in 2010. 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 2010, the 17,065 campus members and 6.38 million square feet of building space at UND was responsible for the consumption of 2,740,223 MMBtu of energy and the emissions of 137,780 MTCDE (Figure 1). From 1993 to 2010, emissions increased by 8% with total energy consumption increasing by 9% in the same time frame. Meanwhile, square footage increased by 23%.
Emissions per campus member decreased by 5%, while emissions per 1000 square feet decreased by 20%.

A potential reason for the decrease in emissions is the multiple energy efficiency projects that have been implemented. Energy use per full-time student has decreased by 8% and energy use per 1000 square feet has also decreased by 18%.

The major sources of UND’s emissions in 2010 result from on-campus stationary sources (58%), purchased electricity (17%), and transportation (commuting, air travel, direct transportation—21%). The steam plant, which uses coal as its main fuel source, is responsible for 61% of total emissions on average from 1993-2010. Electricity has increased its contribution to emissions; emissions from electricity sources have increased by 28% 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 15 selected institutions who have reported their emissions to the ACUPCC. The average MTCDE per full time student is 7.5 MTCDE, compared to UND’s 12.6 MTCDE. The regional average MTCDE per 1000 square feet is 17.5 MTCDE, compared to UND’s 21.5 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 are covered in the Climate Action Plan, which was released to the ACUPCC and the public on May 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. 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. 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. 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. Agriculture, water resources and tourism may be affected in a variety of ways and could result in significant losses.

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. The signatories to the commitment, currently numbered at 685 schools in all 50 states, pledge to eliminate their campuses’ GHG emissions in a reasonable period of time as determined by each institution.

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.”
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.\textsuperscript{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.\textsuperscript{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% 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 recyle 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.\textsuperscript{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 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 most 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 was the initial GHG emissions inventory and then the development of the Climate Action Plan. Now an updated GHG inventory report is due every other year, this is UND’s second biennial report.

**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 841 faculty and 2,030 staff, and had 10,845 students enrolled in FY 2010. North Dakota residents make up 46% of the students, while the rest represent 49 states, eight Canadian provinces and more than 50 nations. The campus includes 223 buildings (6.38 million square feet) on 549 acres. UND has a large campus, covering 449 square feet per student in FY 2010.

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

### Table 1: Summary of institutional data

<table>
<thead>
<tr>
<th></th>
<th>1993</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty</td>
<td>687</td>
<td>841</td>
</tr>
<tr>
<td>Staff</td>
<td>2,294</td>
<td>2,030</td>
</tr>
<tr>
<td>Full time students</td>
<td>9,224</td>
<td>10,845</td>
</tr>
<tr>
<td>Part time students</td>
<td>2,774</td>
<td>3,349</td>
</tr>
<tr>
<td>Campus population</td>
<td>14,979</td>
<td>17,065</td>
</tr>
<tr>
<td>(campus members)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square feet</td>
<td>4,905,946</td>
<td>6,377,470</td>
</tr>
<tr>
<td>Square feet per</td>
<td>409</td>
<td>449</td>
</tr>
<tr>
<td>student</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Walkways provide scenery as well as opportunities to navigate the campus without using cars.
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, 70 undergraduate minors, 59 masters programs, 24 doctoral programs, two professional programs (medicine and law), and one specialist diploma program. UND’s operating budget in 2010 totaled $350 million with research expenses totaling $48 million or 14%. 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, Odegard 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% of UND’s energy goes to space heating, 22% to water heating, 22% to lighting, 5% to space cooling and 17% 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 11.19 miles of piping to 7.9 million square feet. 6.38 million square feet are campus buildings and the remaining is sold to outlying or surrounding entities. On-campus buildings represent between 70 and 80% of demand for steam produced by the plant. The plant burns approximately 48,673 tons of coal, or 507 rail cars per year of Montana sub-bituminous coal from Westmoreland Coal Company. It produces approximately 712 million pounds of steam each year at the current cost of $9.03 per 1,000 pounds of steam. It also produces 4,694 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.

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 2010, UND purchased approximately 79,722,912 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 at a rate of $0.02426/kWh. WAPA produces electricity via hydropower in western North Dakota. Through WAPA, between 50 and 60% 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 $0.0477/kWh.

![The campus steam plant is the largest consumer of energy and the greatest source of emissions on campus.](image)

![Figure 2: UND electricity providers. Data is based on average percentages of the last 15 years.](image)
Approximately 50% of Xcel Energy’s electricity is coal-based, and the remaining is from natural gas, nuclear, and oil. Finally, Nodak Electric provides 100% 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 60-80 hours per year. This is a 50% reduction from FY 2007.

**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. Since the completion of the Greenhouse Gas Report in 2007, a $1 million grant was received for additional energy conservation measures.

The Council on Environmental Stewardship and Sustainability continued work to meet the commitments made when former UND President Charles Kupchella signed the American College and University Presidents’ Climate Commitment in January 2008. The following accomplishments of the Council and Facilities Management for FY10 are:

- Current UND President Robert O. Kelley was appointed to a prestigious 15-person Energy Initiative Advisory Committee by the Washington, D.C.-based Association of Public and Land-grant Universities.
- UND has embarked on a comprehensive energy efficiency improvement program using state bond funding.
- Established a number of environmental programs, including a wide variety of programs at the Energy & Environmental Research Center (EERC) in such areas as environmental engineering, sustainable energy engineering, environmental geosciences, environmental management, and environmental studies.
• Coordination of the Sustainable Energy Research, Infrastructure and Supporting Education (SUNRISE) program, a student-centered, faculty organized super cluster consisting of 29 faculty in 13 separate academic departments at UND, ND State University, Mayville State University, and the ND State College of Science.

• Research is being carried out by SUNRISE and the EERC on the use of bio-fuels and other renewable fuel projects.

• Sustainability web page was established.

• UND has an established recycling program which keeps nearly 500 tons of waste material out of area landfills annually.

• Completion of the University of North Dakota “Climate Action Plan”.

• Expanded The Council on Environmental Stewardship and Sustainability to include subcommittees to focus on specific areas of: Energy, Recycling – Environment, Transportation, Community-Outreach, Procurement, Research, and Education. Also a position was added to the Steering Committee to include a student government representative.

• Facilities Management utilized student involvement for sustainability efforts. Students assisted with the production of the Climate Action Plan, updating the Green House Gas Inventory, and a Capstone project during the ESSP 501 class.

• Facilities Management procured a $1,000,000 American Recovery and Reinvestment Act grant to be applied to energy efficiency projects.

• Facilities Management coal consumption dropped below an annual use of 50,000 tons of coal. This is the first time on record (beginning in 1985) this has occurred. Credit to the substantial reduction in coal use is attributed to the energy efficiency projects and combustion efficiency in the Steam Plant.

• The following major energy efficiency projects were completed this year resulting in energy improvements:
  - Biological Research; heat recovery project
  - Housing Office: mechanical and control upgrades
  - Hyslop Pool; heat recovery project
  - Resident Halls; shower head replacement project
  - Campus building metering for electricity and steam

Major work was done during this year to complete the Climate Action Plan. The Council on Environmental Stewardship and Sustainability established trajectories for reducing greenhouse gas emissions are shown in figure 3 and 4.

<table>
<thead>
<tr>
<th>Years</th>
<th>GHG Levels</th>
<th>Percent Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>120,000</td>
<td>-</td>
</tr>
<tr>
<td>2020</td>
<td>111,333</td>
<td>7%</td>
</tr>
<tr>
<td>2050</td>
<td>58,833</td>
<td>51%</td>
</tr>
</tbody>
</table>

Figure 3: GHG levels for the 1990 baseline and estimated trajectory for 2020 and 2050.
In order to meet this trajectory, a comprehensive approach is needed to reduce carbon emissions. Members of the Council on Environmental Stewardship and Sustainability had identified a total of 106 Sustainability Improvement Measures (SIM) that could be incorporated throughout the campus, focusing on areas of research, education, energy, procurement, recycling, transportation, and outreach. Since these are broad areas, sub-committees were organized as shown in figure 5 below:

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**Figure 4:** UND’s projected trajectory if consistent with current amount of annual investments ($500,000) in efficiency projects. The projected trajectory estimates a 7% reduction by 2020 and a 51% reduction by 2050.

**Figure 5:** Map of Sustainability Council sub-committees
The seven sub-committees were tasked with generating, reviewing and prioritizing the projects and relevant actions on the SIM table developed earlier. Each SIM was evaluated for the estimated cost, potential annual cost or savings, simple payback over the years of the project, the net primary value after 20 years, and the carbon reduction associated with each action. Many of the proposed SIM will directly affect the student population on campus, thus it is important to keep them informed of the projects. Also, obtaining buy-in from the students will increase the success of the projects and will make the students more aware of impacts in other areas of their lives along with providing an avenue for solicitation of additional ideas and projects from the students.

The chart on the following page identifies several projects that will be pursued during FY11. The majority of the projects are being administered through Facilities Management with funding sources from bonded energy efficiency projects or ARRA energy efficiency grants.
<table>
<thead>
<tr>
<th>Project Description/Relevant Project ID</th>
<th>Priorit y (L-M-H)</th>
<th>Status</th>
<th>Estimated Initial Capital Cost</th>
<th>Potential Annual Savings / Revenue</th>
<th>Simple Payback (years)</th>
<th>Annual Carbon Reduction (MMTCDE)</th>
<th>Funded Cost ($/MTCD E)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campus Energy Cockpit</td>
<td>H</td>
<td>d</td>
<td>$30,000</td>
<td>$100,000</td>
<td>NA</td>
<td>NA</td>
<td>PR</td>
<td>PR</td>
</tr>
<tr>
<td>Establish an Energy and Sustainability Policy (Draft Policy Drafted for Review)</td>
<td>H</td>
<td>c</td>
<td>$75,000</td>
<td>$50,000</td>
<td>0.43</td>
<td>5,175</td>
<td>$14</td>
<td>Funding required - highly visible and high impact project</td>
</tr>
<tr>
<td>Heat Recovery</td>
<td>H</td>
<td>c</td>
<td>$5,993,722</td>
<td>$10,000</td>
<td>10.57</td>
<td>16,768</td>
<td>$357</td>
<td>Funding required - targeted as potential grant project. Targeting a $750,000 ARRA Grant</td>
</tr>
<tr>
<td>Steam Plant Variable Frequency Drive Control</td>
<td>H</td>
<td>b</td>
<td>$233,786</td>
<td>0</td>
<td>0.68</td>
<td>352</td>
<td>$664</td>
<td>Funded - waiting board approval and engineering</td>
</tr>
<tr>
<td>Clifford Hall Lighting Efficiency</td>
<td>H</td>
<td>b</td>
<td>$120,962</td>
<td>0</td>
<td>8.87</td>
<td>125</td>
<td>$968</td>
<td>Funded - waiting board approval and engineering</td>
</tr>
<tr>
<td>School of Medicine Lighting Efficiency</td>
<td>H</td>
<td>b</td>
<td>$90,999</td>
<td>0</td>
<td>9.50</td>
<td>88</td>
<td>$1,038</td>
<td>Funded - waiting board approval and engineering</td>
</tr>
<tr>
<td>Kitchen Range Hood Control</td>
<td>H</td>
<td>b</td>
<td>$612,873</td>
<td>0</td>
<td>9.02</td>
<td>1,279</td>
<td>$479</td>
<td>Funded - waiting board approval and engineering</td>
</tr>
<tr>
<td>Streibel Hall DVC and CO2 Control</td>
<td>H</td>
<td>b</td>
<td>$90,320</td>
<td>0</td>
<td>8.91</td>
<td>286</td>
<td>$316</td>
<td>Funded - waiting board approval and engineering</td>
</tr>
<tr>
<td>Installing Occupancy Sensors in Classrooms, Labs, and Restrooms</td>
<td>H</td>
<td>a</td>
<td>$195,068</td>
<td>0</td>
<td>9.10</td>
<td>196</td>
<td>$995</td>
<td>Partially funded - pilot project Leonard - $15,000</td>
</tr>
<tr>
<td>Vendor Machines</td>
<td>H</td>
<td>c</td>
<td>$78,050</td>
<td>0</td>
<td>2.94</td>
<td>243</td>
<td>$321</td>
<td>Work partially completed, not verified or measured</td>
</tr>
<tr>
<td>HVAC CO2 Control</td>
<td>H</td>
<td>b</td>
<td>$733,552</td>
<td>$8,000</td>
<td>3.41</td>
<td>6,640</td>
<td>$110</td>
<td>Partially funded - $175,000</td>
</tr>
<tr>
<td>Hyslop Sports Center Control Retrofit &amp; CO2 Conversion</td>
<td>H</td>
<td>a</td>
<td>$174,264</td>
<td>0</td>
<td>3.44</td>
<td>1,332</td>
<td>$131</td>
<td>Funded - waiting construction</td>
</tr>
<tr>
<td>Merrifield Hall YAV Conversion &amp; CO2 Control</td>
<td>H</td>
<td>a</td>
<td>$116,070</td>
<td>0</td>
<td>4.50</td>
<td>576</td>
<td>$202</td>
<td>Funded - waiting construction</td>
</tr>
<tr>
<td>Witmer Hall YAV Conversion &amp; CO2 Controls</td>
<td>H</td>
<td>a</td>
<td>$116,095</td>
<td>0</td>
<td>3.55</td>
<td>937</td>
<td>$124</td>
<td>Funded - waiting construction</td>
</tr>
<tr>
<td>Ryan/RTC Controls &amp; Windows</td>
<td>H</td>
<td>a</td>
<td>$364,550</td>
<td>0</td>
<td>5.16</td>
<td>992</td>
<td>$367</td>
<td>Funded - waiting construction</td>
</tr>
<tr>
<td>Abbott Hall Mechanical Heat Recovery and Control Retrofit</td>
<td>H</td>
<td>a</td>
<td>$161,064</td>
<td>0</td>
<td>7.54</td>
<td>4,036</td>
<td>$40</td>
<td>Funded - waiting construction</td>
</tr>
<tr>
<td>Biomedical Research Mechanical Heat Recovery Retrofit</td>
<td>H</td>
<td>a</td>
<td>$34,330</td>
<td>0</td>
<td>1.28</td>
<td>5,397</td>
<td>$6</td>
<td>Work Completed, beginning measurement and verification</td>
</tr>
<tr>
<td>School of Medicine and Health Sciences Mechanical Control Retrofit</td>
<td>H</td>
<td>a</td>
<td>$119,812</td>
<td>0</td>
<td>1.73</td>
<td>1,325</td>
<td>$90</td>
<td>Funded - waiting construction</td>
</tr>
<tr>
<td>Development of Sustainability Center</td>
<td>L</td>
<td>e</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>ESSP - 501: Capstone Project - Research and Feasibility Study: No funding required at this time.</td>
</tr>
<tr>
<td>Biomass with existing boilers</td>
<td>L</td>
<td>d</td>
<td>$355,000</td>
<td>$50,000</td>
<td>1.07</td>
<td>46,133</td>
<td>$15</td>
<td>Research &amp; Feasibility Facilities Steam Plant assisted by ESSP 501: No funding required at this time.</td>
</tr>
</tbody>
</table>

High Visibility Projects that Require Funding:
Projects Funded (ARRA Grant); Design and Construction Pending
Projects Funded (ND State Energy Efficiency Grant Program) Design and Construction Pending
Projects under investigation for feasibility and costs. Student involvement through ESSP 501 Capstone Project

University of North Dakota 2010 Greenhouse Gas Emissions Inventory
MTCDE = Metric tons of carbon dioxide emissions (an emissions measurement)
MMBtu = million British thermal units (an energy measurement)
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 2010 were calculated based on the data collected in 2010 from various departments across campus. This report covers July 1, 1992 through June 30, 2010. 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 6). 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.

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. 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).
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 were 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, the information was detailed in a protocol document.
created for the initial inventory. The 2008 protocol provided a framework for suggestions and recommendations to improve methods of data collection, analysis, and record-keeping, which has made future inventories more efficient and accurate. This inventory report used this protocol directly.
RESULTS

Overall Emissions and Trends

- UND’s total emissions increased from 126,799 MTCDE in 1993 to 137,780 MTCDE in 2010, which is an 8% increase (Figure 7). UND’s emissions peaked in 1994 at 140,503 MTCDE. UND emits on average 133,089 MTCDE per year.
• UND’s energy consumption increased from 2,491,009 MMBtu in 1993 to 2,740,223 MMBtu in 2010, which is a 9% increase (Figure 8). UND's energy consumption peaked in 2003 at 2,749,786 MMBtu. On average, UND consumes 2,532,234 MMBtu per year.
• UND relies predominantly on fossil fuels to meet its energy needs. In 2010, 80% 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% of energy needs, nuclear was 1.5%, and other renewable sources made up 0.1% 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 2,337 students since 1993. The student population in 2010 was 14,194. The campus area has increased by 1,471,524 square feet since 1993, an increase of 23%. Campus area in 2010 covered 6,377,470 square feet.

![Figure 9: Emissions and energy use per thousand square feet](image)

![Figure 10: Emissions and energy use per full-time student](image)

• UND’s emissions per campus member (full and part time students, faculty, and staff) decreased by 5%, from 8.47 MTCDE per person in 1993 to 8.04 MTCDE per person in 2010. The average over the 17 years reported was 9.01 MTCDE per person. Total emissions per 1000 square feet decreased by 20%, from 25.85 MTCDE in 1993 to 21.5 in 2010 (Figure 9). The average over the 17 year reporting period was 25.06 MTCDE.

Total energy use has increased by 9%, with energy use per student decreasing by 10% and energy use per 1000 square feet also decreasing by 18% from 1993-2010 (Figure 10).
Composition of Emissions

- The major sources of UND’s emissions in 2010 result from on-campus stationary sources (57%), transportation including commuting, air travel, and direct transportation (21%), and purchased electricity (17%). Remaining sources (5%) 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 61% of total emissions on average from 1993-2010.
- 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 28% since 1993, the largest increase in any category (Table 3).

<table>
<thead>
<tr>
<th>Emissions source</th>
<th>Percent of total 1993 emissions</th>
<th>Percent of total 2010 emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Campus Stationary Sources</td>
<td>63.64%</td>
<td>57.57%</td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>13.57%</td>
<td>17.27%</td>
</tr>
<tr>
<td>Commuting</td>
<td>8.63%</td>
<td>9.63%</td>
</tr>
<tr>
<td>Air Travel</td>
<td>4.46%</td>
<td>5.86%</td>
</tr>
<tr>
<td>Direct Transportation</td>
<td>5.76%</td>
<td>5.86%</td>
</tr>
<tr>
<td>Scope 2 T&amp;D Losses</td>
<td>1.34%</td>
<td>1.71%</td>
</tr>
<tr>
<td>Waste</td>
<td>2.04%</td>
<td>1.57%</td>
</tr>
<tr>
<td>Refrigerants</td>
<td>0.38%</td>
<td>0.83%</td>
</tr>
<tr>
<td>Paper</td>
<td>0.19%</td>
<td>0.19%</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Table 2: Composition of emissions by category in 1993 and 2010

<table>
<thead>
<tr>
<th>Source</th>
<th>1993 MTCDE</th>
<th>2010 MTCDE</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Campus Stationary Sources</td>
<td>80,691</td>
<td>79,317</td>
<td>-2%</td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>17,211</td>
<td>23,795</td>
<td>28%</td>
</tr>
<tr>
<td>Commuting</td>
<td>10,937</td>
<td>13,266</td>
<td>18%</td>
</tr>
<tr>
<td>Air Travel</td>
<td>5,657</td>
<td>7,405</td>
<td>24%</td>
</tr>
<tr>
<td>Direct Transportation</td>
<td>7,297</td>
<td>8,070</td>
<td>10%</td>
</tr>
<tr>
<td>Scope 2 T&amp;D Losses</td>
<td>1,702</td>
<td>2,353</td>
<td>28%</td>
</tr>
<tr>
<td>Waste</td>
<td>2,587</td>
<td>2,162</td>
<td>-20%</td>
</tr>
<tr>
<td>Refrigerants</td>
<td>477</td>
<td>1,148</td>
<td>58%</td>
</tr>
<tr>
<td>Paper</td>
<td>237</td>
<td>260</td>
<td>9%</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>3</td>
<td>3</td>
<td>0%</td>
</tr>
<tr>
<td>Total emissions</td>
<td>126,799</td>
<td>137,780</td>
<td>8%</td>
</tr>
</tbody>
</table>

Table 3: Percent change in emissions per source for 1993 to 2010
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 11 shows that 64% 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 17% 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 19% 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 a substantial opportunity for error in data collection, the ACUPCC has reporting institutions report their emissions with and without Scope 3.

Scopes 1 and 2
Scope 1 and 2 include only the Steam Plant, electricity, refrigerants, direct transportation, and agriculture (Table 4). There was a slight decrease of 350 MTCDE of the total emissions of scope 1 and 2 from 2009-2010 (Figure 12). Overall since 1993, scope 1 has decreased by 0.63% and scope 2 has increased by 27.67%. The increase of scope 2 is mostly likely caused by the increase of total square footage of the campus which has increased by 23%.

<table>
<thead>
<tr>
<th>Source</th>
<th>1993 MTCDE</th>
<th>2010 MTCDE</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Campus Stationary</td>
<td>80,691</td>
<td>79,317</td>
<td>-1.73%</td>
</tr>
<tr>
<td>Direct Transportation</td>
<td>7,297</td>
<td>8,070</td>
<td>9.57%</td>
</tr>
<tr>
<td>Refrigerants &amp; Chemicals</td>
<td>477</td>
<td>1,148</td>
<td>58.45%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>3</td>
<td>3</td>
<td>0.00%</td>
</tr>
<tr>
<td>Scope 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchased Electricity</td>
<td>17,211</td>
<td>23,795</td>
<td>27.67%</td>
</tr>
<tr>
<td>Total Emissions</td>
<td>105,679</td>
<td>112,333</td>
<td>5.92%</td>
</tr>
</tbody>
</table>

Table 4: Comparison of scopes 1 and 2 for 1993 and 2010

Figure 12: Total MTCDE of scopes 1 and 2 for 1993-2010
On-Campus Stationary Sources
Campus stationary sources produce the highest percentage of overall emissions, the campus Steam Plant being the main contributor. In FY 2010, on-campus stationary sources produced approximately 79,317 metric tons of CO₂ emissions (MTCDE) which accounted for 61% of total campus emissions (Table 5). The Steam Plant, which is fueled primarily by coal and secondarily by #2 distillate oil and natural gas, is responsible for approximately 98% of on-campus stationary source emissions (Figure 13). 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.

Steam Plant
UND’s Steam Plant is the largest consumer of energy and the greatest source of emissions on campus. In FY 2010, the Steam Plant used approximately 854,076 MMBtu and 77,800 MTCDE. Steam Plant emissions have been relatively stable since base year 1993 with little overall change. The highest emissions (67%) were seen in 1994, while 2010 marked the lowest point (57%). 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. More recent data from 2008 to 2010 show emissions continuing to decrease. 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 14: Steam Plant emissions per heating degree day, 1993-2010. This shows the efficiency of the steam plant over time.

Figure 14 shows the Steam Plant’s emissions per heating degree day, which provides a graphical representation of the plant’s efficiency. Figure 15 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.

Figure 15: Steam Plant emissions and heating degree days, 1993-2010. This shows the relationship between steam plant emissions and heating degree days.
Electricity Sources
The second largest contributor to campus emissions comes from purchased electricity. UND campus electrical usage for FY 2010 was responsible for approximately 843,029 MMBtu and 23,795 MTCDE, which is 17% of total emissions (Figure 16). 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. Energy consumption has increased by 15% from 1993-2010, while emissions from electricity have increased by 28% (Figure 17). The higher increase in emissions is due to the declining percentage of hydroelectricity as a source.

![Figure 16: Emissions and energy consumption from electricity, 1993-2010](image1)

![Figure 17: Energy units(MMBtu) from electricity, per thousand square feet of building space](image2)
Table 6 shows UND’s fuel sources from 1993-2010. 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 7). Nodak Electric provides UND’s airport facilities with electricity, which accounts for 2 to 3% 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.

**Table 6: Fuel sources of electricity purchased by UND, 1993-2010**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Electricity Purchased (kWh)</th>
<th>Hydro-Electric (%)</th>
<th>Coal (%)</th>
<th>Natural Gas (%)</th>
<th>Nuclear (%)</th>
<th>Distillate Oil (#1-#4) (%)</th>
<th>Waste to Energy (%)</th>
<th>Renewable Energy (wind, solar) (%)</th>
<th>Residual Oil (#5-#6) (%)</th>
<th>Biomass (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>68,002,458</td>
<td>65.80</td>
<td>19.90</td>
<td>9.90</td>
<td>3.30</td>
<td>0.90</td>
<td>0.10</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1994</td>
<td>68,002,458</td>
<td>65.80</td>
<td>19.90</td>
<td>9.90</td>
<td>3.30</td>
<td>0.90</td>
<td>0.10</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1995</td>
<td>68,002,458</td>
<td>65.80</td>
<td>19.90</td>
<td>9.90</td>
<td>3.30</td>
<td>0.90</td>
<td>0.10</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1996</td>
<td>67,643,321</td>
<td>66.10</td>
<td>19.70</td>
<td>9.80</td>
<td>3.20</td>
<td>0.90</td>
<td>0.10</td>
<td>0.10</td>
<td>0.00</td>
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</tr>
<tr>
<td>1997</td>
<td>71,688,972</td>
<td>62.60</td>
<td>21.50</td>
<td>11.00</td>
<td>3.60</td>
<td>1.00</td>
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<td>0.10</td>
<td>0.00</td>
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<tr>
<td>1998</td>
<td>74,506,187</td>
<td>60.30</td>
<td>22.70</td>
<td>11.80</td>
<td>3.90</td>
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<td>1999</td>
<td>76,417,176</td>
<td>58.90</td>
<td>23.40</td>
<td>12.20</td>
<td>4.00</td>
<td>1.10</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2000</td>
<td>72,977,198</td>
<td>61.50</td>
<td>22.10</td>
<td>11.40</td>
<td>3.70</td>
<td>1.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.00</td>
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<tr>
<td>2001</td>
<td>73,993,925</td>
<td>60.70</td>
<td>22.50</td>
<td>11.60</td>
<td>3.80</td>
<td>1.10</td>
<td>0.10</td>
<td>0.10</td>
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<tr>
<td>2002</td>
<td>73,492,361</td>
<td>61.10</td>
<td>22.30</td>
<td>11.50</td>
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<td>1.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>2003</td>
<td>76,040,977</td>
<td>59.20</td>
<td>23.30</td>
<td>12.10</td>
<td>4.00</td>
<td>1.10</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>2004</td>
<td>80,388,100</td>
<td>56.20</td>
<td>24.90</td>
<td>13.10</td>
<td>4.30</td>
<td>1.20</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2005</td>
<td>81,739,406</td>
<td>55.30</td>
<td>25.30</td>
<td>13.40</td>
<td>4.40</td>
<td>1.30</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2006</td>
<td>81,357,146</td>
<td>55.40</td>
<td>25.10</td>
<td>13.50</td>
<td>4.40</td>
<td>1.30</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2007</td>
<td>79,351,339</td>
<td>56.90</td>
<td>24.40</td>
<td>13.00</td>
<td>4.30</td>
<td>1.20</td>
<td>0.20</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2008</td>
<td>79,949,872</td>
<td>56.46</td>
<td>24.62</td>
<td>13.11</td>
<td>4.30</td>
<td>1.22</td>
<td>0.17</td>
<td>0.08</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2009</td>
<td>79,149,708</td>
<td>57.74</td>
<td>23.60</td>
<td>9.95</td>
<td>4.98</td>
<td>0.00</td>
<td>0.41</td>
<td>3.32</td>
<td>0.00</td>
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</tr>
<tr>
<td>2010</td>
<td>79,722,912</td>
<td>57.37</td>
<td>23.74</td>
<td>10.07</td>
<td>5.04</td>
<td>0.00</td>
<td>0.42</td>
<td>3.36</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Table 7: Fuel sources for UND purchased electricity**

<table>
<thead>
<tr>
<th>Electricity Supplier</th>
<th>Generation Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAPA</td>
<td>Hydro</td>
<td>100%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Coal</td>
<td>50%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Natural Gas</td>
<td>24%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Nuclear</td>
<td>12%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Hydro</td>
<td>5%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Oil</td>
<td>0%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Refuse</td>
<td>1%</td>
</tr>
<tr>
<td>Xcel Energy</td>
<td>Wind</td>
<td>8%</td>
</tr>
<tr>
<td>Nodak</td>
<td>Coal</td>
<td>100%</td>
</tr>
</tbody>
</table>
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 2010, all categories of campus transportation combined for total energy use of 938,719 MMBtu, which is 34% of overall energy use, and 28,741 MTCDE, which is 21% of campus emissions (Figure 18).

Transportation is a key aspect of UND’s overall emissions. Commuting is the largest source of emissions—student, faculty and staff commuting make up 46% of transportation emissions (Figure 19). 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 25% 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 23% of the transportation emissions. Finally, the university fleet makes up 5% of 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 18). The highest amounts of transportation emissions are 2008, 2009, 2010 respectively. The increase in emissions is due to the improved data collection methodology.
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 86,446 gallons of gasoline and 59,111 gallons of diesel fuel in FY 2010. Emissions from the university fleet totaled 1,444 MTCDE, or about 1% of all campus emissions.

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 120 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 2010, UND Aerospace used approximately 211,600 gallons of jet fuel and 721,300 gallons of aviation fuel, which make up 20% of the energy used by UND. This use emitted 6,466 MTCDE, or 5% of all campus emissions.

The aviation school accounted for about 5% of UND’s total emissions in FY 2010.
Commuting
With a population of over 17,000 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 2009. 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 mileage driven by the student community was 7,301,311 in FY 2010. The mileage driven by faculty and staff in FY 2010 was estimated to be 13,392,788. A special acknowledgement is in order for the 2009 Earth System and Science Policy class for collecting and analyzing the data.

Emissions from commuting estimates totaled 13,266 MTCDE, or 10% of total campus emissions in FY 2010. Commuting consumed 184,495 MMBtu, or 7% of total energy usage.

Directly Financed Outsourced Travel
Emissions from UND financed travel were estimated using detailed projections from the Clean Air Cool Planet Carbon Calculator. The projections are based on 17 years of previously collected data. According to the results, faculty and staff totaled over 6.9 million air miles in FY 2010 which used 27,224 MMBtu and produced 5,364 MTCDE, or 4% 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 million miles in FY 2010, which consumed 10,359 MMBtu of energy and produced 2,041 MTCDE. These numbers represent less than 1% of overall energy usage and about 1% of total campus emissions.
Waste Management
Waste management at UND consists of the disposal of solid waste and wastewater, which accounts for about 2% of campus CO$_2$ 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 20). 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.

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 18 to 22% 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% of all waste was recycled or sold. In FY 2010, UND recycled 588 short tons of waste, sold 77 tons of scrap metal, and landfilled 2,113 tons of waste (Figure 21). Solid waste disposal has stayed relatively stable from 1998 through 2010. 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.

Solid waste disposal accounts for a small percentage of campus CO$_2$ emissions and is the primary source of methane (CH$_4$) emissions, which has 21 times the global warming potential of CO$_2$.$^4$ The city landfill that takes the waste does not currently have CH$_4$ recovery capabilities. Landfilled waste contributed 2,092 MTCDE, or 2% of total campus CO$_2$ emissions in FY 2010. More significantly, solid waste was responsible for approximately 93,248 kg of CH$_4$ emissions, or 87% of overall campus CH$_4$ emissions (Figure 22). Methane emissions from waste have decreased by 16% from 1993-2010.
Wastewater
UND’s wastewater is another small contributor to campus emissions. Water waste from campus generally gets sent to a local water treatment plant. CO₂ emissions from wastewater are insignificant, contributing to less than 1% of total emissions. However, wastewater was responsible for 235 kg of N₂O emissions, or 6% of campus N₂O emissions in FY 2010.

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 1489 pounds of CFC-22’s lost in FY 2010, accounting for 1,148 MTCDE (Figure 23). Less than 1% 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% of paper purchased has a recycled content of 30%, while the rest does not have any recycled content. The paper purchased in FY 2010 produced 260 MTCDE, less than 1% of total emissions.

Fertilizer
UND does not practice agriculture, but it does apply fertilizer to practice fields and flower beds, and the biology department greenhouse, 2,600 pounds of synthetic fertilizer was used on campus. The fertilizer used contained 28% nitrogen. This amount of fertilizer is responsible for no more than 3 MTCDE per year. In the Climate Action Plan an idea has been proposed of a campus composting site. This compost would potentially be used to fertilize the needed areas. This natural fertilizer would have less of a negative impact on both GHG emissions and pollution.

Flowers flourish during the spring at UND.
COMPARISON WITH OTHER INSTITUTIONS

A comparison of emissions profiles with other institutions explains the significance of numbers. Figure 24 and Table 7 compares reporting institutions in Idaho, Maine, Minnesota, Montana, North Dakota, South Dakota, Wyoming, and the University of Maryland at Baltimore. The comparison also includes two aviation schools: Cornell University, New York and the University of Cincinnati, Ohio. The emissions data, which includes all three scopes of emissions, was reported by the institutions to the ACUPCC and posted online by the Advancement of Sustainability in Higher Education (AASHE).¹ All of the universities except two have no offsets. The exceptions include Bemidji State University with a 2% offset, and Cornell University with a 5% offset. Figure 24 shows how the institutions compare when emissions are normalized by gross MTCDE per 1000 square feet and gross MTCDE per full time enrollment.

![Graph comparing emissions of various institutions](image)

Figure 24: Comparison of emissions of other institutions, as reported to the Association for the Advancement of Sustainability in Higher Education¹ (AASHE)
Table 8 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. Climate zones are used by the Department of Energy to determine building standards. Of the 15 institutions listed below, the average MTCDE per full time student is 7.5 MTCDE, and the average MTCDE per 1000 square feet is 17.5 MTCDE. UND’s emissions are above average.

Table 8: Comparison of emissions of other institutions as reported to AASHE¹.

<table>
<thead>
<tr>
<th>Institution</th>
<th>State</th>
<th>USDOE Climate Zone</th>
<th>Enrollment</th>
<th>Total MTCDE Emissions</th>
<th>MTCDE per FT student</th>
<th>MTCDE per 1000 square feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Maryland Baltimore</td>
<td>MD</td>
<td>4</td>
<td>11,263</td>
<td>87,061</td>
<td>7.7</td>
<td>27.2</td>
</tr>
<tr>
<td>University of Cincinnati</td>
<td>OH</td>
<td>4</td>
<td>25,612</td>
<td>432,502</td>
<td>16.9</td>
<td>30.2</td>
</tr>
<tr>
<td>University of Idaho</td>
<td>ID</td>
<td>5</td>
<td>10,775</td>
<td>30,347</td>
<td>2.8</td>
<td>8.2</td>
</tr>
<tr>
<td>Macalester College</td>
<td>MN</td>
<td>6</td>
<td>1,872</td>
<td>19,335</td>
<td>10.3</td>
<td>14.3</td>
</tr>
<tr>
<td>College of Saint Benedict</td>
<td>MN</td>
<td>6</td>
<td>2,036</td>
<td>15,073</td>
<td>7.4</td>
<td>18.6</td>
</tr>
<tr>
<td>Black Hills State University</td>
<td>SD</td>
<td>6</td>
<td>2,229</td>
<td>10,504</td>
<td>4.7</td>
<td>14.4</td>
</tr>
<tr>
<td>Winona State University</td>
<td>MN</td>
<td>6</td>
<td>7,911</td>
<td>29,950</td>
<td>3.8</td>
<td>14.1</td>
</tr>
<tr>
<td>Montana State University Bozeman</td>
<td>MT</td>
<td>6</td>
<td>10,930</td>
<td>77,377</td>
<td>7.1</td>
<td>18.8</td>
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<tr>
<td>University of Wyoming</td>
<td>WY</td>
<td>6</td>
<td>11,032</td>
<td>120,247</td>
<td>10.9</td>
<td>16.6</td>
</tr>
<tr>
<td>University of Saint Thomas</td>
<td>MN</td>
<td>6</td>
<td>12,546</td>
<td>71,275</td>
<td>5.7</td>
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<tr>
<td>Saint Cloud State University</td>
<td>MN</td>
<td>6</td>
<td>14,148</td>
<td>57,776</td>
<td>4.1</td>
<td>18.5</td>
</tr>
<tr>
<td>Cornell University</td>
<td>NY</td>
<td>6</td>
<td>20,600</td>
<td>236,000</td>
<td>11.5</td>
<td>15.7</td>
</tr>
<tr>
<td>University of Maine at Presque Isle</td>
<td>ME</td>
<td>7</td>
<td>1,533</td>
<td>4,214</td>
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<td>10.2</td>
</tr>
<tr>
<td>Bemidji State University</td>
<td>MN</td>
<td>7</td>
<td>4,296</td>
<td>20,234</td>
<td>4.7</td>
<td>12.3</td>
</tr>
<tr>
<td>University of North Dakota</td>
<td>ND</td>
<td>7</td>
<td>10,845</td>
<td>137,780</td>
<td>12.6</td>
<td>21.5</td>
</tr>
</tbody>
</table>
SUMMARY

This report entails a comprehensive review of the GHG emissions of UND from 1993 to 2010. 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. The path to reach climate neutrality has been defined in UND’s Climate Action Plan, which was submitted to the ACUPCC and the public in May 2010. To reach climate neutrality, UND will focus on reducing its major emissions.

In 2010 FY, UND produced 137,780 MTCDE. The major sources of UND’s emissions in 2010 result from on-campus stationary sources (58%), transportation including commuting, air travel, direct transportation (21%), and purchased electricity (17%). The campus Steam Plant is responsible for 98% of on-campus stationary sources each year, and has accounted for 61% of total emissions on average from 1993-2010. During FY 2010, there were dramatic increases in paper, refrigerants, and commuting. The increase within commuting is due to the improved data collection methodology. The use of paper and refrigerants should be examined to help reduce future emissions.

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 has included project recommendations such as energy efficiency projects and has addressed the financial obligations of the projects. It has projected a target date for climate neutrality along with interim milestones and timeframes for specific projects. It has also shown projections of what emissions would have been with no changes and what emissions would be with proposed changes.
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 the initial 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 take the lead in its community towards mitigating society’s greatest crisis.
ACKNOWLEDGMENTS

• Business School
  o Jersey Benson, Student Temporary Help
  o Danielle Schermerhorn
• Chemical Engineering, Department of
  o Mike Mann, Chair
• Earth System Science and Policy (ESSP), Department of
  o Soizik Laguette, Chair
  o Rebecca Romsdahl, Assistant Professor
  o ESSP 501 Graduate Study Program
    o 2008 Class
      ▪ Anduin Kirkbride McElroy
      ▪ Shawn O’Neil
      ▪ Santosh Rijal
      ▪ Navin Thapa
      ▪ Junyu Yang
    o 2009 Class
      ▪ Chao Wang
      ▪ David Barta
      ▪ Kate Overmoe
      ▪ Qiang Zhou
      ▪ Seth Fore
      ▪ Shumila Ahmad
      ▪ Tetiana Nemitchenko
    o 2010 Class
      ▪ Andrea Hewitt
      ▪ Rebecca Lemons
• Facilities Management, Department of
  o Larry Zitzow, Director
  o Randy Bohlman, Technology Advancement Coordinator
  o Janice Hallin, Assistant to Director
  o Diane Fugleberg, Utility Accountant
  o Larry Evenson, Steam Plant Manager
  o Craig Berntsen, Space Manager
  o Vern Anderson, Systems Supervisor
  o Kristen Peterson, Administrative Assistant
  o Laura Thoreson, Business Manager
  o Laura Harmon, Student Temporary Help
• John D. Odegard School of Aerospace Science
  o Frank Argenziano, Assistant Director, Flight Operations
• North Dakota Department of Transportation/State Fleet Services
  o Karen Bagenstoss, Fleet Operations Manager
• Office of International Programs
  o Neva Hendrickson, Advisor, Educational Abroad

A female wood duck swims with her young in the coulee.
• Purchasing Office  
  o Scott Schreiner, Director of Purchasing  
• Transportation, Department of  
  o Mary L. Metcalf, Manager

Images in the report are courtesy of Chuck Kimmerle with the UND University Relations office. The software to compute emissions was provided free of charge by Clean Air-Cool Planet.

Implementation Liaison: Larry Zitzow  
  Director of Facilities Management  
larryzitzow@mail.und.nodak.edu  
701.777.2594

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


