Bemidji State University Climate Action Plan

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Feb. 25, 2011

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The Bemidji State University Climate Action Plan
was developed by the following entities:

Bemidji State University:
Erika Bailey-Johnson - Sustainability Coordinator
Environmental Advisory Committee, BSU

The City of Bemidji:
Sustainability Committee

Lead Consultants:
Emmons & Olivier Resources
contributed to sections on
Carbon Offsets, Alternative Financing Strategies, Water Conservation, Natural Resources Management, Stormwater Management, Waste & Recycling

Sub-Consultants:
Conservis
contributed to sections on
GHG Emissions Inventory

HGA Architects
contributed to sections on
Efficient Space Planning, Energy Efficient Green Building Design, Sustainability Building Practices, Energy Conservation & Efficiency, Power Plant Fuel Conversions, Alternative/Renewable Energy, Green Power Purchasing

Sustainability Associates
led seminar on Sutainability and the Natural Step Framework

Transit for Livable Communities
contributed to sections on
Sustainable Transportation Planning

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INTRODUCTION

In 2010, Bemidji State University (BSU) engaged a team of consultants to assist with the preparation of its greenhouse gas (GHG) emissions inventory and Climate Action Plan. This team of consultants includes: Emmons & Olivier Resources, Inc.; Conservis, Hammel, Green and Abrahamson, Inc.; Transit for Livable Communities; and Sustainability Associates. As reported to the ACUPCC, the University's total carbon emissions for FY2009 were 27,428 metric tons of carbon dioxide equivalent (MTCO2e). This worked out to be approximately 5 $MTCO_2e$ per full time enrollment, or 17 MTCO2e per 1,000 square feet of building space.

In 2009, BSU completed a Strategic Plan for Sustainability for the academic years 2008 to 2013. This strategic plan identifies a number of goals under the following three strategies:

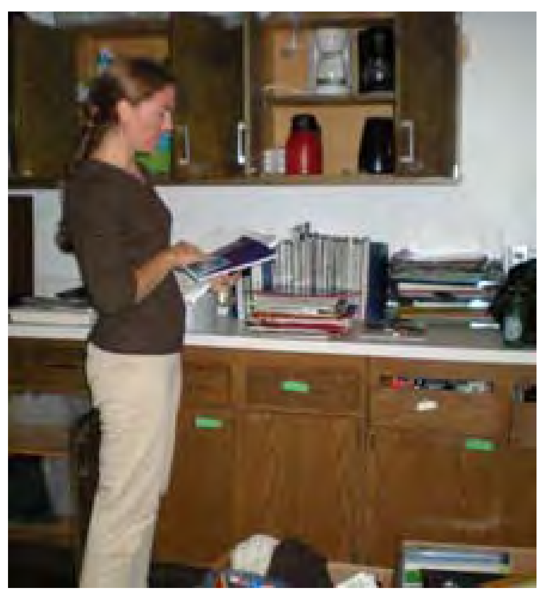
Reduce BSU's Carbon Footprint;

Model Stewardship of Land & Water;

Motivate, Educate, & Outreach on Sustainability Issues.

Since the completion of this strategic plan, BSU has accomplished a number of initiatives related to reducing greenhouse gas emissions and promoting sustainability. For example, BSU operates a successful "reuse room" in the Sustainability Office, has performed an energy audit and participated in the Minnesota Schools Cutting Carbon Program, replaces fixtures and appliances with high efficiency models and has an undergraduate requirement called "People and the Environment" to name a few of its accomplishments.

This Climate Action Plan was developed in conjunction with BSU's Sustainability Coordinator as well as members of the Environmental Advisory Committee.



Re-use room at BSU.

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CAMPUS EMISSIONS

This section of the report summarizes the greenhouse gas (GHG) emissions inventory performed for fiscal year 2009 and contains all of the background information required to document the methods used to perform the inventory. In addition, this report includes an inventory of supplemental information that is provided to assist BSU track its overall sustainability performance. For example, Table 5 (of Appendix C) includes documentation of BSU's energy demand, purchased water, sewage generation and waste generation.

A greenhouse gas emissions inventory is an accounting of the amount of greenhouse gases emitted to or removed from the atmosphere over a specific period of time (e.g. one year). This accounting system tracks emissions under the following categories Scope 1, Scope 2 or Scope 3 as illustrated and described on pages 14 through 17 of this document.

The actual GHG emissions inventory, performed for BSU FY 2009, was developed using an entity-wide greenhouse gas management software program called Emissions Tracker developed by Conservis.

If, after its experiment with entity-wide software, BSU wishes to continue entity-wide, source-specific data collection, it is recommend that BSU either purchase entity-wide GHG accounting software or develop its own database application to handle the larger amounts of data required to maintain this level of detail. If annual ACUPCC reporting is the only objective, and verification is not a concern, then use of a spreadsheet application such as Clean Air Cool Planet may be the desired option. If BSU decides to continue with the entity-wide carbon accounting software it can do so until April 30, 2011. At that time, BSU will need to negotiate a SaaS (Software as a Service) Agreement with Conservis should it wish to continue to have access to Emission Tracker. BSU should contact Patrick Christie, CEO, Conservis at 612-424-6301, 1624 Harmon Place, Minneapolis, MN, 55403 for additional details.

Greenhouse Gas Results

As reported to the ACUPCC, BSU's total Scope 1, 2 and reported Scope 3 carbon emissions for FY2009 were 27,428 metric tons of carbon dioxide equivalent ($MTCO_2e$). This works out to be approximately 5 $MTCO_2e$ per full time enrollment, or 17 MTCO2e per 1,000 square feet of building space.

The 2009 GHG inventory included Scope 1, 2, and reported 3 carbon emissions and was calculated using the Climate Registry General Reporting Protocol (GRP), Version 1.1, May 2008 (including Updates and Clarifications, published 2/12/2010 and 5/12/2010). While BSU is not required to report most Scope 3 emissions under both the ACUPCC and the Climate Registry requirements, several of Scope 3 emissions are being reported since this is the area where BSU can effect the greatest change. The ACUPCC Implementation Guide states:

> Consistent with the GHG Protocol standards, ACUPCC signatories agree to account for and report on emissions from Scopes 1 and 2. In addition, as specified in the Commitment, signatories agree to report some Scope 3 emissions, specifically those from air travel paid for by or through the institution and regular commuting to and from campus, to the extent that data are available. For purposes of the Commitment, commuting is defined as travel to and from campus on a day-to-day basis by students,

faculty, and staff. It does not include student travel to and from campus at the beginning and end of term or during break periods.

Emissions from commuting and from air travel paid for by or through the institution are the only Scope 3 emissions sources that signatories are required to report on. However, signatories are strongly encouraged, to the extent practical, to investigate and report on additional Scope 3 emissions, especially those from sources that are large and can be meaningfully influenced by the institution. Other Scope 3 emissions sources that signatories may choose to include in their inventory include, but are not limited to: waste disposal; embodied emissions from extraction, production, and transportation of purchased goods; outsourced activities; contractor owned-vehicles; and line loss from electricity transmission and distribution.

Emissions sources included in the calculations were:

Scope 1 – fossil fuel, BSU's vehicle fleet and refrigerants;

Scope 2 – purchased electricity; and

Scope 3 – steam, contract bus services, faculty/staff commuting, air travel, and solid waste.

The inventory revealed that BSU's largest source of emissions is attributed to Scope 1 activities accounting for approximately 36% of total emissions. The second largest source of emissions is attributed to Scope 2 activities (approximately 34%) while the Scope 3 activities account for approximately 30% of total emissions. The actual breakdown of GHG emissions inventory is provided in Table 1 and further illustrated in Figures 1 through 3. This information was used by BSU to develop its Climate Action Plan.

Table 1. BSU FY2009 GHG Emissions Inventory Summary

	CO2e Tonnes (MTCO2e)	% CO2e
SCOPE 1		
- Fleet Vehicles	313	3.2
- Natural Gas	9,473	96
- Oil	8	0.1
- Refrigerant	65	0.7
SUB-TOTAL	9,859	100%
SCOPE 2		
- Electricity	9,368	100%
SUB-TOTAL	9,368	100%
SCOPE 3		
- Owned Steam Consumption	6,431	78%
- Contract Bus Services	0.3	0%
- Commuting	1,463	18%
- Down Stream Emissions from Waste Disposal	119	2%
- Employee Business Travel (commercial air)	188	2%
SUB-TOTAL	8,201	100%

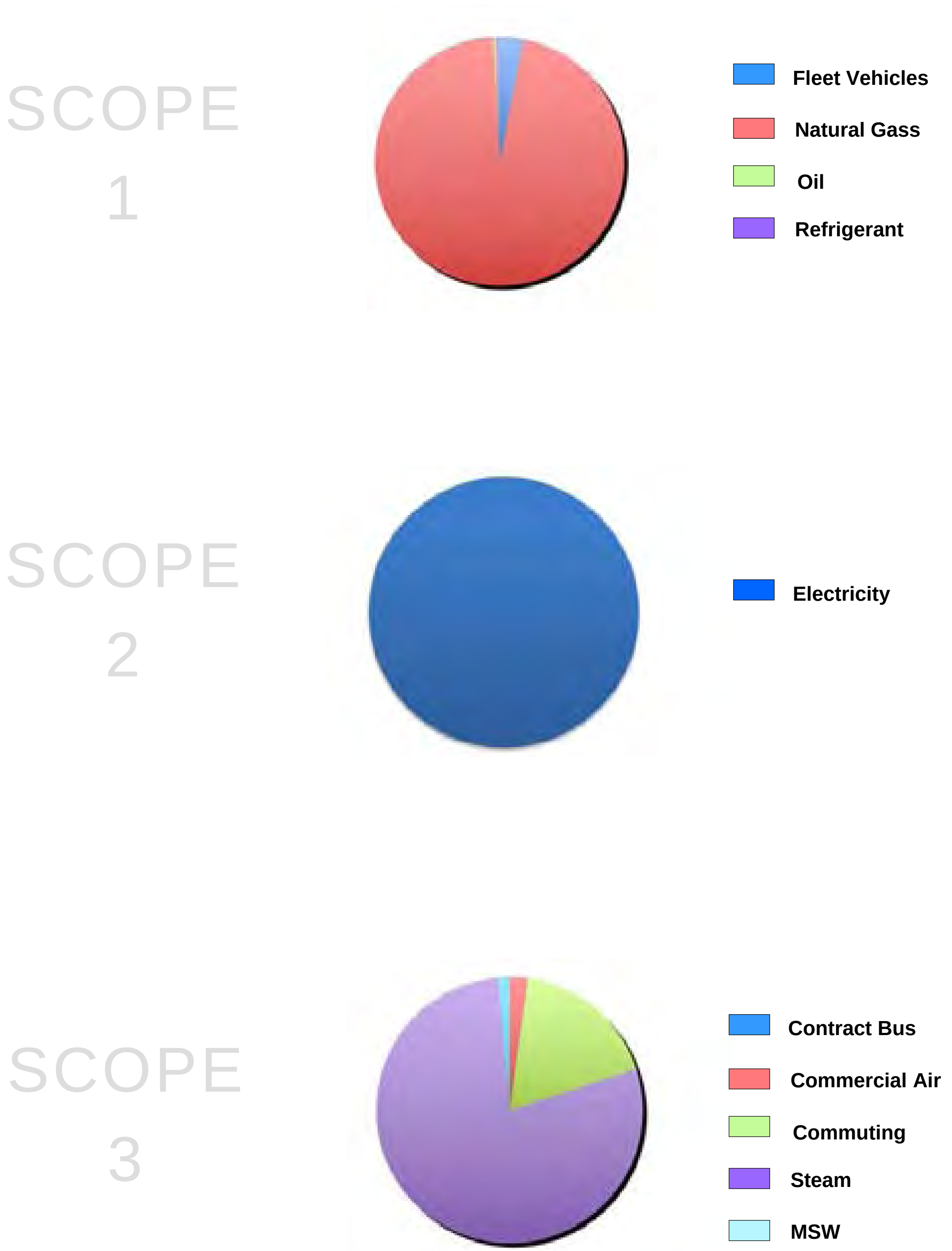


Figure 1. BSU FY2009 Scope Emissions

As stated previously, BSU (as an ACUPCC signatory) agrees to account for and report on emissions from Scopes 1 and 2. In addition, as specified in the Commitment, signatories agree to report some Scope 3 emissions, specifically those from air travel paid for by or through the institution and regular commuting to and from campus, to the extent that data are available. As a result, the amount of GHG emissions BSU is required to mitigate in its carbon reduction plan are illustrated in Table 2.

Table 2. BSU FY2009 GHG Emissions Inventory Summary of ACUPCC Requirements

	CO2e Tonnes (MTCO2e)	% CO2e
SCOPE 1		
- Fleet Vehicles	**313**	**3.2**
- Natural Gas	**9,473**	**96**
- Oil	**8**	**0.1**
- Refrigerant	**65**	**0.7**
SUB-TOTAL	**9,859**	**100%** *47% (of amt requiring mitigation per ACUPCC)*
SCOPE 2		
- Electricity	**9,368**	**100%**
SUB-TOTAL	**9,368**	**100%** *45% (of amt requiring mitigation per ACUPCC)*
SCOPE 3		
- Contract Bus Services	**0.3**	**0%**
- Commuting	**1,463**	**18%**
- Employee Business Travel (commercial air)	**188**	**2%**
SUB-TOTAL	**1,651.3**	**100%** *8% (of amt requiring mitigation per ACUPCC)*
TOTAL	**20,878.3**	**100%**

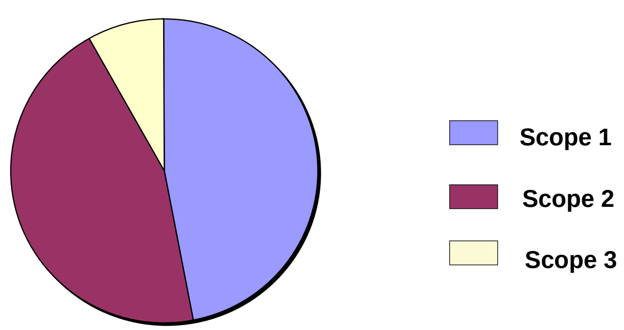


Figure 2. BSU FY2009 Total Emissions Requiring Mitigation per ACUPCC requirements

Applicable Protocol

The Climate Registry General Reporting Protocol (GRP), Version 1.1, May 2008 (including Updates and Clarifications, published 2/12/2010 and 5/12/2010) is the applicable accounting protocol used to conduct the BSU greenhouse gas inventory. The California Climate Action Registry General Reporting Protocol, Version 3.1, January 2009 has also been reviewed. BSU should be aware that the last year of reporting to The California Climate Action Registry (CCAR) was Emission Year (EY) 2009 and membership with CCAR may not be applicable based upon its geographical boundaries. Therefore, it is strongly recommended that BSU consider formal participation in The Climate Registry.

Boundaries

A. Temporal Boundaries

BSU's GHG inventory calculates its emissions over their fiscal year. The BSU GHG accounting database currently contains monthly data from 7/1/2007 to 12/31/2009. For the purposes of this report and the development of the Carbon Reduction Plan, fiscal year 2009 is being used as the year against which future reductions are being measured.

While ACUPCC currently allows for reporting by fiscal year, BSU should be aware that calendar year reporting is the standard used by most formal registries. Should BSU decide to participate in a more formal registry, such as The Climate Registry, it would need to change to calendar year reporting in order to participate. For the purposes of future reporting to The Climate Registry (if BSU decides to participate) the base year would be calendar year 2008. This difference in temporal boundaries is discussed in more detail under IV. Establishing a Base Year.

B. Geographic Boundaries

The Climate Registry requires that at a minimum, BSU must report its emission sources in all Canadian Provinces and territories, Mexican States, and U.S. States and dependant areas. BSU must also indicate if any of its facilities are located in lands designated to tribal nations that are members of The Climate Registry. The inventory includes the BSU campus.

C. Organizational Boundaries

There are two approaches to establishing organizational GHG accounting boundaries: *control* and *equity* share, defined as follows:

- Equity Share Approach:
  If an entity chooses to report its GHG emissions under the *equity share approach*, it must report all emissions sources that are wholly owned and partially owned according to its equity share in each.

- Control Approach:
  If an entity chooses to report under the *control approach*, it must report 100 percent of the emissions from sources that are under its control, including both wholly owned and partially owned sources.

Control can be defined in either operational or financial terms. When using the control approach, BSU must choose whether the operational control approach or the financial control approach to consolidate its emissions should be used. These are defined as follows:

- An entity has *operational control* over an operation if the entity or one of its subsidiaries has the full authority to introduce and implement its operating polices. The entity that holds the operating license for operation typically has operational control.
- An entity has financial control over an operation if the entity has the ability to direct the financial polices of the operation with an interest in gaining economic benefits from its activities. Financial control usually exists if the entity has the right to the majority of the benefits of the operation, however these rights are conveyed. An entity has financial control over an operation if the operation is considered a group company or subsidiary for the purpose of financial consolidation, i.e. if the operation is fully consolidated in financial accounts.

Each GHG accounting consolidation approach—equity share, operational control and financial control—has advantages and disadvantages. Operational and financial control approaches may best support an organization's performance tracking of GHG management policies and be most compatible with the majority of regulatory programs. However, the control approach may not fully reflect the organization's financial risks and opportunities associated with climate change. Conversely, while the equity share approach may best support an organization's financial risk management, it may be less effective at tracking the operational performance of its GHG management policies.

The Climate Registry (TCR) requires that BSU report its entity-wide emissions on a *control* basis. When reporting on a control basis, TCR members may report using operational or financial control. TCR also encourages its Members to additionally report using equity share. BSU defines its organizational boundary using *operational control* under the *Control Approach*.

Leased Facilities/Vehicles and Landlord/Tenant Arrangements

The ACUPCC requires a listing of institution-owned, leased or operated buildings or other holdings that should fall within the organizational boundaries. Lease space physically on the BSU campus has been provided. Given that no other information regarding leased facilities have been provided to the consultant team this information has been excluded from the greenhouse gas emissions inventory. This item has been included in the recommendations for future GHG emissions tracking.

D. Operational Boundaries

Consistent with GHG Protocol standards, BSU tracks and reports its emissions of the six GHG gases covered under the Kyoto Protocol: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. As an ACUPCC participant, BSU is expected to calculate the emissions of each gas separately, and aggregate them into units of carbon dioxide equivalents (CO_2e).

CO_2e is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential (GWP), when measured over a specified timescale (generally 100 years). CO_2e thus reflects the time-integrated radiative forcing of a quantity of emissions or rate of greenhouse gas emission—a flow into the atmosphere—rather than the instantaneous value of the radiative forcing of the stock (concentration) of greenhouse gases in the atmosphere described as CO_2e. The CO_2e for a gas is obtained by multiplying the mass and the GWP of the gas. Current calculations are based on the Intergovernmental Panel on Climate Change Second Assessment Report, over a 100-year time horizon. [1] GHG calculations have been completed using the following:

- <u>Required Scopes:</u>
  The Climate Registry requires that BSU report both Scope 1 and Scope 2 data. Reporting of Scope 3 is optional. The ACUPCC Implementation Guide states that ACUPCC signatories must report Scope 3 greenhouse gas emissions from commuting and from air travel paid by or through the institution. The BSU Scope 3 database includes owned steam consumption, contract bus services, commuting, downstream emissions from waste disposal, and employee business travel. In accordance with The Climate Registry's General Reporting Protocol, direct CO2 emission from the combustion of biomass in stationary and mobile sources is not included in Scope 1 and is reported separately from the scopes. The rationale for this is described under Section III D. Activity and Emissions Data 4. Emissions from Biomass Combustion.

- <u>Small Emissions Sources (De Minimis Emissions)</u>
  ACUPCC signatories are encouraged to track and report their emissions to the fullest extent that is practical. However, ACUPCC Guidance provides that, consistent with the rules for participation in the Chicago Climate Exchange and the California Climate Action Registry, BSU may designate small emission sources that are difficult to track as *de minimis* and exclude them from its inventory, provided that the emissions sources collectively comprise less than 5% of the institution's total GHG emissions. BSU, in declaring certain emissions sources as *de minimis* should use rough, upper-bound estimates to ensure that these emission sources do in fact contribute less than 5% of its total emissions.

[1] http://www.ipcc.ch/pdf/climate-changes-1995/ipcc-2nd-assessment/2nd-assessment-en.pdf

E. Facility Level Reporting

BSU is required to report emissions separately for each facility within an entity. In general, a facility is defined as a single physical premises. BSU is encouraged, but not required, to report emissions data at the unit level for its stationary combustion units, if the data is available.

Mobile Sources.
The term "facility" generally refers to single physical premises and therefore does not apply to mobile combustion sources such as automobiles, airplanes, and marine vessels.

- Facility-Specific Mobile Sources:
  When mobile sources are assigned to a single facility and do not operate beyond that facility's premises, the equipment is considered to be part of the facility and the emissions from the equipment must be included in the facility's emissions.

- Non-Facility Specific Mobile Sources
  The Climate Registry provides flexibility in deciding how BSU will want to aggregate its mobile sources.

  - For ground-based mobile sources, BSU has the option of aggregating emissions by geographic location or by vehicle type.

  - For air and marine-based mobile combustion sources, BSU must report emissions on a country basis whenever possible. Emissions from domestic flights and voyages must be assigned to the specific country in which the flight/voyage originated and terminated. If an international flight or voyage includes a domestic stopover or port of call, the emissions from the domestic leg of the flight or voyage should be assigned to the country in which the domestic leg originates and terminates. BSU is strongly encouraged, but not required, to report emissions from legs of flights or voyages that originate and/or terminate outside of Canada, the US or Mexico.

Establishing the Base Year

A "Base Year" is a benchmark against which BSU's emissions are compared over time. Setting and updating a Base Year provides a standardized benchmark that reflects BSU's evolving structure over time, allowing changes in organizational structure to be tracked in a meaningful fashion.

The ACUPCC does not require BSU to declare a Base Year. Under The Climate Registry, BSU's Base Year is defined as the earliest reporting year in which it submits a "complete" emission report. It may set a historical year as its Base Year, if it submits complete data for the historical year and all subsequent years.

Should BSU decide to set a Base Year, there are instances when an entity's Base Year must be recalculated. For example, The Climate Registry will require BSU to adjust (recalculate) its Base Year emissions when either:

1. A structural change in its organizational boundaries (merger, acquisition, or divestiture) triggers a significant cumulative change in its base year emissions;
2. A change in its calculation methodologies or emission factors that trigger a significant cumulative change in its base year emissions; or
3. It discovers a significant error or a number of cumulative errors that are collectively significant.

Significant is defined by TCR as a cumulative change of 5% of larger in BSU's total Base Year emissions (Scope 1 plus Scope 2, as well as Scope 3 if BSU is reporting Scope 3 emissions, on a CO_2e basis).

BSU would not need to adjust its Base Year emissions in any of the following situations:

- Acquisition (or in-sourcing) or divestiture (or out-sourcing) of a facility or business unit that did not exist in the Base Year.
- Structural changes due to "out-sourcing" if it is reporting its indirect emissions from the relevant outsourced emissions in the current Reporting Year
- Structural changes due to "in-sourcing" (the converse of outsourcing) if BSU already included the indirect emissions associated with the in-sourced activities in its Base Year report
- Organic growth or decline.

Activity Data

A. Calculation Methodologies Used

The Climate Registry approved calculation methodologies have been used whenever possible. If The Climate Registry has not endorsed guidelines from a particular emissions source, methods based on internationally accepted best practices have been used whenever possible, such as the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories; the World Resources Institute and World Business Council for Sustainable Development (WRI WBCSD) GHG Protocol calculation tools and calculation guidance and other internationally recognized sources.

Effective February 11, 2010, The Climate Registry has eliminated the use of data quality tiers in its voluntary program. The Climate Registry's General Reporting Protocol (GRP) and the industry -specific protocols contain many calculation methodologies. Each separate methodology provides a specific level of accuracy. In the forthcoming The Climate Registry GRP 2.0 (to be released fall 2010), each calculation methodology will be assigned a unique reference identifier, rather than a general tier designation. The Climate Registry is not removing or altering the calculation methodologies in the GRP, only the Tier designations are being eliminated.

B. Simplified Estimation Methodologies Used

In order to reduce the reporting burden while retaining the requirement for complete emission reporting, BSU is allowed to use alternative, simplified estimation methods for any combination of individual emission sources and/or gases, provided that the emissions from these sources and/or gases are less than or equal to 5% of its total emissions (i.e. the sum of its Scope 1 and Scope 2 and biogenic emissions from stationary and mobile combustion, aggregated on a CO_2e basis). The remaining 95% of its emissions must be calculated using The Climate Registry's calculation methodologies, if possible.

C. Additional Building, Population and Contextual Data

In addition to the data required to conduct a greenhouse gas inventory under The Climate Registry's General Reporting Protocols, ACUPCC requires its signatories to submit additional building, population and contextual data. This data includes:

1. Total amount in gross square feet of building space – *1,630,685 square feet*
2. Total net assignable square feet of laboratory space – *29,987 square feet**
3. Total net assignable square feet of health care space – *34,857 square feet*
4. Total net assignable square feet of residential space – *587,273 square feet*
5. Total student enrollment – *5,175 students*
6. Total full-time students – *3,658 students*
7. Total part-time students – *1,517 students*
8. Total residential students – *1,094 students*
9. Total full-time commuter students – *TBD***
10. Total part-time commuter students – *TBD***
11. Total non-credit students – *170*
12. Total full-time faculty – *265*
13. Total part-time faculty – *130*
14. Total full-time staff – *205*
15. Total part-time staff – *11*
16. Total endowment size – *$12M*
17. Total heating degree days – *8,646*
18. Total cooling degree days – 306

* *Figure represents BSU lab space prior to the remodel.*

** *To be included in future commuter survey.*

D. Activity & Emissions Data

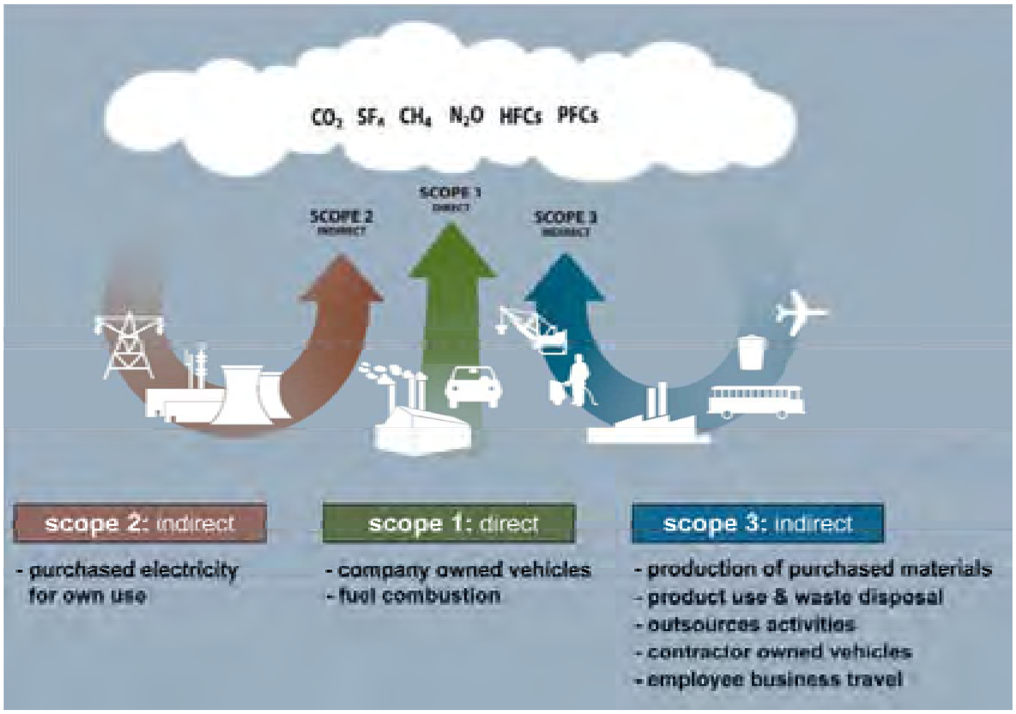
To help differentiate direct and indirect emission sources, improve transparency, facilitate fair comparisons, and provide a means to communicate different climate policies and goals, the GHG Protocol defines three scopes for GHG accounting and reporting purposes. Consistent with the GHG Protocol standards, ACUPCC signatories agree to account for and report on emissions from Scopes 1 and 2. In addition, as specified in the Commitment, signatories “agree to report some Scope 3 emissions, specifically those from air travel paid for by or through BSU and regular commuting to and from campus, to the extent that data is available. For the purposes of the Commitment, commuting is defined as travel to and from campus on a day-to-day basis by students, faculty, and staff. It does not include student travel to and from campus at the beginning and end of term or during break periods.”

BSU is encouraged to track and report its emissions to the fullest extent practical. However, consistent with the California Climate Action Registry, participants may designate small emissions sources that are difficult to track as *de minimis* and exclude them from the inventory, provided that the emissions sources collectively comprise less than 5% of BSU’s total GHG emissions. BSU, in declaring certain emissions sources as *de minimis* should use rough, upper-bound estimates to ensure that these emissions sources do in fact contribute less than 5% of its total emissions.

To date data for remote campus locations have not been included in this GHG emissions inventory (only the BSU physical campus is included). In addition, the amounts of personal vehicle miles traveled have not been included in the GHG emissions inventory: where personal vehicle miles traveled is when employees take their personal vehicles on business travel (which is different than commuting). These missing sources have been designated as de minimis as we believe collectively they comprise less than five percent of the total emissions.

Upon completing the BSU GHG emissions inventory it is apparent that improvements in data collection can be made, for example: airline data does not tell us how many people traveled just flight and mileage or in terms of evaluating options, we know how much water was consumed by a building but we don’t know what consumed the water (e.g. how many toilets). While improved data collection practices are discussed in the Tracking Progress section of the BSU Climate Action Plan, recommendations for improvement are also presented as part of this GHG emissions inventory. In addition, recommendations for improvements in data recording will also be made as some data used for the inventory appears to be estimates versus actual metered data.

Figure 5. Illustration of Scope 1, 2 and 3 Emissions



Base Source: WRI/WBCSD GHG Protocol, Corporate Accounting & Reporting Standard (Revised Edition), Chapter 4.

1. Scope 1 Emissions

Scope 1 emissions are direct GHG emissions occurring from sources that are owned or controlled by BSU, including on-campus stationary combustion of fossil fuels; mobile combustion of fossil fuels by BSU owned/controlled vehicles; physical and process emissions, "fugitive emissions", and sequestration.

- Stationary Combustion
  Stationary combustion in the General Reporting Protocol does not consist only of fuels combusted to produce electricity, steam, heat or power. It more specifically refers to combustion of any fuel in a fixed location, including boilers, furnaces, burners, turbines, heaters, incinerators, engines, flares, etc. In compliance with the Climate Registry's General Reporting Protocol, biogenic carbon emissions must be reported separately. The rationale for this is described under Section III D. Activity and Emissions Data 4. Emissions from Biomass Combustion.

- Mobile Combustion
  Mobile combustion refers to the burning of fuels by BSU-owned transportation devices such as cars, trucks, tractors, and buses. Biogenic carbon emissions must be reported separately. The rationale for this is described under Section III D. Activity and Emissions Data 4. Emissions from Biomass Combustion.

- Physical and Chemical Process Emissions
  Process emissions are direct GHG emissions from physical or chemical processes rather than from fuel combustion. Institutions of higher education are unlikely to have any process emissions.

- Fugitive Emissions
  Fugitive GHG emissions are due to the intentional or unintentional release of GHGs in the production, processing, transmission, storage, and use of fuels and other substances. Examples include HFC releases during the use of refrigeration and air conditioning equipment. Emissions that come through an exhaust pipe, stack, chimney, vent or other functionally equivalent opening do not count as fugitive emissions.

- Sequestration
  The ACUPCC Implementation Guide states that BSU may include carbon sequestered by its forest in their GHG inventory. In doing so, BSU should follow the CCAR Forest Project Protocol Version 3.1. In addition, the WRI/WBCSD GHG Protocol's Land Use, Land Use Change, and Forestry Guidance for GHG Project Accounting has also been consulted to ensure that reductions measured from its forest lands are real, lasting and "additional".

  BSU acquired the 240-acre Hobson Memorial Forest in 1948 for the purpose of outdoor recreation, education and research. There is no formal management plan for the forest. As a result, we recommend excluding Hobson Memorial Forest from BSU's inventory.

Photo of Hobson Memorial Forest
© 2003 SF Johnson & Dept. of Physics/Science BSU

2. Scope 2 Emissions

Scope 2 emissions are a special category of indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating or cooling. It typically represents one of the largest sources for an entity and represents a significant opportunity for GHG management and reduction.

It is important to understand that indirect emissions reported by one entity may also be reported as direct emissions by another entity. This dual reporting does not constitute double counting of emissions as the entities report the emissions associated with electricity production and use in different scopes. Emissions can only be aggregated meaningfully within a scope—not across scopes. By definition, Scope 2 emissions will always be accounted for by another entity as Scope 1 emissions.

- <u>Purchased Electricity</u>
  Indirect GHG emissions resulting from the generation of electricity purchased and used by BSU. BSU purchases “green power” from its electric utility. While The Climate Registry protocols do not allow BSU to deduct these purchases from its Scope 2 emissions, it can report them as supplemental information. This approach is consistent with existing GHG accounting guidance provided by CCAR, WRI and EPA. While these purchases do not have a direct accounting effect on BSU’s Scope 2 emissions, these purchases represent committed leadership to renewable energy an should continue to be encouraged.

- <u>Leased Spaces</u>
  An alternative method for estimating electricity in leased spaces was introduced through the General Reporting Protocol Updates and Clarifications dated April 27, 2009. This alternative method can be used by lessees to determine the emissions they should report and by lessors to determine the emissions they should subtract when calculating their inventory. BSU may use the alternative methodology to calculate indirect emissions from leased space in the U.S. if

  - It does not receive information about electricity usage directly
  - It is unable to obtain information about the building’s electricity usage from its landlord/property owner/property manager, and
  - It indicates in its emission report that it has used an estimation methodology to determine its electricity usage.

3. Scope 3 Emissions

ACUPCC only requires its signatories to report on emissions from commuting and from air travel paid for by or through BSU. However, ACUPCC signatories are strongly encouraged, to the extent practical, to investigate and report on additional Scope 3 emissions, especially those from sources that are large and can be meaningfully influenced by the institution.

While data availability and reliability may influence which Scope 3 activities are included in the inventory, it is accepted that data accuracy may be lower than Scope 1 and Scope 2 data. Emission estimates are generally acceptable as long as there is transparency and the data used for the analysis is adequate to support inventory objectives.

It is possible that the same Scope 3 emissions may be reported as Scope 3 emissions by more than one Reporter. For this reason, Scope 3 emissions should never be summed across entities or mixed with Scope 1 and Scope 2 emissions. For example, The Climate Registry does not add Scope 3 emissions together or mix Scope 3 with Scope 1 and 2 emissions. WRI/WBCSD GHG Protocol offers Scope 3 calculation tools and guidance. A WRI/WBCSD Scope 3 Guidance is expected to be finalized in spring of 2011. BSU's Supply Chain was not included in this inventory effort.

- Steam
  Because BSU generates its own steam, its indirect GHG emissions resulting from the generation of steam used are reported in Scope 3, "Energy-Related Activities Not Included in Scope 2".
  - Employee/Student Commuting
  - Contract Bus Service
  - Commercial Air Travel
  - Municipal Solid Waste

4. Emissions from Biomass Combustion

The combustion of biomass and biomass-based fuels (such as wood, wood waste, landfill gas, ethanol, etc) emit GHGs. Unlike other fuels, biomass combustion must be tracked separately from other direct emissions. As a result, BSU must report CO_2 emissions from biomass combustion from stationary combustion and mobile combustion separately from the scopes.

CO_2 emissions from biomass combustion are reported separately because the carbon in biomass is of a biogenic origin—meaning that it was recently contained in living organic matter—while the carbon in fossil fuels has been trapped in geologic formations for millennia. Because of this biogenic origin, the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories requires that CO_2 emissions from biomass combustion be reported separately.

Because biofuels are often mixed with fossil fuels prior to combustion, BSU must separately calculate its CO_2 emissions from biomass combustion from its CO_2 emissions from fossil fuels. The separate reporting of CO_2 emissions from biomass combustion applies only to CO_2 and not to methane (CH_4) and nitrous oxide (N_2O). Unlike CO_2 emissions, the CH_4 and N_2O emitted from biomass combustion are not of a biogenic origin and must be reported as part of BSU's Scope 1 CH_4 and N_2O emissions.

GHG Emissions Inventory Recommendations

As stated previously this GHG emissions inventory was performed to document BSU's current carbon footprint and to establish the benchmark against which future emissions can be measured. As BSU moves forward with its GHG emissions inventorying process, it should take the following recommendations into consideration. Additional discussion of these recommendations (and others) will be provided in the "Tracking Progress" section of the BSU Climate Action Plan.

1. Use ACUPCC web form to submit instead of Clean Air-Cool Planet because steam is a Scope 3 emission that is relevant because BSU creates its own steam.

2. Consider selecting a Base Year.

3. Consider participating in the Climate Registry (would require calendar year rather than fiscal year).

4. Consider including remote locations.

5. Determine whether or not BSU wants to continue with enterprise carbon management software or if they want to manage future data in a spreadsheet format. (e.g. Clean Air-Cool Planet). Enterprise carbon management software would give BSU more operational tools as it is possible to view performance on a source-by-source basis. This is very difficult and time consuming to try to accomplish using a spreadsheet as the amount of data needed to support source specific tracking grows exponentially from a simple spreadsheet report. If BSU's goal is to perform annual reporting to the ACUPCC, then a Clean Air-Cool Planet spreadsheet will be sufficient. However, if BSU decides to join The Climate Registry and make their data more operational, they will need some sort of entity-wide database to manage their data.

6. Consider inclusion of its supply chain in its FY2012 inventory and in the next periodic review of its Climate Action Plan.

7. Consider fuel economy as an important consideration in its fleet purchasing decisions.

8. Improve air travel data collection in a manner that is compliant with TCR.

9. Improve commuting data collection in a manner that is compliant with TCR.

10. Improve VMT data collection in a manner that is compliant with TCR.

11. Improve refrigerant data collection in a manner that is compliant with TCR.

12. Improve leased space data collection in a manner that is compliant with TCR.

MITIGATION STRATEGIES

Goal for Achieving Carbon Neutrality

Within two years of their implementation start date, signatories agree to develop a climate action plan that includes a target date and interim milestones for achieving carbon neutrality. For purposes of the ACUPCC, carbon neutrality is defined as having no net greenhouse (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. To achieve carbon neutrality under the terms of the Commitment, all Scope 1 and 2 emissions, as well as those Scope 3 emissions from air travel paid for by or through the institution and regular commuting to and from campus, must be neutralized. The ACUPCC would like to see institutions achieve carbon neutrality as soon as possible.

After performing the GHG emissions inventory and evaluating the sources of BSU's emissions it is apparent that most of the institution's emissions are related to the heating and cooling systems: approximately 96 % of Scope 1 emissions and 100 % of Scope 2 emissions. Given the investments recently made by BSU to replace its boilers and the average life span of these systems, it has been recommended that BSU set a target date of 2050 for achieving carbon neutrality. As this section of the Climate Action Plan illustrates, much of the GHG emissions reductions by BSU will be realized when the boilers are replaced in (or around) 2040. In the mean time, BSU can implement strategies aimed at reducing the GHG emissions related to energy use and other activities such as energy conservation, transportation and waste management.

Achieve Carbon Neutrality by 2050

Adaptive Management Plan

"Adaptive management is a tool designed after the scientific research process which requires a measurable objective, monitoring to determine the effectiveness of the management practices in achieving the objective, evaluation to determine if the objective is being reached, and adaptation based on the results" (Source: Bureau of Land Management).

This carbon reduction plan identifies strategies BSU should take in the short-, mid- and long-term to achieve its goal of becoming a carbon neutral institution by 2050. As this plan demonstrates, the proposed strategies result in an 89% reduction in Scope 1 emissions, an 87% reduction in Scope 2 emissions and a 41% reduction in the Scope 3 emissions that signatories are committed to addressing.

While the remaining GHG emissions can be addressed by purchasing carbon offsets, it is recommended that BSU apply an adaptive management approach to achieving its goal by tracking not only its performance in meeting the goal for carbon neutrality but also by tracking financial opportunities, advancements in technology and potential partnerships. It is highly probable that over the course of the next 40 years, new technologies will be made available that BSU may want to consider in its suite of GHG emissions reduction strategies that will not only assist the institution in meeting its goal for achieving carbon neutrality but it may be possible to achieve this goal on a faster time frame.

Carbon Reduction Plan

The format of this Carbon Reduction Plan mirrors the format developed for the BSU Strategic Plan: carbon reduction strategies are identified under the same goal headings or Action Areas presented in the strategic plan.

Before presenting the strategies developed for BSU's Carbon Reduction Plan, there are a number of assumptions worth noting:

1. There were no assumptions made for enrollment on the carbon side as the accounting rules do not allow for "expansion" of an entities footprint if enrollment goes up. The baseline as well as subsequent emissions are absolute. Enrollment numbers were taken into account on the energy modeling demand side of the equation in an effort to estimate future energy requirements.

2. All new construction on campus will be conducted in a carbon neutral fashion: there will be no new emissions added to the system.

3. Carbon Reductions related to changes in behavior were not included in the predictions: in some cases these changes will help BSU meet the goals stated in this Plan and in some cases these changes could exceed the goals stated in this Plan.

As the GHG emissions inventory reported BSU is required to mitigate the following (as illustrated in Figure 4 of this document):

Scope 1 Emissions	**9,859 MTCO2e** = **47%** of total amount requiring mitigation per ACUPCC
Scope 2 Emissions	**9,368 MTCO2e** = **45%** of total amount requiring mitigation per ACUPCC
Scope 3 Emissions	**1,651.3 MTCO2e** = **8%** of total amount requiring mitigation per ACUPCC

Table 3. Summary of Carbon Reductions as a Percent of the Total Achievable Reduction

	A	B	C	D	E
	2009 CO2e Tonnes (MTCO2e)	2050 CO2e Tonnes (MTCO2e)	% CO2e Reduction (from 2009)	A-B	% CO2e Reduction (of total)
SCOPE 1					
- Fleet Vehicles	313	210	33%	103	0.6
- Natural Gas	9,473	826	91%	8647	49.1
- Oil	8	0	100%	8	0.0
- Refrigerant	65	65	0%	0	0.0
SUB-TOTAL	**9,859**	**1,101**	**89%**		
SCOPE 2					
- Electricity	9,368	1,234	87%	8134	46.3
SUB-TOTAL	**9,368**	**1,234**	**87%**		
SCOPE 3					
- Contract Bus Services	0.3	0.2	33%	0.1	0
- Commuting	1,463	782	47%	681	4
- Employee Business Travel (commercial air)	188	188	0%	0	0
SUB-TOTAL	**1,651.3**	**970.2**	**41%**		
TOTAL	**20,878.3**	**3,305**	**84%**	**17,573.1**	**100%**

As Table 3 illustrates, this Carbon Reduction Plan gets BSU to within 16% of the goal for carbon neutrality (equates to 3,305 MTCO2e). As the GHG emissions inventory section describes, there were some limitations in the data provided for calculation of BSU's emissions. As a result, it was not always feasible to quantify the carbon reductions associated with an individual strategy or group of strategies. For example, no strategies were proposed for reducing emissions related to employee/student business travel (air travel) since background data used to perform the GHG emissions inventory did not provide the level of detail needed to develop strategies (e.g. airline data did not report how many people traveled just flight and mileage).

As BSU continues to fine tune its data collection and GHG emissions inventory process, it is possible that the quantification of all strategies proposed in this carbon reduction plan will address the remaining 16% of its current emissions. If not, there will be new technologies that BSU can incorporate in the future as well as the option of acquiring renewable Energy Credits (RECs).

% Reduction by Action Area:

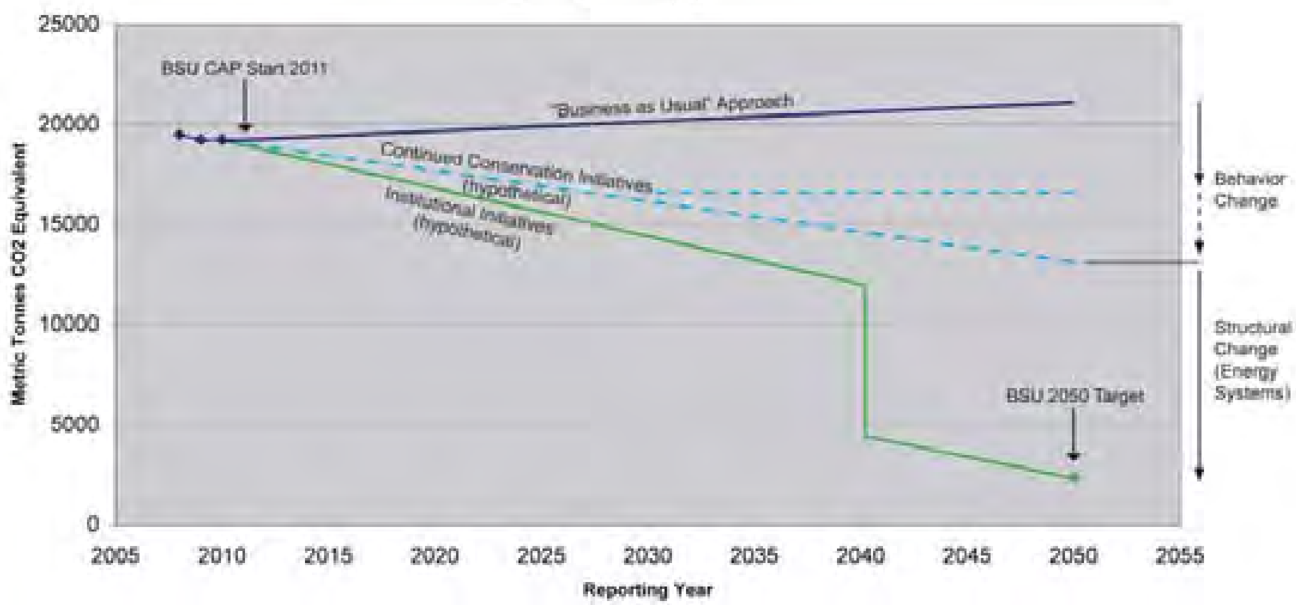
1. Energy Conservation and Efficiency	**Action Area 1** * an area to explore
2. Waste and Recycling	**Action Area 2** * an area to explore
3. Transportation	**Action Area 3** accounts for at least 4.6% reduction towards 2050 goal.
4. Renewable Energy	**Action Area 4** accounts for at least 95.4% reduction towards 2050 goal.
5. Water Quality and Water Conservation	**Action Area 5** * an area to explore
6. Native Vegetation	**Action Area 6** * an area to explore

** An area to explore for further CO_2 reductions as goal not qualified in this version of the Carbon Reduction Plan due to limitations.*

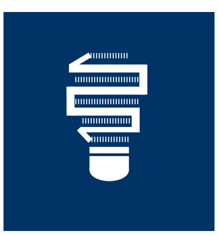
To summarize, there are a number of factors that will help BSU achieve its goal for becoming a carbon neutral institution by 2050 (or earlier). These factors include behavioral changes and structural or institutional changes. While it is possible to make a significant amount of progress via behavioral changes (as illustrated conceptually in Figure 6) it is evident that these changes need to occur in conjunction with the types of structural changes recommended in this carbon reduction plan.

Some of these behavior changes will be made easily (e.g. low hanging fruit like turning off lights and making less copies) while others make take more effort (e.g. reducing the number of showers taken in a week). These differences in behavioral change are illustrated by the two dashed lines on Figure 6. On top of the behavioral changes, BSU will begin implementing the institutional changes recommended in this Carbon Reduction Plan which will further decrease the GHG emissions from the institution. However, as the GHG emissions inventory reported, BSU will not see a big reduction in GHG emissions until it can implement retrofits to its energy infrastructure (illustrated by the data point in 2040). At this point in time, it appears that BSU will still have some GHG emissions that will need to be addressed either through new technologies, more aggressing planning or through the acquisition of Renewable Energy Credits.

Figure 6. Conceptual Summary of BSU Carbon Reduction Plan



Action Area 1: Energy Conservation and Efficiency



Energy efficiency is the most cost-effective way to reduce greenhouse gas emissions. BSU can lead by example by reducing energy use of campus buildings and by educating students and staff about how to reduce their energy use. Creating strategic partnerships with the City of Bemidji, other educational institutions and local businesses can also help to educate the public and promote energy efficiency and conservation.

While the energy audit performed for the Minnesota Schools Cutting Carbon Program in 2009 reports that BSU is performing better than average with respect to energy usage, it is evident that there is room for improvement when comparing total energy consumed. BSU uses approximately 4% less energy per square foot than the average participating school does.

BSU may see considerable energy savings from improvements that could be made within the buildings. They include the following strategies:

Table 4. Example Strategies for Improving Energy Conservation and Efficiency

	On-Going	Short-Term	Long-Term	Examples
Lighting improvements	√	√	√	Solar Tubes, LED, motion sensors
Plumbing efficiency improvements	√	√	√	Low flush toilet, greywater re-use, compost toilets
Building envelope improvements		√	√	Window replacements, green roofs, living walls
Steam trap improvements	√	√	√	Steam energy/steam trap/boiler house audits
Pipe & valve insulation	√	√	√	NA
Retrofit of existing HVAC systems		√	√	NA
Control upgrades and retro-commissioning	√	√	√	LEED certification, programmable thermostats, replacing old monitors
PC power management	√	√		Auto shut-off, tech support
Metering of thermal energy and electricity at each building to support energy management through measurement		√	√	"Floating" meters, on-time/real-time reporting
Education	√	√	√	LEED certification, building operations (retro-commissioning)

- **Goal #1:**

  Achieve a 1% per quarter in reductions and maintain this reduction for five (5) years resulting in an equivalent reduction of greenhouse gases per year.

  Strategies

  – Installing thermal meters and electrical meters at each building is an important step toward managing energy and reporting emissions.

  – New construction should meet Minnesota State Colleges & Universities (MNSCU) standards, B3 State of Minnesota Sustainable Building Guidelines (B3-MSBG) or LEED Silver and hire experienced design professionals to ensure cost effectiveness. Of design and construction process

  – Develop educational materials to educate faculty, staff and students about standby power or phantom loads and address these loads by using power strips

  – Evaluate the need/feasibility of incorporating the strategies identified in Table 4 on a building-by-building basis versus on an as needed basis.

  – Evaluate potential for improving ice rink refrigeration system.

<u>Action Area 2</u>: Waste and Recycling

Waste, and our choice to reduce waste, has a significant impact on the environment. Waste in incinerators and landfills create greenhouse gas emissions such as carbon dioxide, nitrous oxide, and methane. If the full life-cycle costs of the products we use on a daily basis are taken into account the actual impact of waste grows significantly. According to the Minnesota Schools Cutting Carbon Program, an evaluation of BSU performed in 2009 suggests that there is room for improvement when it comes to recycling: it was estimated that BSU recycled 9% of its waste compared to rates of 29% for participating schools average. Given the amount of waste produced (3,835 yards in 2009) and the annual cost of waste and recycling (estimated to be $132,256) there would be direct benefits to increasing recycling rates and reducing the amount of waste generated.

- **Goal #1:**
  Decrease Waste Generation by 30%

  Strategies:

  - Review all policies, procedures, and regulations that impact waste reduction and address areas where change is needed
  - Conduct waste audit
  - Participate in programs such as RecycleMania to increase recycling rates and interest
  - Provide consistent and easy to use recycling containers in all buildings, offices, dorm rooms, and public spaces on campus
  - Establish purchasing policies that ensure that items purchased are, to the maximum extent possible, reusable and recyclable
  - Compost all campus food waste from dining services and on-campus food vendors
  - Evaluate effectiveness of trayless cafeteria and update process as necessary
  - Review Waste Management contract to ensure performance criteria are included (e.g. recycling rates) and there is an allowance for composting of organic waste
  - Create Pay-to-Print program and require students to pay for copies
  - Create more web-based courses as well as web-based homework assignments to reduce the amount of paper being printed and distributed
  - Educate faculty, staff and students about the need to reduce waste
  - Set all copy machines to duplexing
  - Provide scanners for each department to reduce the distribution of hard copies

<u>Action Area 3</u>: Transportation

Transportation emissions comprised approximately 12% of BSU emissions in FY2009. Those emissions are generated primarily by the combustion of jet and motor fuel by planes, cars, and trucks. The emissions are estimated to be broken down into these categories:

- Students, faculty and staff who commute to and from campus (1,463 tonnes CO2e)
- 30 or so fleet vehicles owned and operated by BSU (313 tonnes CO2e)
- Air travel by BSU faculty and staff (188 tonnes CO2e)
- Bus trips taken by sports teams (less than one tonne CO2e)

New fuel economy standards promulgated by the US Environmental Protection Agency increase the required corporate average fuel economy by 5 percent annually between 2012 and 2016 for manufacturers of new light duty vehicles. Those requirements will increase overall fuel economy and lower GHG emissions. Nevertheless, the slow turnover rate of the existing vehicle fleet (the average motor vehicle lasts approximately 10 years) may mean that the improvements in fuel economy overall will be less than 1 percent per year during that time period.

The average amount people drive each year in Minnesota has been flat since 2006, possibly ending a long trend of increases. Any future increase in the price of gasoline would likely reduce per capita driving and increase the use of alternative modes, but even big increases in price ($1 per gallon) are likely to result in only modest reductions in fuel use since the relationship between fuel price and demand is quite inelastic.

More significant reductions in vehicle emissions could result from steps taken by BSU to reduce commuter miles driven and increase the use of carpooling, public transit, bicycling and walking. A survey for 2009 estimated that commuter trips (to and from campus) resulted in 13 million miles driven in 2009. The survey shows that commuter behavior breaks down in this way:

Current Travel Mode / Activity	# responses in category	% of total survey responses	% of total driven	Miles per yr. by category
On line classes	59	4.3%	--	--
Walk/bike/get ride	551	40.5%	--	--
Less than 1 mile	55	4.0%	7.3%	967,743
1-5 miles	261	19.2%	34.8%	4,592,380
6-10 miles	157	11.5%	20.9%	2,762,466
11-25 miles	107	7.9%	14.3%	1,882,700
26-50 miles	55	4.0%	7.3%	967,743
Over 50 miles	115	8.5%	15.3%	2,023,462
TOTALS	1,360	100%	100%	13,196,494

- **Goal #1:**

  Goals for transportation summarized in the following table

  The following table provides estimates for target increases in walking, bicycling, transit use and carpooling and reduced reliance on driving alone. For example, strategies could be employed to increase by five (5) percent annually the number of people who now drive 1-5 miles to/from campus to walk, bike, or take transit instead. Within a decade, the target would be a 50% increase.

Current Travel Mode / Activity	Proposed Action Increase Reliance on:	Annual % Increase	Annual Estimated Decrease in VMT
On line classes	NA	--	--
Walk/bike/get ride	NA	--	--
Less than 1 mile	Walking	5	48,387
1-5 miles	Bike/walk/transit	5	229,619
6-10 miles	Bike/carpool	2	55,249
11-25 miles	Carpool	1	18,827
26-50 miles	Carpool/overnight housing	1	9,677
Over 50 miles	Overnight housing	0.5	10,117
		TOTAL	**371,877**

Strategies:

– **Increase the use of Paul Bunyan Transit.** Continue to increase ridership by students and faculty on Paul Bunyan Transit. Bus service is now free for students, so increases in ridership would come as a result from improved service or increased promotion. A bus shelter (which will be solar powered) was installed on campus in the fall of 2010. Ridership on Paul Bunyan Transit has increased from 7,600 rides during the 2007-8 school year to 12,000 rides in 2009-2010. Nevertheless much of this ridership is for shopping trips or trips to North West Technical College and not commuting.

– **Encourage bicycle use for trips under six miles.** BSU can expand its free bike or bike rental program to encourage students to use a bicycle for short trips on campus or to destinations within a few miles of campus. In fall 2010, BSU began to rent refurbished bicycles (and a helmet) to students for $10 per semester. Initial reports are that students have shown interest in renting a bike.

Bike Usage Gillett Recreation Center, BSU

Additional bicycle racks, of a more convenient and secure type could, over time, be purchased for locations across campus. Bicycle racks can serve as a form of art, local identity, and promotion of bicycle use. BSU can also ensure that students living in the dorm have a secure indoor place to store a bicycle (currently only one dorm provides indoor storage). Many students take their bicycle home during the winter. If new dorms are constructed they could include a room for indoor bike storage.

Interested students at BSU could be trained as part of the League of American Bicyclists training program. There may be a League certified instructor living in Bemidji or someone who could come to campus to provide the training.

- **Increase parking fees.** Most students have access to free parking by parking on neighborhood streets adjacent to campus. There are several campus parking lots that charge from $90 to $350 annually depending on location and these are reported to be near capacity. If BSU were to increase these parking fees, and/or install parking meters on streets adjacent to campus, and/or implement permit parking in neighborhoods adjacent to campus, these changes would result in increased rates of walking, bicycling, and carpooling. Books and academic papers have been written about parking availability and cost (in most cases subsidy) and how it is a very great influence on how people choose to get around.

  - Develop a fee structure based on prioritized parking. Includes a lower rate for individuals that car pool, a higher rate if you live off campus (a distance from campus) and the highest rate if you live on or close to campus.

- **Improve convenience, safety, and access through support of a complete streets policy and trail improvements.** With the passage of legislation in 2010 making "complete streets" a policy of the state of Minnesota, BSU could work with the City of Bemidji and Active Living Beltrami County to develop a bicycle and pedestrian plan. That plan should consider changes to roadway design near campus that could make it safer and more appealing for students to walk or bicycle to and from campus. MN 197 (Paul Bunyan Drive), which runs parallel to campus, is a good candidate for a "road diet" and a conversion from four travel lanes to three lanes including a center turn lane. A conversion would make walking on the sidewalk along the road more appealing and it would make it easier and safer to cross the road. A restriped Paul Bunyan Drive could increase walking and bicycling trips to and from BSU.

- **Establish a ride-share program online to reduce commuter miles and encourage carpooling for trips longer than 6 miles.** Given the great distances that some faculty and students commute each weekday to BSU, this ride sharing program could reduce emissions significantly. Establishing a web based ride board, could be a project of a computer class or club at BSU. The BSU Student Senate has started using U-Loop, an on-line carpooling service for trips to campus and trips to the Twin Cities.

- **Advertise bus travel to faculty and staff so they are aware of options, bus locations and travel times.** Currently, travel routes are organized around student housing. To further promote the use of this mode of transportation make bus travel free to BSU faculty and staff.

- **Explore options for off campus students and faculty who may want to stay at BSU occasionally overnight.** Given the great distances that some faculty and students commute each weekday to BSU, and given the frequency of inclement winter weather, the school could explore the potential to provide small bunk room accommodations that students could rent on an overnight basis. To keep the costs low (well below motel rates), students could be required to provide their own sleeping bag and towel.

- **Bus trips taken by sports teams.** This is a very small percentage of total emission and team travel for sporting events an important part of the BSU experience. No estimate was included to reduce travel or change travel behavior for sports teams so for this analysis emissions stay the same.

- **Air travel.** This category of emissions (188 tonnes per year in 2009) comes from faculty and staff traveling to out-of-region and out-of-state meetings. This type of travel is often an important means by which faculty improve their skills, network, and secure outside funding. One small way to reduce the emissions is to fly direct instead of with stops, but this often increases the cost – which is hard to do with tight budgets. We could look into the feasibility of having BSU purchase offsets that could be invested in on-campus strategies to reduce other emissions. No estimate was included in this analysis to reduce travel or change air travel so emissions stay the same.

  - BSU should develop a system to track air travel by sports teams (miles, not $) in an effort to get a better handle on the GHG emissions associated with this source.

  - Develop/obtain sustainable software which would allow faculty, staff and students to see the GHG emissions associated with flights and allow user to purchase carbon offsets before purchasing airline tickets.

- **Goal #2:**
  Replace fleet vehicles with hydrids, plug-in hydrids, & fully electric vehicles

  Strategies

- In 2008 BSU owned and operated 72 vans and trucks and 8 cars which generated approximately 313 tonnes of GHG emissions per year. Two vehicles are Escape hybrids. Currently there are no cars in the fleet that get exceptional fuel economy. As the fleet turns over, BSU can ensure that fuel economy is an important consideration in its purchasing decisions. Given required federal improvements in fuel economy, fuel use from fleet vehicles is estimated to be reduced by 1 percent annually.

Action Area 4: Renewable Energy

An evaluation of local resources and a variety of engineered systems were evaluated in an effort to identify the systems and resources that could be relied upon to meet the energy needs of the campus and the environmental goal of a smaller carbon footprint. While not all of the options were explored in depth, they were tested for subjective and objective measures that could shape the recommendations of this carbon reduction plan. The following resources were considered as part of this evaluation:

- *Lake Water* – Lake Bemidji creates an opportunity to expand the use of late water to bring efficiency to BSU's heating system. Energy from Lake Bemidji may be considered geothermal since it could act as a heat sink for BSU cooling loads, or as solar energy since the sun contributes to late water that could be used as a heat source.

- *Municipal Sold Waste* - Bemidji has a population of approximately 13,000 people. Most populations generate approximately one (1) ton of MSW per person per year. The waste stream is considered renewable by many, including the federal government, and is a potential source of energy. (The waste stream may already be committed to other facilities.)

- *Waste Wood* - Manufacturers and processors in the area have an abundant amount of waste wood; however, historically the supply of woody material has been dominated by bark, which also carries a large amount of dirt.

- *Wind* - Wind power could possibly reduce greenhouse gas emissions, provide a renewable resource and reduce fossil fuel consumption. Wind availability is not the only driving factor on a potential wind turbine project. Local and state codes, turbine siting issues, safety, connection configuration, power use and financing strategies must also be considered.

- *Solar* - The use of photovoltaic technologies could be used to offset a small portion of the electrical loads on campus. Solar thermal strategies could be also be used in domestic hot water loops to alleviate the loads incurred by heating the water in cafeterias or other places of large water loads. The cost of implementing solar is very high and the benefits are relatively low, so these options will receive limited use.

- *Geothermal* - Heat pump systems increase Scope 2 emissions because they trade on-site gas use for off-site electrical power. It is short sighted to only include Scope 1 emissions when considering the impact of heat pump addition. Including a CHP system is key to reducing emissions associated with electric production, as reflected in numbers such as the eCO_2 emissions.

A more in-depth description of the evaluation performed for each of these renewable resources is provided in Appendix D of this report.

- **Goal #1:**
  Develop a Biomass System for Combined Heat & Power (CHP)

  Use the inherent efficiencies of a CHP since the scale of a campus-wide system (district energy) suits itself well to investment in a CHP configuration. The biomass system evaluated for this carbon reduction plan is comprised of three components:

  1. Adopt a set of energy/environmental performance goals
  2. Add an absorption chiller or replace an existing chiller with an absorption machine
  3. Develop a biomass-fueled combined heat, power and cooling system

  Strategies

  – A number of different strategies were evaluated in an attempt to determine a realistic range of reductions. The evaluation also examined which combination provides the most GHG emissions reductions at the best cost. These strategies are described in detail in Appendix D.

  – Install a much smaller biomass gasifier/boiler/generator at the north end of campus (in the Maple Hall parking lot, for example) to supply electricity and steam heat to the north end of campus only (such as Maple Hall and Oak Hall). While this strategy does not convert the entire district steam heating system, it does convert a significant portion of it which may allow for earlier implementation. This would leave only the remainder of the district heat load for the physical plant to provide.

- **Goal #2:**
  Explore/Develop Partnerships for Regional Renewable Energy (e.g. Solar & Wind)

  Strategies

  – Explore feasibility of BSU/City district energy system

  – Explore partnerships with City and/or Ottertail Power for wind power (SE side of lake) and/or solar and seek funding from grant programs (e.g. federal energy block grants)

  – Talk to the City of Bemidji about continuing the sales tax of $0.05 for sustainability initiatives

- **Goal #3:**
  Participate in Renewable Energy Credits (RECs)

  Renewable Energy Credits (RECs), also known as Renewable Energy Credits, Renewable Electricity Credits, or Tradable Renewable Certificates, are tradable, non-tangible energy commodities in the United States that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy source. These certificates can be sole and traded and the owner of the REC can claim to have purchased renewable energy. According to the U.S. Department of Energy's Green Power Network, RECs represent the environmental attributes of the power produced from renewable energy projects and are sold separate from commodity electricity. While traditional carbon emissions trading programs promote low-carbon technologies by increasing the cost of emitting carbon, RECs can incentivize carbon-neutral renewable energy by providing a production subsidy to electricity generated from renewable resources.

Some purchase agreements with utility companies has already taken place and BSU currently purchases 10% of its electricity from renewable sources. These purchases, in the form of RECs, are managed by the campus and can be pursued as aggressively as the administration chooses. Since it is difficult at best and expensive at its worst to develop grid free operations, the balance of the reductions could be obtained through the Renewable Energy Credit market.

Strategies

Evaluate the desire to purchase RECs to off-set GHG emissions until a combined heat and power system can be put in place

- Evaluate the need to purchase REC's to make up the difference in GHG emissions once the combined heat and power system has been implemented

Action Area 5: Water Quality and Water Conservation

Bemidji State University is located on the banks of Lake Bemidji, one of the first lakes along the Mississippi River. The lake is a point of pride and a focus for recreation for the BSU as well as the City of Bemidji. Protecting the quality and quantity of stormwater runoff entering the lake will be an important strategy for the long-term protection of this resource. In addition to surface water management, BSU is also concerned about protecting groundwater resources and plans to implement strategies that reduce groundwater withdrawal while promoting groundwater recharge.

As a first step in promoting water conservation, BSU hired Water & Energy Solutions, Inc. (WES) to perform an on-site indoor water use assessment with a majority of the high-use buildings on the BSU campus. This water use assessment reported water use, water/sewer costs and annual cost savings by implementing the recommendations made by WES.

The goal of this area is to improve the overall landscape by creating opportunities to reduce water use and promote water conservation. It should be noted that a number of the strategies proposed for this area will provide little if any GHG emissions reductions but they do contribute to the overall sustainability initiatives being pursued by BSU.

- **Goal #1:**
  Reduce In-Building Water Use by 30%

  Strategies
  - Replace all current fixtures with low flow fixtures (faucets, showers) in all buildings
  - Replace all current toilets with low flow toilets
  - Replace all current urinals with waterless urinals
  - Select only water efficient clothes washers, dishwashers (e.g Water Sense, Energy Star certified)
  - Select only water efficient food service equipment (e.g. Water Sense, Energy Star certified) such as dishwashers, pre-rinse spray valves, steamers, and other water using equipment
  - Select laboratory and other equipment that minimizes water use

- **Goal #2:**
  Reduce Irrigation Use of Potable Water and Groundwater by 75%

  Strategies
  - Convert 25% of the campus landscape to non-irrigated native vegetation
  - Select turf varieties with low water needs for all landscaping areas that include turf
  - Covert current irrigation systems to weather sensor or soil moisture sensor based systems
  - Install systems to capture rainwater or greywater for irrigation use
  - Conduct regular maintenance on the system to address leaks, watering of impervious areas, and system function
  - Evaluate the use of Better Site Design (BSD) and/or Low Impact Development (LID) techniques on all projects and stormwater management improvements
  - Utilize the American Society of Landscape Architects (ASLAs) Sustainable Sites Initiative in all new construction and reconstruction projects on campus
  - Retrofit all direct discharges to the lake to be treated with raingardens or similar Best Management Practices (BMPs) to attain 1-inch of volume control from all impervious surfaces
  - Develop a Comprehensive Stormwater Management Plan for campus modeling discharges ad infrastructure retrofit opportunities

Quantification of Impact
The impact of these strategies on reduced greenhouse gas emissions cannot be quantified at this time with the available information. Additional information is required (e.g. quantification of irrigation rates and extent of irrigation system and separately meter water use for irrigation to track progress).

Action Area 6: Native Vegetation

Developed landscapes currently require a significant amount of inputs to make their landscapes productive and appear healthy. These inputs consist of massive amounts of fertilizers, herbicides, and pesticides, as well as the embodied energy to create, transport, and apply these inputs on the landscape. Additionally, the rich soils of the prairies and forest landscapes have been mines of their nutrients and are often compacted to the point that they function as an impervious surface. The continuing cycle of added inputs and poor soil structure leads to large amounts of contaminated runoff reaching surface waters and decreased infiltration of runoff and groundwater recharge.

The goal of this area is to improve the overall landscape by creating opportunities to reintroduce beneficial elements of the pre-settlement landscape. It should be noted that a number of the strategies proposed for this area will provide little if any GHG emissions reductions but they do contribute to the overall sustainability initiatives being pursued by BSU.

- **Goal #1:**
  Replace a portion of the impervious landscape with green surfaces

  Strategies
  - "Greening" parking lots
  - Construct green roofs utilizing native vegetation

- **Goal #2:**
  Use native landscaping to provide water quality treatment

  Strategies
  - Restore native buffer (where needed/feasible) along the lake and incorporate designated access points

Carbon Reduction Plan Recommendations

This carbon reduction plan identifies a number of strategies that BSU should take over the next forty years (or less) to reach its goal of being a carbon neutral institution by 2050. While these strategies have been quantified to the best of our abilities (given the availability of data) it is up to BSU to determine when and how these strategies are implemented. The following recommendations are being made as logical next steps as BSU moves forward with the implementation of this Climate Action Plan. Additional discussion of these recommendations (and others) will be provided in the "Tracking Progress" section of the BSU Climate Action Plan.

Short-Term Next Steps:

1) Form a sub-committee for each Action Area and develop a work plan to:
    a. Evaluate need for improvements to data collection process
    b. Conduct feasibility studies
    c. Conduct a "savings" study (short /long term cost/benefit analysis) which can also be used as an educational and public relations tool in annual reporting documents This information will be useful for securing grant funding as well as for leveraging other funds (e.g. City of Bemidji funds) for project implementation.
    d. Be on the look out for new strategies
    e. Assign reductions to individual strategies
    f. Identify specific target dates / target benchmarks
    g. Develop educational program
2) Implement better data collection methods as articulated in the GHG Emissions Inventory Recommendations.
3) Implement the strategies proposed in this plan and periodically re-evaluate short, mid and long-term performance, emissions and finances every 5 years (i.e. apply an Adaptive Management Approach to achieving goal for carbon neutrality).
4) If BSU does any thing new (i.e. new construction, procurement policies, etc.) these activities shall be designed/developed with its carbon neutrality goal in mind.
5) Develop a monitoring program to identify which building envelope improvements will have the greatest carbon reductions (by systems, floor, etc.)

Long-Term Next Steps:

6) Continue to monitor and evaluate new technologies.
7) Continue to implement strategies proposed in this plan and periodically re-evaluate short, mid and long-term performance, emissions and finances every 5 years (i.e. apply an Adaptive Management Approach to achieving goal for carbon neutrality).
8) Repeat Commuter Survey to estimate whether actual commuting behavior has changed and whether vehicle miles traveled and GHG emissions have declined. Future surveys should ask:
    - Why so many people commute such long distances & what might motivate them to carpool
    - Whether increased parking costs on campus would increase rates of biking/walking. Could use this revenue to fund alternative transportation.
    - Conduct an additional survey now to better understand deterrents / incentives
    - What are the deterrents/incentives to using alternative modes of transportation?

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EDUCATIONAL, RESEARCH, COMMUNITY OUTREACH EFFORTS

As a signatory of the American College & University Presidents' Climate Commitment BSU is committed to integrating sustainability into the curriculum and making it part of the educational experience. BSU's vision for educational, research and community outreach efforts is to establish a campus and program where students and staff are educated on climate impacts and sustainability and these students and staff support BSU's efforts to move toward sustainability and carbon neutrality. While BSU has had an undergraduate requirement in place for over a decade called "People and the Environment" which addresses issues such as climate change and sustainability it recognizes the need to weave these topics into all facets of education, research and community outreach efforts.

As a first step in making climate neutrality and sustainability a part of the curriculum and/or educational experience, BSU conducted a survey which was distributed to all BSU faculty in the fall of 2010. This survey was designed to evaluate how well climate change and sustainability are addressed within the existing curriculum, extra-curricular activities and research as well as determining what would be the most effective strategies for integrating climate change and sustainability into future curriculum and research.

Survey Results

The BSU Sustainability Coordinator distributed an online survey to the BSU faculty and staff, approximately 400 people. Sixty-four complete responses were received with an additional fourteen partial responses, about a 10% response rate. The survey asked eleven questions related to the curriculum, research, and extra-curricular activities:

1. Have you taught any courses at BSU within the past 3 years whose ***main focus*** is on sustainability or climate change?

2. Have you taught any courses at BSU within the past 3 years that include climate change or sustainability concepts in the curriculum ***but do not have this content as the main focus***?

3. Are you interested in developing a course that focuses on climate change or sustainability concepts?

4. Are informal seminars (outside of coursework) available on campus that discuss ***climate change concepts*** or methods to address climate change?

5. Are informal seminars (outside of coursework) available on campus that discuss ***sustainability concepts*** or methods to move toward sustainability?

6. Please indicate how well you believe each of these ***climate change topics*** are addressed in BSU curriculum.

   Concept/Topic
   - Defining climate change
   - Climate change in Earth's history
   - Climate change impacts (economic, social, environmental impact)
   - Adaptation to climate change
   - Importance of climate change
   - Methods to reduce climate change impacts
   - Global climate modeling

7. Please indicate how well you believe each of these sustainability topics are addressed in BSU curriculum.

   Concept/Topic
   - What is sustainability
   - Why sustainability matters
   - Multi-modal transportation (bike, walk, bus, etc.)
   - Energy efficiency and conservation
   - Renewable energy
   - "Green" building and sustainable materials
   - Water resource protection
   - Water efficiency and conservation
   - Recycling/ Waste reduction/ Product reuse and stewardship
   - Preferable purchasing
   - Local and sustainable food systems
   - Sustainable landscapes/natural resource protection
   - Community health
   - Greenhouse gas emissions & tracking

8. Please indicate what you feel would be the most effective two methods to integrate climate change into the BSU curriculum.

   Method
   - Hold periodic seminars on climate change topics and climate research in all departments
   - Offer required courses specific to climate change as it relates to each discipline or major (e.g. climate change modeling, political discourse on climate change, chemistry of greenhouse gases and climate change, climate change literature)
   - Offer elective courses specific to climate change as it relates to each discipline or major (e.g. climate change modeling, political discourse on climate change, chemistry of greenhouse gases and climate change, climate change literature)
   - Freshman seminar course on climate change and/or sustainability
   - Integrate some climate change examples and climate change topics into a variety of required courses in each department

9. Are you conducting any research addressing climate change impacts, climate change mitigation, or climate change adaptation?

10. Are you conducting any research related to sustainability?

11. Are you aware of the following extra-curricular activities or programs at BSU?

Activity

- Community garden
- Recycling and waste reduction challenges
- Rideshare or carpool programs
- Transit promotion programs
- Climate-action related student groups
- Environmental-action related student groups
- Human rights or social issues-related student groups
- Earth day or earth week events
- Renewable energy student groups
- Green technology student groups
- Sustainability or climate-action related student groups

The survey results are summarized below and are categorized by topic: Education, Research, and Community Outreach.

Education

Formal coursework provides the foundation for the BSU curriculum activities related to sustainability and climate change. Survey results show that about 14% of respondents had taught a course with a main focus on sustainability or climate change and 37% had taught a course that included some discussion of sustainability or climate change in the curriculum. The survey identified nine individual courses held within the past three years that specifically targeted to sustainability or climate change in the current curriculum at Bemidji State University: Environmental Sociology, Disaster in the Human Environment, English Composition: Environmental Theme, People and the Environment, Construction Materials and Practices, Psychology of Sustainability, Environmental Justice and Sustainability, Environmental Economics, and Environmental Law and Policy. These courses typically enroll 15 to 45 students each section, and are estimated to enroll about 450 students annually (about 8% of the total BSU enrollment). In addition, 58 other courses were identified that include some curriculum oriented to sustainability or climate change.

The majority (67%) of respondents were not interested in developing additional courses focusing on sustainability or climate change. However, 18% of respondents were interested in developing a course focusing on both sustainability and climate change and 7% were interested in developing a course focusing solely on sustainability. Another 7% were interested in developing a course only if additional faculty staffing is provided.

With respect to climate change topics in the BSU curriculum, the majority (about 55% to 70%) of respondents didn't know how well any of the topics were incorporated into the curriculum. Of those who did indicate how well climate change topics are integrated into the BSU curriculum, most felt there is a "good" level of integration regarding climate change in general, climate change in the earth's history, climate change impacts and the importance of climate change, a "fair" level of integration regarding methods to reduce climate change impacts, and a "fair" to "poor" level of integration regarding global climate modeling.

Regarding sustainability topics in the BSU curriculum, slightly fewer respondents (about 35% - 50%) indicated they didn't know how well the topics are addressed in BSU curriculum. Of those who did indicate how well the topics are incorporated, the majority felt there is "good" integration in the curriculum regarding multi-modal transportation, energy efficiency and conservation, renewable energy, water resource protection, water efficiency and conservation, recycling and waste reduction, natural resource protection, and why sustainability matters, "good" to "fair" integration regarding community health, local and sustainable food systems, green building and sustainable materials, and what sustainability is, and a "fair" level of integration for preferable purchasing and greenhouse gas emissions and tracking.

The top three methods selected by respondents to improve integration of climate change into the BSU curriculum are holding periodic seminars on climate change and climate research, integrating climate change into required departmental courses, and holding freshman seminar courses on climate change and sustainability.

Research

Research and testing and evaluation of new methods is another way that faculty and staff can support BSU's sustainability and carbon reduction efforts. Research and evaluation Research activities regarding climate change or sustainability are being conducted by about 10% of the respondents. Topics range from climate impacts on wetlands to zero energy design to socio-economic impacts to composting. Respondents also indicated specific initiatives such as authoring a book on environmental justice and assisting theater students in implementing LED lighting for the theater programs carbon footprint reduction program.

Community Outreach

Student and campus engagement with sustainability and climate change issues provide another aspect of BSU sustainability and climate change-related curriculum. The survey results indicate that about half of the respondents are aware of informal seminars available regularly or occasionally on campus that are related to sustainability or climate change. Of those that were aware of these informal seminars, 11% had organized a sustainability or climate change seminar, 20% had presented at one of the seminars and 43% had simply attended at least one of the seminars. The Sustainability Office, Environmental Advisory Committee, Optivation, and Environmental Studies Department were the most common hosts referenced for sustainability or climate change seminars.

The most commonly recognized extra-curricular programs at BSU are recycling and waste reduction challenges and earth day or earth week events with over 80% of respondents aware of these activities on campus. Transit promotion programs, environmental action student groups, and human rights student groups were identified by over half of respondents as being active and available on campus. The remainder the identified activities and programs are less clearly available on campus. Half of respondents stated that rideshare or carpool programs are available, while half of respondents didn't know if these programs are available. About 30% of respondents stated they were aware of community gardens, climate action student groups, renewable energy student groups, green technology student groups and sustainability or climate related student groups, but over 60% of respondents stated they didn't know if these activities or groups were available.

Promoting awareness of existing BSU programs could increase the number of students and staff utilizing the current BSU programs and further support the sustainability and carbon reduction efforts.

Educational, Research, Community Outreach Goals

Understanding that all undergraduate students are required to take the course called "People and the Environment", the curriculum progress metric is to quantify annual enrollment in designated climate and sustainability-focused courses with the long-term goal of 25% of BSU enrollment have completed a climate and/or sustainability focused course annually.

The research progress metric is to continue to support staff and student research activities.

The community outreach progress metric is increasing awareness of BSU sustainability and carbon reduction programs to 80%, as was currently measured for recycling and earth day events. A second metric is to maintain participation in BSU-led efforts at 60%.

Educational, Research, Community Outreach Recommendations

To meet the overall carbon reduction goals set by BSU, the University will need the support and active engagement of its students and staff. Curriculum and extra-curricular activities should support BSU's efforts by educating and actively engaging BSU students and staff in actions to reduce climate impacts. The surrounding community will be engaged in these efforts through BSU's partnership with the City of Bemidji.

To improve the integration of sustainability and climate change concepts into the BSU curriculum, research, and community outreach efforts it is recommended that BSU:

1) Integrate climate change and sustainability concepts into at least one of each department's required courses.
2) Promote awareness of existing programs available on campus that are not as well known currently.
    a. Transit programs
    b. Seminars
    c. Student group activities
3) Increase participation in sustainability and climate change adaptation and mitigation efforts through contests, awards, and BSU-wide semester-long focus on one type of improvement or behavior change.
    a. Waste reduction contest
    b. Energy reduction contest
    c. Student-led activity sustainability award
    d. Department carbon reduction award
    e. BSU-wide focus on energy use reduction (lighting, heating, cooling)

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FINANCING

Bemidji State University is committed to securing the resources required to achieve the goals of the Presidents' Climate Commitment. This Climate Action Plan identifies a general course of action that BSU should take as it moves towards becoming a carbon neutral institution. While some of the carbon reduction strategies proposed in this Plan have little or no cost associated with them, others will require further study and evaluation.

As other Institutions have found, the implementation of this Climate Action Plan could result in direct cost savings to BSU. With fossil fuel-related energy prices rising, the economics can become more favorable. These cost savings could result in lower tuition costs. For example, the use of wind power at the University of Minnesota Morris directly helps the University to keep tuition costs down[2], according to Vice Chancellor Lowell Rasmussen. In addition to the cost savings resulting from the use of alternative energy sources, BSU could see a reduction in water use costs, sewer/wastewater costs, and water heating costs among others.

As BSU moves forward with the implementation of this Plan, each of the following mechanisms will be evaluated for its compatibility with the Institution's Mission:

- **Cost Savings Resulting from Conservation Efforts** – As stated above, BSU could see cost savings resulting from the use of alternative energy sources as well as from a reduction in water use costs, sewer/wastewater costs, and water heating costs among others.
- **Grant Funding** – There are a number of grant programs that BSU should explore through Federal and State sources. For example, the U.S. Environmental Protection Agency offers carbon reduction grants through the "Black Carbon's Role in Global to Local Scale Climate ad Air Quality" Program, the U.S. Agency for International Development offers carbon reduction grants through the "Energy Efficiency and Renewable Energy Program", and the U.S. Department of Transportation's Federal Transit Administration offers carbon reduction grants through the "Clean Fuels" program.
- **Creative Partnerships at the State and Local Level -** For example, exploring the possibility of alternative energy sources (e.g. wind power on Lake Bemidji) with the City of Bemidji and Ottertail Power can result in savings due to economies of scale.
- **Private Sector Endowments**
- **Entrepreneurial Possibilities** – An example of this may be looking for a small business interested in taking BSU's food waste to generate compost material for sale.
- **Revenue Sharing as a Result of Green Industry Public/Private Partnerships**
- **Revolving Loan Funds** – A pool of program funds managed by the State of Minnesota (e.g. Minnesota Department of Health's Drinking Water Revolving Loan Fund which provides below market rate loans for public water system improvements)
- **Development of a Sustainability Fund** – Consider the creation of a separate fund account specific to achieving carbon neutrality or to sustainability initiatives. This fund could be built on a number of potential sources including: demand response payments, parking fees, and/or a percentage of annual utility cost savings. BSU should engage with its student body to discuss the feasibility of a student fee that would go directly toward funding carbon reduction/sustainability projects. A $5/year fee per student would yield approximately $25,875/year assuming a student population of 5,175 students.

[2] Sustainability – The Government takes a pass, and businesses point the way. Chris Farrell. The Star Tribune. January 15, 2011.

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TRACKING PROGRESS

This carbon reduction plan identifies strategies BSU should take in the short-, mid- and long-term to achieve its goal of becoming a carbon neutral institution by 2050. As this plan demonstrates, the proposed strategies result in an 89% reduction in Scope 1 emissions, an 87% reduction in Scope 2 emissions and a 41% reduction in the Scope 3 emissions that signatories are committed to addressing.

While the remaining GHG emissions can be addressed by purchasing carbon offsets, it is recommended that BSU apply an adaptive management approach to achieving its goal by tracking not only its performance in meeting the goal for carbon neutrality but also by tracking financial opportunities, advancements in technology and potential partnerships. It is highly probable that over the course of the next 40 years, new technologies will be made available that BSU may want to consider in its suite of GHG emissions reduction strategies that will not only assist the institution in meeting its goal for achieving carbon neutrality but it may be possible to achieve this goal on a faster time frame.

1. BSU will perform annual GHG emissions inventories to evaluate its performance in meeting its goal for achieving carbon neutrality by 2050.

2. Progress reports will be written and published yearly after each annual GHG inventory report has been completed.

3. Carbon reductions, progress towards becoming a more sustainable institution and cost savings will be communicated to BSU students and staff as well as the community as a whole.

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APPENDICES

"The institutional body responsible for the ACUPCC should record and compile information about the process of developing the plan. This record should include minutes from meetings, input from stakeholder groups, and a longer, more detailed report with descriptions of emissions reduction activities, plan for contingency (e.g. if interim targets are missed, or if the plan needs to be amended), and information about key actors, technologies, etc. This will allow the signatory schools to retain important institutional memory and to assess the value of steps taken in implementing the action plan."

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A. Environmental Subcommittee Meetings

Over the course of the project two (2) stakeholder meetings were held: the first meeting was held at the beginning of the project to develop a vision and goals for the Climate Action Plan as well as the Sustainability Framework and the second meeting was held at the end of the project to review a draft of the GHG Emissions Inventory and Carbon Reduction Plan. Members of BSU's Environmental Advisory Committee, BSU students and City of Bemidji Staff were invited to attend each of these meetings.

The agenda and meeting summary for each of these meetings are provided on the following pages:

Bemidji State University – Sustainability Vision and Goals Setting
May 24, 2010

Meeting Agenda

Meeting #1 – Seminar on Sustainability and the Natural Step Framework

4:00 – 4:15 Introductions to Project and Project Team – Brett Emmons

4:15 – 4:30 Introductions – Project Stakeholders – Erika Bailey-Johnson

4:30 – 6:00 Natural Step Framework Presentation – Terry Gipps

6:00 – 7:00 Dinner Hour

Meeting #2 – Stakeholder Sustainability Engagement and Action Planning Session

7:00 – 7:15 Description of the Project (setting expectations) – Brett Emmons and Karen Utt

- Re-visit BSU's involvement in ACUPCC
- Describe BSU's Sustainability Plan
- Describe BSU's GHG Emissions Inventory
- What does the GHG Emissions Inventory for BSU look like today?
- What do future projections of the GHG Emissions Inventory look like?
- What will the Climate Action Plan and Sustainability Plan Framework look like?

7:15 – 8:45 Series of three (3) brainstorming sessions to identify GHG reduction strategies and sustainability initiatives. The following guidelines apply to each session:

1. Brainstorming and documenting all ideas shared by stakeholders including GHG reduction strategies and sustainability initiatives
2. If we can get the group to identify risks and opportunities associated with GHG reduction strategies we would like to collect this information as well
3. EOR Team will organize information after the meeting by (1) separating GHG reduction strategies from sustainability initiatives and (2) developing a draft climate action plan by meshing GHG reduction strategies with GHG emissions inventory data and risks/opportunities
4. Prioritization of GHG reduction strategies and sustainability initiatives will happen with stakeholders later in the process via project web-site or on-site meeting

7:15 – 7:45 Session #1 – Energy & Buildings – Facilitated by Doug Maust, HGA and Karen Utt, Conservis

5 min. Describe the Segment Energy and Buildings – Doug Maust
Includes GHG Reductions, Alternative Energy, Energy Efficiency, Building Practices

10 min. Highlight what is in existing BSU Sustainability Plan

Review poster (poster #1)

10 min. Identify Additional GHG reduction strategies

Review GHG reduction strategies on a poster (poster #2)

5 min. Identify strategies that could be applied community-wide

Facilitator(s) can apply stickers to those GHG reduction strategies or sustainability initiatives that (1) are already complete, (2) planned for implementation, and (3) items that could be applied community wide for inclusion in the Sustainability Framework

7:45 – 8:15 Session #2 – Planning & Natural Systems – Facilitated by Barb Thoman, Transit for Livable Communities and Brett Emmons, EOR

5 min. Describe the Segment Planning & Natural Systems – Barb Thoman and Brett Emmons
Includes Land Use Policies, Sustainable Multi-Modal Transportation, Community health, Healthy Urban Forests, Surface and Groundwater Protection, Mississippi River Water Conservation

Rest of the session repeats information presented in Segment #1

8:15 – 8:45 Session #3 – Products and Waste – Facilitated by Terry Gipps, Sustainability Associates and Brett Emmons, EOR

5 min. Describe the Products and Waste – Terry Gipps
Includes Preferable Purchasing, Product Stewardship, Recycling and Waste Reduction, Food Systems/Practices

Rest of the session repeats information presented in Segment #1

8:45 – 9:00 Project Timeline and Next Steps – Camilla Correll

- Review Project Timeline
- Introduce Project Web-Site
- Identify Next Steps

651 Hale Avenue North Oakdale, Minnesota 55128 telephone: 651.770.8448 facsimile: 651.770.2552 www.eorinc.com

Date | June 3, 2010

To | Erika Bailey-Johnson, BSU Sustainability Coordinator

cc |

From | Camilla Correll, EOR

Regarding | Sustainability Vision and Goals Setting Meetings held on May 24, 2010

Meeting Attendees:

Erika Bailey-Johnson, Bemidji Sustainability Coordinator
Kyle Crocker, BSU Faculty
Wendy Larson, BSU Staff
Shannon Murray, Bemidji Sustainability Committee Member
Dave Bahr, BSU Faculty and Bemidji Sustainability Committee Member
Lacie Noehring, BSU
Brett Emmons, EOR
Camilla Correll, EOR
Terry Gips,
Karen Utt, Conservis
Doug Maust, HGA
Barb Thoman, Transit for Livable Communities

Meeting Minutes – Seminar on Sustainability and the Natural Step Framework:

After the project team and stakeholders introduced themselves, Terry Gips gave a presentation on Sustainability and the Natural Step Framework. A copy of this presentation has been posted to the BSU Climate Action Plan project web-site.

During the presentation, Terry asked the audience a number of questions. The first question was "What do you think sustainability means?" to which people responded as follows:

- Operational mode maintained forever
- Balance
- Endure
- Maintenance of the natural order

Terry then asked the group to break out in pairs and to discuss individual concerns with sustainability. The responses articulated by the group are as follows:

- Availability and cost of sustainably grown food
- Growth
- Money
- While people are generally concerned about the environment they don't know what to do. People need direction (organization and education) to help them accomplish what they fundamentally want to do; protect the environment.
- Green washing at the corporate and local level
- Awareness about food waste
- Wet blanket response in the academic setting to college students desire to reduce the use of excess paper by going paperless (frustrations that faculty are met with on a daily basis)

- Boundary issues and how to make it fair so that environmental actions are not seen as green washing

Meeting Minutes – Stakeholder Sustainability Engagement and Action Planning Session:
The project team gave a brief presentation describing BSU's accomplishments related to sustainability, the project, and the results of BSU's GHG Emissions Inventory. Highlights of BSU's GHG Emissions Inventory as reported by Karen Utt, Conservis include:

- Biggest area of risks/opportunities typically found in Scope 2 and/or Scope 3 emissions
- Question about whether or not we need to re-visit how company owned vehicles were accounted for in the BSU inventory
- Largest source of GHG emissions from purchased electricity and natural gas
- Next steps for this project related to the GHG emissions inventory will be to work with Erika Bailey-Johnson to establish the protocol BSU would like to use, define the boundaries, and develop a tracking process

Following this general presentation, the stakeholders were asked to brainstorm GHG reduction strategies and sustainability initiatives as they relate to the following topic areas: Energy & Buildings; Planning & Natural Systems; and Products & Waste. After a brief presentation on the topic area, the group was asked to review activities already identified in the BSU Sustainability Plan as well as additional options that the group would like to see addressed in the Climate Action Plan and/or the Sustainability Framework. The following bullets summarize this brainstorming activity:

Session 1: Energy & Buildings

Action Item	Complete	Completed in next Year	Problems	City-Wide Application	Notes:
Bemidji State University Sustainability Plan					
Calculate BSU's campus carbon footprint	✓				
Develop a Climate Action Plan		✓			
Challenge students to reduce energy consumption via the "Do It In The Dark" contest	✓				
Contract outside specialists to perform building audits, identifying potential areas for improvement in heating, cooling, insulation, and lighting	✓	On-going		✓	Audits could be expanded to include waste, composting, water use (low flow fixtures), stormwater management, heat recovery opportunities (existing bldg exhaust points)
Review hybrids, plug-in hybrids, and fully electric vehicles for BSU fleet replacement over time				✓	This review should include the University's 2 security vehicles
Encourage high-efficiency lighting upgrades throughout campus	✓	On-going	✓		Problems include: Staff time, buildings not unoccupied. Opportunities include Schools Cutting Carbon Grant
Participate in the Minnesota Campus Energy Challenge to encourage campus-wide energy conservation	✓	Annual event			
Promote green building design, construction, and destruction; encourage LEED certification or similar standard (Laurel House as MN Greenstar Certified)				✓	
Investigate options for less energy-intensive yard equipment				✓	

Investigate options for solar energy on campus; implement where appropriate and feasible				✓	
Continue to purchase Ottertail Tailwinds				✓	
Investigate options for wind energy on campus and in the community; implement where appropriate and feasible				✓	This would have application to Northwest Technical College as well – BSU initiating a wind/energy technician training program
Begin conversations about a sustainable living laboratory on the old high school property					
Continue to investigate alternatives for electricity and heating; implement when feasible					
Be aware and involved in local renewable energy projects					
Other Options for Sustainability					
Increase the use of State and National Cooperative Purchasing Contracts that are committed to providing environmentally preferable products and services	✓				Renovate Memorial Sanford & Union – reduce square footage (overbuilt)
Develop a list of environmentally preferred local vendors to choose from					
Annually train staff responsible for purchasing on current purchasing best practices		In progress			
Create a coalition of health care organizations and others to educate the public about pharmaceuticals in the drinking water and safely collect and dispose of pharmaceuticals					Hospital/clinic – big interest in the future. Could be part of nursing program.
Consider looking at installing solar thermal domestic hot water systems	✓	In progress			BSU has researched solar options
Explore installing a demonstration photovoltaic system		In progress		✓	BSU exploring this in conjunction with the City
Consider funding mechanisms to encourage residents/building owners to install renewable energy systems				✓	Pilot implementers
Encourage proper solar orientation and passive solar construction for new construction and retrofits					
Consider hybrid medium duty chassis for larger vehicles					University has a small amount of large vehicles
Explore the incorporation of a geothermal system					Not applicable to BSU campus
Utilize the B3 Benchmarking Database for all buildings to evaluate how well buildings perform and direct resources accordingly	✓				State $
Create strategic partnerships with businesses to educate owners on the benefits of energy efficiency and conservation				✓	Northwest Technical College does this
Establish energy and water use targets for buildings					Look for heat recovery piping opportunities (toilets, labs); fume hoods (exhaust air); marquees and the use of LED; building re-commissioning (3 year rotation); energy benchmark compared to other schools
Partner with local retail venues on ways to	✓			✓	e.g. reusable coffee mugs,

educate the public at point-of-sale and/or restaurant vendors					and signage at recycling stations

Session 2: Planning & Natural Systems

Action Item	Complete	Completed in next Year	Problems	City-Wide Application	Notes:
Bemidji State University Sustainability Plan					
Consider a tobacco-free campus policy	✓				
Co-host a Bike Bemidji event to encourage bicycling and bike safety	✓				
Promote and increase ridership on Paul Bunyan Transit	✓				Consider off grid bus shelter, adjust stops and communicate schedule better
Investigate biodiesel production and use					Rich Marsolek
Communicate with those involved in biking/walking trails				✓	Investigate City bike trail plan
Investigate a bike rental/free bike program					
Establish a ride-share program online to reduce commuter miles and encourage carpooling		In progress			Zip car. BSU looking into transit and ride boards. Looked into flex car, car-sharing for IT staff.
Perform a water audit to determine where water-saving measures can be cost-effective	✓				
Implement recommendations of water audit such as low-flow shower heads and low flush toilets	✓				
Discourage parking on Lake Bemidji	✓				
Implement runoff mitigation strategies	✓	In progress			Have implemented some native landscaping, buffer zone, raingardens but stormwater management needs improvement
Investigate options for irrigation systems					
Consider green roofs and permeable parking lot material for future building projects			✓		Problem: Green roof was being considered for Science Bldg but cost prohibitive
Review current use of pesticides and herbicides					
Continue to replace annual bed and lawn space with native perennials					
Continue to educate regarding the benefits of native perennials by creating signs, giving presentations, etc.					
Coordinate native planting with NTC's landscaping design class					
Investigate options for office/department adoptions of the native plant beds to assist in maintenance					
Investigate options for various types of native plant beds					
Encourage the planting of native trees					
Review the Master Facility Plan to ensure that sustainability of the land is incorporated					
Continue to monitor the use of Hobson Forest					

Other Options for Sustainability					
Periodically provide sustainable land use workshops for those who deal with land use issues, including pertinent staff, commissions, councils, and committees				✓	
Coordinate or sponsor community wide sustainability workshops				✓	
Work towards ensuring that facilities provide a model example of how to use land in a sustainable manner					
Develop and implement a sustainable land use awards program					
Develop and implement protocols relating to land use decisions				✓	
Coordinate land use issues with neighbors and overlapping jurisdictions				✓	
Identify underperforming and/or blighted land uses for redevelopment/reuse				✓	
Protect critical natural areas and provide natural buffers					
Provide links to the open space system				✓	
Provide for farmers markets				✓	
Improve transit infrastructure: Make shelters and bus stop locations more appealing for users; Provide facilities for bike parking; Improve bike/ped connections to transit locations			✓		Problem: Roads recently re-done (lost opportunity). Paul Bunyon Drive has bike lanes and pedestrian medians in the middle – good example of what can be dine in the future
Reduce employee trips & explore flex time and telecommuting options			✓		Problem: Night classes – trying to consolidate into 1 building but instructors prefer to remain in their own buildings
Explore a car sharing policy: Organize and promote program					Ride-matching (electronic) allows for car sharing at student, faculty, community level
Monitor parking requirements and continue to implement "Right Size" Parking strategies				✓	Campus parking policies (fees, not allowed for freshman, smaller)
Obtain grants from public, private, and non-profit sources to create new healthy living opportunities					SHIP grants; Blue Cross/Blue Shield grants
Enhance the convenience and safety of existing city bicycle and pedestrian trails where possible, maintain separation between trails and traffic, improve lighting and signage					
Make corridor design changes as necessary to provide adequate bike and walking trail width and separation, safety from motorized traffic; obtain rights-of-way as necessary					
Evaluate and track carbon storage capacity of campus and city trees					
Use plant materials that are locally grown or produced					
Set lawn design standards to require restoration					

of soil permeability after construction activity					
Retrofit sprinkler systems with weather sensors					
New Item: landscaping at Northwest Technical College – new program					
New Item: Incorporate sustainable landscaping in curriculum					Sustainable landscaping – part of program at Northwest Technical Community College

Session 3: Products & Waste

Note that we ran out of time. As a result, the group decided to skip the discussion on activities already identified in the BSU Sustainability Plan (Erika Bailey-Johnson to fill in at a later date) and focus the discussion on the "Other Options for Sustainability" items.

Action Item	Complete	Completed in next Year	Problems	City-Wide Application	Notes:
Bemidji State University Sustainability Plan					
Consider a Green Purchasing Policy					
Encourage the purchase of recycled products and more sustainable products in general (paper, office furniture, cleaning supplies, etc.)					
Promote the use of local foods					
Establish an Energy Star Purchasing Policy					
Implement a trayless policy to conserve water and reduce waste					
Perform a waste audit of Hagg-Sauer Hall					
Monitor and implement strategies to increase recycling					
Investigate options to reduce cost for waste and recycling					
Salvage food grade oil (Dan Houg)					
Investigate options for composting to decrease food and yard waste and provide a valuable (perhaps profitable) commodity					
Implement a reusable take-out container program					
Implement a bottled water policy to reduce plastic waste and encourage the use of tap water					
Implement a paper policy to reduce paper waste					
Encourage the reuse of water bottles and coffee mugs					
Encourage efficient hand-driers to reduce paper towel waste					
Communicate with General Maintenance Workers, Waste Management, faculty, staff, and students regarding waste and recycling opportunities for improvement					
Investigate a "reuse room" in the Sustainability Office					
New Item: Compost/Food Audit	✓	In progress			Composting program on campus – an organic farmer has contacted BSU re: the collection and use of compost. BSU in the process of

					developing these relationships
Other Options for Sustainability					
Standardize Recycling Containers and signage					
Conduct Employee and student orientation/ongoing recycling training	✓				
Establish recycling and waste reduction goals					Could establish vendor requirements – Sysco trying to do more on this front
Adopt a green meeting policy					
Establish a community food garden				✓	
Serve locally grown, organic food at meetings and events when possible			✓		Local food network is strong – opportunity for BSU to develop relationships. Red Lake Walleye and wild rice. Problem: price and supply tough for promotion of organics
Host no waste events					

The group discussed reporting and applicability to organizational structure. For example, in retrospect BSU should have performed an audit prior to establishing a trayless policy in order to measure or quantify the benefits of the program. Form an educational stand point it would be useful to have statistics or numbers to share with students, faculty and staff on money being saved, the quantity of trash generated now that program in place, etc…

At the end of the presentation, Camilla Correll (EOR) quickly went through the project timeline and next steps as follows:

- June
  - Discuss GHG emissions inventory needs with BSU
  - Begin organizing information collected at this meeting and draft carbon reduction strategies and sustainability framework
  - Collect information regarding existing curriculum and outreach efforts related to sustainability and climate change
- July
  - Review of materials by BSU and Sustainability Sub-Committee via project web-site
- August
  - Draft of Climate Action Plan complete for review by BSU and Sustainability Sub-Committee

A copy of this presentation can also be found of the BSU Project Web-site.

Bemidji State University
Climate Action plan

BSU Environmental Advisory Committee
Climate Action Plan Review

Wednesday December 1, 2010
2:00 – 4:00 p.m.

Crying Wolf Room
Lower Hobson Union

AGENDA

1. Review GHG Emissions Inventory

2. Discuss Target Date for Carbon Neutrality

3. Review DRAFT Carbon Reduction Plan

4. Summary of Curriculum Survey

5. Next Steps
    a. Process for Review and Comment
    b. Project Timeline

6. Questions / Comments?

Meeting #2 Meeting Summary: Meeting Attendees
Chinwuba Okafur

Dave Bahr, BSU Faculty and Bemidji Sustainability Committee Member

Eric Pouliot

Erika Bailey-Johnson, Bemidji Sustainability Coordinator

Lacie Noehring, BSU

Laurie Desiderato

Nancy Haugen

Richard Marsolek, BSU Environmental Health & Safety

Scott Borchers

Brett Emmons, EOR

Camilla Correll, EOR

Meeting Attendees:

EOR presented a draft copy of the following documents for review and discussion:

1. DRAFT GHG Emissions Inventory
2. DRAFT Carbon Reduction Plan
3. DRAFT Education, Research, Community Outreach

All notes/comments received during this meeting have been incorporated in the final draft of the BSU Climate Action Plan.

B. Sustainability Plan Framework

BSU understands that while it can effect change on some aspects to make itself more sustainable, the University with its students, faculty, and employees are still part of a larger community. The ability of the University to be more sustainable is intertwined with its surrounding community. BSU may be interested to look at its surrounding sphere of influence and see where it can engage others in promoting the principles of sustainability. At the next logical level, BSU can look to its local community, the City of Bemidji, as a potential partner in promoting sustainability when it makes sense for the community to do so.

As part of several Community Sustainability Planning efforts that EOR has been involved with, our team can provide the following examples and some guidance in the case that the City of Bemidji would like to move forward with its own sustainability plan.

Example Planning Process

A. Review of Background Information

B. Web-based Survey of Existing Practices

C. Education Sessions on Sustainability

D. Community Engagement Sessions to Develop Vision, Goals, and Actions

E. Update Goals and Vision

F. Summary of Recommended Actions

G. Community Engagement Session to Review Recommended Action Plan

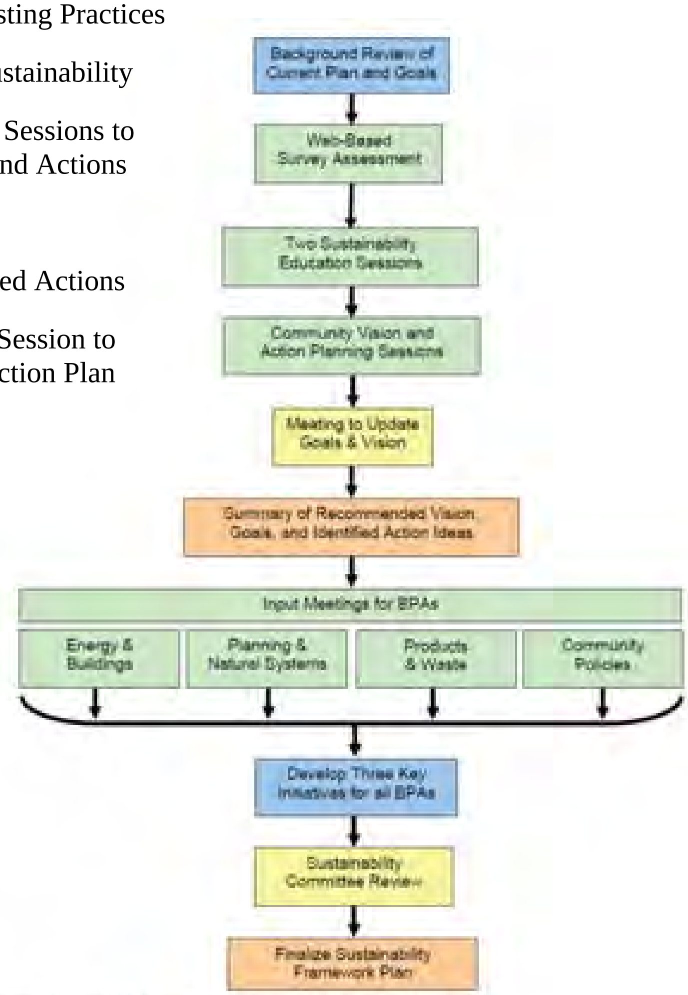


Figure 1. Flow Chart of Sustainability Framework Plan Development Process

Defining Sustainability - Four Principles of the Natural Step Framework (NSF)

The Natural Step Framework (NSF) was established with the purpose of developing and sharing a common framework composed of easily understood, scientifically based principles that serve as a compass to guide society toward a just and sustainable future. The NSF emphasizes that the only long-term, sustainable manner in which business and society can operate is within the Earth's natural cycles. This can be accomplished by meeting four basic sustainability conditions:

The Natural Step Framework (Natural Step www.naturalstep.org) holds that in a sustainable society, nature won't be subject to systematically increasing:

1. Concentrations of substances extracted from the earth's crust;
2. Concentrations of substances produced by society;
3. Degradation by physical means; And, in that society,
4. people are not subject to conditions that systematically undermine their capacity to meet their needs.

Example Community Goals

Below are some broad goals that were adopted by a Regional Authority interested in promoting sustainable growth.

> <u>*Goal:*</u>
> Manage growth and urban sprawl to balance agricultural issues and land preservation with planned urban development to protect and enhance both the Region's rural character and its natural resources.
>
> <u>*Goal:*</u>
> Preserve and manage all of the Region's natural resources, including but not limited to air, water, green spaces, natural areas and farmlands, through sustainable land use practices.
>
> <u>*Goal:*</u>
> Encourage transportation planning that is sensitive to both the natural environment and neighborhoods.
>
> <u>*Goal:*</u>
> Maintain the integrity, heritage and local character of the Region's natural and built environment.

Technical Aspects of a Community Sustainability Plan

Below is a list or checklist of possible community sustainability best practices areas (BPAs) that could be included in a Community Sustainability Plan. Not all aspects may fit a given community or be priorities for a given community.

1 – Environmentally Preferable Purchasing

2 – Product Stewardship

3 – Greenhouse Gas Reductions

4 – Sustainable Land Use Policies

5 – Sustainable Multi-Modal Transportation

6 – Alternative Energy

7 – Energy Efficiency

8 – Sustainable Building Practices

9 – Community Health

10 – Recycling and Waste Reduction

11 – Healthy Urban Forests

12 – Sustainability Education

13 – Surface and Groundwater Resources

14 – Innovative Opportunities

15– Sustainable Government Policies/Practices

16 – Sustainable Systems/Practices

Initiatives and Action Steps

The following are examples of action steps (grouped by similar BPAs) identified through public input that reflect local stakeholder's views and priorities in a community that recently completed the Sustainability Plan development process. In this example similar Best Practice Areas (BPAs) were grouped together where there were similar issues and then Initiatives and Action Steps were identified. If a community were developing a Sustainability Plan, significantly more detail would be provided under each Initiative/Action to describe the who, how, when, and what associated with each item.

Environmentally Preferable Purchasing / Product Stewardship / Waste Reduction

- ✓ Create jobs and green cash, not a pile of trash
- ✓ When Zero makes your community Number One!
- ✓ Vote for the environment with your dollars

Greenhouse Gas Reductions

- ✓ Teach reduction
- ✓ Raise MPG, Switch to Alternatives

Land Use
- ✓ Connect with nature
- ✓ Stop sprawl
- ✓ Meet housing needs

Multi-Modal Transportation
- ✓ Complete, Connected Streets
- ✓ Viable transit options
- ✓ Don't build your way out of congestion

Renewable Energy / Energy Efficiency
- ✓ Use less
- ✓ Transition to clean

Building Practices
- ✓ Document baseline and set new targets
- ✓ Educate and engage public
- ✓ Renovate first, deconstruct and sell next, demolish not

Community Health
- ✓ Animate the system
- ✓ A strong economy does not exist in a vacuum
- ✓ Promote fitness on the road to sustainability

Health Rural and Urban Landscapes
- ✓ Healthy parks build healthy communities
- ✓ Just say no to drugs for the landscape
- ✓ More trees for healthy streets

Sustainability Education
- ✓ Municipalities educating themselves to practice what they preach
- ✓ Upping the community sustainability IQ
- ✓ Education for our future and present

Surface and Groundwater Protection
- ✓ Stormwater wise
- ✓ Healthy waters, healthy people
- ✓ Sustainable ordinances for a sustainable BSU area

Mississippi River Conservation
- ✓ Renaissance, Renaissance, Renaissance
- ✓ Less is more…Water
- ✓ Big River, clean water

Innovative Opportunities
- ✓ Promote awareness and understanding
- ✓ Planning and encouragement
- ✓ Recognition and assessment

Government Policies

- ✓ Learning and growing together
- ✓ Move forward with a shared understanding of sustainability
- ✓ Make sustainability easy

Food and Agriculture

- ✓ Grow your own
- ✓ Make it local
- ✓ Healthy food for all

Measuring Performance

Local government and private sector partners' will potentially give significant commitments of time and resources to the formation of a sustainability committee and subsequent planning processes. Typically there is a strong expectation that the Sustainability Plan will be a living document that guides future action rather than sitting on a shelf. Benchmarking is an essential element to promoting greater utilization of sustainable practices suggested in the Plan. As such, a number of benchmarking and reporting strategies can be used.

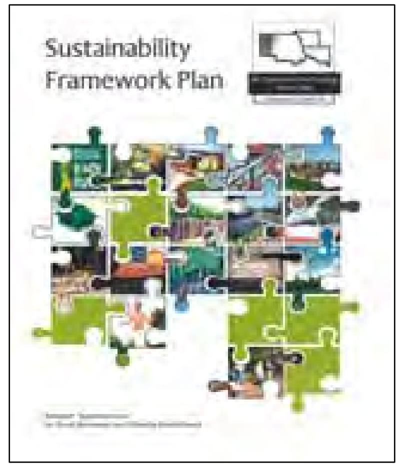
Local Examples – "Learning from Others"

- Minneapolis and St. Paul completed an Urban CO2 Reduction Project Plan in 1993, with implementation plans in 1997, 2005, and 2007.
  - St. Paul reported reduced greenhouse gas emissions by 960,000 tons per year, at a total cost savings of $59,000,000, not including significant operational savings in Public Works.
  - Minneapolis reported an economic and environmental savings exceeding 65,000 tons of CO2 reduced (1998 – 1999), and an annual savings of $21,642,000.
  - Minneapolis met 2005 goal of reducing carbon dioxide emissions by 20% from 1988 levels.

- Lacrosse (City of), WI adopted the Sustainability Initiative, it has passed an ordinance to encourage small wind systems, begun construction of a new transit center with a green roof and implanted an award winning Household Hazardous Waste Program.

- Burnsville adopted its Sustainability Guide Plan in 2008. Since adoption, approved geothermal system for its Ice Arena – before geothermal, the ice arena contributed 46% of the City's total CO2 emissions. Also, the plan's CO2 reduction goals and clear steps for implementation has put the City a step ahead of others and increased grant dollars received.

- Greater St. Cloud Regional Sustainability Framework Plan was adopted by the regional planning authority as guidance for the local communities that includes seven cities, six townships, three counties, and several colleges/universities. The plan will give the overall region a coherent strategy for growth, energy, and several other key factors that effect community sustainability.



C. BSU GHG Inventory Source Tables by Scope

Table 1. Scope 1 Sources

Source ID	Strategy	Book	Source Model Used	FY08 = 7/1/2007 to 6/30/2008 Inventory (Tonnes CO2e)	FY09 = 7/1/2008 to 6/30/2009 Inventory (Tonnes CO2e)	FY10 = 7/1/2009 to 6/30/2010 Inventory (Tonnes CO2e)	Activity Data
Campus Wide -FleetVehicles	Transportat-ion-5	Fleet Vehicles -5	Transport GHG	312.66	312.66		FY09=18,573.309 gal. No data for FY08 & FY10. Assuming FY08 representative of FY09.
1509-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	11.14	9.31		FY09=1707 CCF FY08=2043 CCF
1521-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	10.06	9.26		FY09=1697 CCF FY08=1843 CCF
1600-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	18.24	20.45		FY09=3752 CCF FY08=3345 CCF
1715-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	0	29.74		FY09=5455 CCF FY08=0 CCF
1805-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	0.25	0.75		FY09=137 CCF FY08=48 CCF
AIRC-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	53.96	53.88		FY09=9884 CCF FY08=9894 CCF
CMB-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	41.78	40.14		FY09=7366 CCF FY08=7662 CCF
Chiller500 Ton-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	11.27	12.53		FY09=2298 CCF FY08=2067 CCF
1501-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	26.82	28.54		FY09=5235 CCF FY08=4920 CCF
Education Arts-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	0	0		FY09=0 CCF FY08=0 CCF
Lone Pine Plaza-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	63.52	81.66		FY09=14976 CCF FY08=11648 CCF
Sattgast-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	0.28	0.30		FY09=51 CCF FY08=49 CCF
Walnut-NG-I	Buildings -4	Natural Gas-4	NGInterruptible GHG	16.29	20.28		FY09=3718 CCF FY08=2987 CCF
Heating Plant-NG-I	Energy Production-4	Natural Gas-4	NGInterruptible GHG	702.43	641.04		FY09=117,566 CCF FY08=127,208 CCF
Heating Plant-HighSulfur-Oil	Energy Production-4	Oil-4	Oil GHG	0	0		FY09= 0 gallons FY08=0 gallons
Heating Plant -Oil	Energy Production-4	Oil-4	Oil GHG	24.37	8.09		FY09=795 gallons FY08=2396 gallons
Refrigerant-404A	Refrigerant-4	404A-4	Refrigerant GHG	266.16	44.36		FY08=180 lbs FY09=30 lbs
Refrigerant-HCFC22	Refrigerant-4	HCFC-22-4	Refrigerant GHG	163.28	20.41		FY08=240 lbs FY09=30 lobs
Total Scope 1 CO2e Tonnes				**1,722.51**	**1,333.4**		

Table 2. Scope 2 Sources

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory (Tonnes CO2e)	FY09= 7/1/2008 to 6/30/2009 Inventory (Tonnes CO2e)	FY10= 7/1/2009 to 6/30/2010 Inventory (Tonnes CO2e)	Comments
1509-Electricity	Buildings -4	Electricity -4	Electricity GHG	15.6	14.41		Usage & price information from Heating Plant Report data FY08 =18865 KWh FY09=17,434 KWh
1521-Electricity	Buildings -4	Electricity -4	Electricity GHG	10.23	15.03		FY08 = 12,362 KWh FY09=18,178 KWh
1805-Electricity	Buildings -4	Electricity -4	Electricity GHG	0	0.03		FY08= 0 KWh FY09=37 KWh
18thSt-Electricity	Buildings -4	Electricity -4	Electricity GHG	0	0.03		FY08 = 0 KWh FY09= 37 KWh
ACClark-Electricity	Buildings -4	Electricity -4	Electricity GHG	207.97	773.64		FY08=251,600 KWh FY09 = 935,960 KWh
AIRC-Electricity	Buildings -4	Electricity -4	Electricity GHG	79.52	107.44		FY08= 96,228 KWh FY09=129,975 KWh
Bangsberg-Electricity	Buildings -4	Electricity -4	Electricity GHG	414.61	422.88		FY08 = 501,600 KWh FY09= 511,600 KWh
Baseball1-Electricity	Buildings -4	Electricity -4	Electricity GHG	0	0		FY08=0 KWh FY09=0 KWh
Baseball2-Electricity	Buildings -4	Electricity -4	Electricity GHG	0	0		FY08=0 KWh FY09=0 KWh
BB Lights-Electricity	Buildings -4	Electricity -4	Electricity GHG	12.57	14.68		FY08 = 15,220 KWh FY09=17,780 KWh
Birch-Electricity	Buildings -4	Electricity -4	Electricity GHG	104.35	107.66		FY08=126,240 KWh FY09=130,240 KWh
Bridgeman-Electricity	Buildings -4	Electricity -4	Electricity GHG	377.74	359.86		FY08=457,000 KWh FY09=435,360 KWh
CAET-Electricity	Buildings -4	Electricity -4	Electricity GHG	143.82	171.15		FY08 =174,000 KWh FY09=435,360 KWh
Cedar Apts-Electricity	Buildings -4	Electricity -4	Electricity GHG	152.91	177.72		FY08=185,000 KWh FY09=215,000 KWh
CMB-Electricity	Buildings -4	Electricity -4	Electricity GHG	63.13	58.47		FY08=76,380 KWH FY09=70,740 KWh
Chiller 500 Ton-Electricity	Buildings -4	Electricity -4	Electricity GHG	5.58	14.71		FY08=6,746 KWh FY09=17,788 KWh
Chiller 550 Ton-Electricity	Buildings -4	Electricity -4	Electricity GHG	0	58.26		FY08=0 KWh FY09=70,482 KWh
1501-Electricity	Buildings -4	Electricity -4	Electricity GHG	22.07	22.29		FY08=26,704 KWh FY09=26,990 KWh
Decker-Electricity	Buildings -4	Electricity -4	Electricity GHG	85.20	134.93		FY08=103,080 KWh FY09=163,240 KWh
Deputy-Electricity	Buildings -4	Electricity -4	Electricity GHG	976.81	986.14		FY08=1,181,760 KWh FY09=1,193,038 KWh
Education Arts-Electricity	Buildings -4	Electricity -4	Electricity GHG	307.88	346.07		FY08=372,480 KWh FY09=418,680 KWh

Table 2. Scope 2 Sources, continued

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory (Tonnes CO2e)	FY09= 7/1/2008 to 6/30/2009 Inventory (Tonnes CO2e)	FY10= 7/1/2009 to 6/30/2010 Inventory (Tonnes CO2e)	Comments
Gillett-Electricity	Buildings-4	Electricity-4	Electricity GHG	725.91	825.56		FY08=878,208 KWh FY09=998,784 KWh
Glas-Electricity	Buildings-4	Electricity-4	Electricity GHG	555.79	502.23		FY08=672,384 KWh FY09=607,596 KWh
HaggSauer-Electricity	Buildings-4	Electricity-4	Electricity GHG	367.01	360.79		FY08=444,000 KWh FY09=436,500 KWh
Heating Plant-Electricity	Buildings-4	Electricity-4	Electricity GHG	117.45	126.75		FY08=142,080 KWh FY09=153,360 KWh
Linden B-Electricity	Buildings-4	Electricity-4	Electricity GHG	191.75	209.13		FY08=232,000 KWh FY09=253,000 KWh
LonePine Plaza-Electricity	Buildings-4	Electricity-4	Electricity GHG	282.10	281.19		FY08=341,272 KWh FY09=340,184 KWh
Maple A-Electricity	Buildings-4	Electricity-4	Electricity GHG	123.75	0.99		FY08=149,700 KWh FY09=1,200 KWh
Maple B-Electricity	Buildings-4	Electricity-4	Electricity GHG	176.13	40.48		FY08=213,100 KWh FY09=49,000 KWh
Memorial-Electricity	Buildings-4	Electricity-4	Electricity GHG	206.50	296.67		FY08=249,840 KWh FY09=358,920 KWh
Oak A-Electricity	Buildings-4	Electricity-4	Electricity GHG	148.52	161.62		FY08=179,680 KWh FY09=195,520 KWh
Oak B-Electricity	Buildings-4	Electricity-4	Electricity GHG	128.42	137.01		FY08=155,360 KWh FY09=165,760 KWh
Oak C-Electricity	Buildings-4	Electricity-4	Electricity GHG	174.98	179.59		FY08=211,680 KWh FY09=217,280 KWh
OPC - Electricity	Buildings-4	Electricity-4	Electricity GHG	0	0		FY08=0 KWh FY09=0 KWh
PE/FH/RC-Electricity	Buildings-4	Electricity-4	Electricity GHG	399.47	399.48		FY08=483,300 KWh FY09=483,300 KWh
Peters-Electricity	Buildings-4	Electricity-4	Electricity GHG	0	0		FY08=0 KWh FY09=0 KWh
Pine B-Electricity	Buildings-4	Electricity-4	Electricity GHG	138.04	153.74		FY08=167,000 KWh FY09=186,000 KWh
Sanford-Electricity	Buildings-4	Electricity-4	Electricity GHG	463.68	84.84		FY08=560,960 KWh FY09=102,640 KWh
Sattgast-Electricity	Buildings-4	Electricity-4	Electricity GHG	510.59	586.45		FY08=617,700 KWh FY09=709,500 KWh
Tamarack-Electricity	Buildings-4	Electricity-4	Electricity GHG	560.99	483.65		FY08=678,700 KWh FY09=585,100 KWh
Union-Electricity	Buildings-4	Electricity-4	Electricity GHG	648.30	583.98		FY08=784,300 KWh FY09=706,500 KWh
Walnut-Electricity	Buildings-4	Electricity-4	Electricity GHG	744.41	768.86		FY08=900,600 KWh FY09=930,200 KWh
Total Scope 2 CO2e Tonnes				**9,281.57**	**9,367.84**		**FY08=11,228,911 KWh FY09=11,227,395 KWh**

Table 3. Scope 3 Sources – continues next 3 pages

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory (Tonnes CO2e)	FY09= 7/1/2008 to 6/30/2009 Inventory (Tonnes CO2e)	FY10= 7/1/2009 to 6/30/2010 Inventory (Tonnes CO2e)	Comments
Football Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.0208	0.0208	0.0208	7260 miles, 612 passengers in FY 2010. No data 08, 10. Assuming FY08 representative of FY09.
Combined Basketball Travel Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.0175	0.0175	0.0175	FY09=3920 miles, 392 passengers. No data for 08, 10. Assuming FY08 representative of FY09.
Men's Basketball Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.0206	0.0.206	0.0206	FY09=1750 miles, 149 passengers No data for 08, 10. Assuming FY08 representative of FY09.
Men's Hockey Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.1429	0.1429	0.1429	FY09=3590 miles, 440 passengers, no data for 08, 10. Assuming FY08 representative of FY09.
Soccer Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.0222	0.0222	0.0222	FY09=4170 miles, 329 passengers FY 09, | no data 08, 10. Assuming FY08 representative of FY09.
Track Field Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.01429	0.01429	0.01429	FY09=4310 miles, 495 passengers FY09, no data 08
Volleyball Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.0265	0.0265	0.0265	FY09=3550 miles, 235 passengers, no data 08, 10. Assuming FY08 representative of FY09.
Women's Basketball Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by nit	0.0321	0.0321	0.0321	FY09=2580 miles, 141 passengers FY 09, no data 08, 10. Assuming FY08 representative of FY09.
Women's Hockey Travel-Contract Bus	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.0321	0.0321	0.0321	FY09=6350 miles, 377 passengers, no data 08, 10. Assuming FY08 representative of FY09.

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory (Tonnes CO2e)	FY09= 7/1/2008 to 6/30/2009 Inventory (Tonnes CO2e)	FY10= 7/1/2009 to 6/30/2010 Inventory (Tonnes CO2e)	Comments
Campus Wide-Commercial Air Travel	Transportation -5	Commercial Air Travel -5	Air GHG by Unit	188.07	188.07	168.29	2010 data calculated as 838,744 air miles 2009 data calculated 937,332 air miles. Use to estimate 2008
Campus Wide-Commuting	Transportation -5	Commuting -5	Transport GHG	1463.12	1463.12	1463.12	Estimated based on 2010 transportation survey.
Campus Wide-Personal Vehicles	Transportation -5	Personal Vehicles -5	Transport GHG	0.00	0.00	0.00	Missing Activity Data
AC Clark-Steam	Buildings -4	Steam -4	Steam GHG	74.42	68.52		FY08=1,331,326.44 lbs FY09=1,225,887.77 lbs FY10= To be provided
Bangsberg-Steam	Buildings -4	Steam -4	Steam GHG	269.23	208.65		FY08=4,817,347.33 lbs FY09=3,733,628.49 lbs FY10=To be provided
Birch-Steam	Buildings -4	Steam -4	Steam GHG	542.99	248.50		FY08=9,716,137.54 lbs FY09=4,446,951.00 lbs FY10= To be provided
Bridgeman-Steam	Buildings -4	Steam -4	Steam GHG	577.97	947.15		FY08=10,342,210.64 lbs FY09=16,947,764.04 FY10= To be provided
CAET-Steam	Buildings -4	Steam -4	Steam GHG	0	0		FY08=0 lbs FY09=0 lbs FY10= To be provided
Cedar Apts-Steam	Buildings -4	Steam -4	Steam GHG	554.32	678.93		FY08=9,918631.32 lbs FY09=12,148,344 lbs FY10= To be provided
Decker-Steam	Buildings -4	Steam -4	Steam GHG	51.91	50.94		FY08=928,854.99 lbs FY09=911,268.67 FY10= To be provided
Deputy-Steam	Buildings -4	Steam -4	Steam GHG	167.90	154.28		FY08=3,004,222.85 lbs FY09=2,760,770.25 lbs FY10= To be provided
Education Arts-Steam	Buildings -4	Steam -4	Steam GHG	162.42	154.94		FY08=2,906,045.47 lbs FY09=2,843,883.17 lbs FY10= To be provided
Gillett-Steam	Buildings -4	Steam -4	Steam GHG	238.79	295.33		FY08=4,272,945.65 lbs FY09=5,284,269.00 lbs FY10= To be provided
Glas-Steam	Buildings -4	Steam -4	Steam GHG	321.82	297.26		FY08=5,758,248.60 lbs FY09=5,318,735.98 lbs FY10= To be provided
HaggSauer-Steam	Buildings -4	Steam -4	Steam GHG	257.94	606.25		FY08=4,615,463.93 lbs FY09=10,847,873.87 lbs FY10= To be provided
Linden B-Steam	Buildings -4	Steam -4	Steam GHG	0.8	0		FY08=14,286 lbs FY09=0 lbs FY10= To be provided
Linden A-Steam	Buildings -4	Steam -4	Steam GHG	12.67	101.67		FY08=226,692 lbs FY09=1,819,458.00 lbs FY10= To be provided

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory (Tonnes CO2e)	FY09= 7/1/2008 to 6/30/2009 Inventory (Tonnes CO2e)	FY10= 7/1/2009 to 6/30/2010 Inventory (Tonnes CO2e)	Comments
Maple A-Steam	Buildings -4	Steam -4	Steam GHG	411.80	209.71		FY08=7,368,578.82 lbs FY09=3,752,552.00 lbs FY10= To be provided
Maple B-Steam	Buildings -4	Steam -4	Steam GHG	206.34	142.74		FY08=3,692,233.76 lbs FY09=2,553,957.00 lbs FY10= To be provided
Memorial-Steam	Buildings -4	Steam -4	Steam GHG	245.44	399.80		FY08=4,391,867.55 lbs FY09=7,153,845.65 lbs FY10= To be provided
Oak A-Steam	Buildings -4	Steam -4	Steam GHG	293.51	258.25		FY08=5,251,948.86 lbs FY09=4,621,101.00 lbs FY10= To be provided
Oak B-Steam	Buildings -4	Steam -4	Steam GHG	425.10	608.23		FY08=7,606,613.72 lbs FY09=10,883,663.00 lbs FY10= To be provided
Oak C-Steam	Buildings -4	Steam -4	Steam GHG	198.90	171.41		FY08=3,559,050.57 lbs FY09=3,067,361.04 lbs FY10= To be provided
PE/FH/RC-Steam	Buildings -4	Steam -4	Steam GHG	1023.54	1195.23		FY08=18,314,687.86 lbs FY09=21,387,136.36 lbs FY10= To be provided
Peters-Steam	Buildings -4	Steam -4	Steam GHG	27.52	22.51		FY08=492,386.30 lbs FY09=402,838.80 lbs FY10= To be provided
Pine B-Steam	Buildings -4	Steam -4	Steam GHG	239.82	181.68		FY08= 4,291,317.06 lbs FY09=3,251,028.00 lbs FY10= To be provided
Sanford-Steam	Buildings -4	Steam -4	Steam GHG	14.93	16.63		FY08=267,546.94 lbs FY09=297,388.75 lbs FY10= To be provided
Sattgast-Steam	Buildings -4	Steam -4	Steam GHG	362.83	350.29		FY08=6,492,397.85 lbs FY08=6,268,179.26 lbs FY10= To be provided
Tamarack-Steam	Buildings -4	Steam -4	Steam GHG	578.87	566.75		FY08= 10,357,988.89 lbs FY09= 10,141,279.00 lbs FY10= To be provided
Union-Steam	Buildings -4	Steam -4	Steam GHG	361.50	351.75		FY08=6468,164 lbs FY09=6,293,770 lbs FY10= To be provided
Walnut-Steam	Buildings -4	Steam -4	Steam GHG	404.72	317.53		FY08=7,241,910.57 lbs FY09=5,681,771.00 lbs FY10= To be provided
MSW-MSW	Faciliites -4	MSW -4	Waste Amount	140.63	118.83		FY 08= 404.94 Tons FY 09 = 342.18 tons FY10= To be provided
Total Scope 3 CO2e Tonnes				**9820.15**	**10375.26**		

Table 4. Supplemental-Biogenic Sources

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory in CO2e	FY09= 7/1/2008 to 6/30/2009 Inventory in CO2e	FY10= 7/1/2009 to 6/30 2010 Inventory in CO2e	Comments
Football Travel-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00042951	0.00042951	0.00042951	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Combined Baskeball Travel-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00036207	0.00036207	0.00036207	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Men's Basketball Travel-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00036207	0.00042525	0.00036207	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Men's Hockey Travel-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00029542	0.00029542	0.00029542	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Soccer-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00045891	0.00045891	0.00045891	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
TrackField-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00030282	0.00030282	0.00030282	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Volleyball-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00054696	0.00054696	0.00054696	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Women's Basketball Travel-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00066251	0.00066251	0.00066251	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Women's Hockey-Contract Bus BioFuel	Transportation -1	Contract Bus Service -1	Transport GHG by Unit	0.00056603	0.00056603	0.00056603	Assuming B2, No Data 08, 10. Assuming FY08 representative of FY09.
Campus Wide-Fleet Vehicles BioFuel	Transportation -5	Fleet Vehicles -1	Transport GHG	0	0	0	FY09= 18,573.309 gal. No Data for FY08, 10. Assuming gasoline, no E85.
Campus Wide-Commuting BioFuel	Transportation -5	Commuting -5	Transport GHG	0	0	0	Assuming gasoline, no E85.
Total BioFuel CO2e Tonnes				0.0039863	0.0039863	0.0039863	

Table 5. Supplemental Information-Other (Demand, Water, Waste, Etc.) – continues next 3 pages

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory as indicated	FY09= 7/1/2008 to 6/30/2009 Inventory as indicated	FY10= 7/1/2009 to 6/30/2010 Inventory as indicated	Comments
ELECTRICITY DEMAND (KW)							
Demand Charges	Buildings -4	Electricity -4	Electricity GHG	31549.2 KW (cumulative monthly)	30192.6 KW (cumulative monthly)		Classed as supplemental to enable measurement of use & costs, but to avoid double counting.
PURCHASED WATER (gallon)							
1509 - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	20440.00	20180.00		
1521- Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	70780.00	73580.00		
1715 - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	0.00	0.00		
1805 - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	0.00	0.00		
AC Clarck - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	0.00	0.00		
AIRC - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	137400.00	107600.00		
Bangsberg - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	383500.00	316200.00		
Baseball 1- Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	641500.00	1004900.00		
Baseball 2 - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	2600.00	87708.00		
BB Lights - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	0.00	0.00		
Birch Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	1514000.00	1645000.00		
Bridgeman Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	570450.00	148100.00		Note that 2008 is significantly different that 2009.
CAET- Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	37500.00	0.00		Note that 2008 is significantly different that 2009.
Cedar Apts- Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	1061300.00	710000.00		
CMB - Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	47400.00	55100.00		
1501- Purchased Water	Buildings -4	Purchased Water-4	Purchased Water Amount	236880.00	424040.00		

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory as indicated	FY09= 7/1/2008 to 6/30/2009 Inventory as indicated	FY10= 7/1/2009 to 6/30/2010 Inventory as indicated	Comments
PURCHASED WATER (gallon) - continued							
Heating Plant - Purchased Water	Energy Production -4	Purchased Water -4	Purchased Water Amount	2069400.00	2028000.00		
Chiller 500 Ton - Purchased Water	Energy Production -4	Purchased Water-4	Purchased Water Amount	0.00	0.00		
Chiller 550 Ton - Purchased Water	Energy Production -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Decker - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Deputy - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	337200.00	522900.00		
Dugouts - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	59100.00	26908.00		
Education Arts - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	83600.00	0.00		Note that 2008 is significantly different that 2009.
Gillett - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Glas - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	2401000.00	6025000.00		
HaggSauer- Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	193810.00	452940.00		
Linden B - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	485000.00	821900.00		
Linden A - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	255000.00	479700.00		
Lone Pine Plaza- Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Maple A - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	1038000.00	92000.00		
Maple B - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	1130770.00	69800.00		
Memorial - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	604000.00	0.00		Note that 2008 is significantly different that 2009.

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory as indicated	FY09= 7/1/2008 to 6/30/2009 Inventory as indicated	FY10= 7/1/2009 to 6/30/2010 Inventory as indicated	Comments
PURCHASED WATER (gallon) - continued							
Oak A - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	641200.00	881300.00		
Oak B- Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	867400.00	886100.00		
Oak C - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	748200.00	1189000.00		
PEFHRC - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	3050000.00	0.00		Note that 2008 is significantly different that 2009.
Peters - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	11900.00	70300.00		
Pine B - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	467400.00	702100.00		
Sandford - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	406000.00	1140340.00		
Sattgast - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Tamarack - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	2922400.00	3469800.00		
Union - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	1790600.00	708100.00		
Walnut - Purchased Water	Buildings -4	Purchased Water -4	Purchased Water Amount	6980600.00	7544300.00		
TOTAL PURCHASED WATER (gallons)				**24,285,730**	**24,148,596**		

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory as indicated	FY09= 7/1/2008 to 6/30/2009 Inventory as indicated	FY10= 7/1/2009 to 6/30/2010 Inventory as indicated	Comments
SEWAGE (gallons)							
1509-Sewage	Building-4	Sewage-4	Sewage Amount	30885.40	26697.14		
1521-Sewage	Building-4	Sewage-4	Sewage Amount	81296.08	90644.76		
1715-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
AC Clark-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
AIRC-Sewage	Building-4	Sewage-4	Sewage Amount	145196.47	124893.36		
Bangsberg-Sewage	Building-4	Sewage-4	Sewage Amount	352217.66	334130.85		
Baseball 1-Sewage	Building-4	Sewage-4	Sewage Amount	4267.42	0.00		
Baseball2-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
Birch-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
Bridgeman-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
CAET-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
Cedar Apts-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
CMB-Sewage	Building-4	Sewage-4	Sewage Amount	104161.81	63570.58		
1501-Sewage	Building-4	Sewage-4	Sewage Amount	172202.26	441284.43		
Decker-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
Deputy-Sewage	Building-4	Sewage-4	Sewage Amount	304037.42	389211.75		
Education Arts-Sewage	Building-4	Sewage-4	Sewage Amount	92955.51	0.00		
Gillett-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
Glas-Sewage	Building-4	Sewage-4	Sewage Amount	1713137.08	4277824.75		
HaggSauer-Sewage	Building-4	Sewage-4	Sewage Amount	198546.08	467629.48		
Linden B-Sewage	Building-4	Sewage-4	Sewage Amount	239219.91	808707.74		
Lone Pine Plaza-Sewage	Building-4	Sewage-4	Sewage Amount	0.00	0.00		
Maple A-Sewage	Building-4	Sewage-4	Sewage Amount	571629.73	504870.90		
Maple B-Sewage	Building-4	Sewage-4	Sewage Amount	661860.15	565443.41		
Memorial-Sewage	Building-4	Sewage-4	Sewage Amount	484286.01	0.00		
Oak A-Sewage	Building-4	Sewage-4	Sewage Amount	861596.30	778073.86		

Source ID	Strategy	Book	Source Model Used	FY08= 7/1/2007 to 6/30/2008 Inventory as indicated	FY09= 7/1/2008 to 6/30/2009 Inventory as indicated	FY10= 7/1/2009 to 6/30/2010 Inventory as indicated	Comments
SEWAGE (gallons) - continued							
Oak B-Sewage	Building -4	Sewage -4	Sewage Amount	890742.72	1014472.88		
Oak C-Sewage	Building -4	Sewage -4	Sewage Amount	986471.39	1027703.91		
OPC-Sewage	Building -4	Sewage -4	Sewage Amount	0.00	0.00		
PEFHRC-Sewage	Building -4	Sewage -4	Sewage Amount	1737262.72	0.00		
Peters-Sewage	Building -4	Sewage -4	Sewage Amount	24282.18	86669.46		
Pine B-Sewage	Building -4	Sewage -4	Sewage Amount	631215.07	783869.48		
Sanford-Sewage	Building -4	Sewage -4	Sewage Amount	398197.74	1166618.82		
Sattgast-Sewage	Building -4	Sewage -4	Sewage Amount	0.00	0.00		
Tamarack-Sewage	Building -4	Sewage -4	Sewage Amount	3215394.64	3335569.92		
Union-Sewage	Building -4	Sewage -4	Sewage Amount	1695695.36	651891.93		
Walnut-Sewage	Building -4	Sewage -4	Sewage Amount	5716195.96	2144298.91		
Heating Plant-Boiler Make-Up Water	Energy Production -4	Boiler Make-Up Water -4	Water Amount	619100.00	950735.00		
Heating Plant-Cooling Tower Make-Up Water	Energy Production -4	Cooling Tower Make-Up Water -4	Water Amount	2699280.00	6521450.00		
Heating Plant-Purchased Water	Energy Production -4	Purchased Water-4	Purchased Water Amount	2069400.00	2028000.00		
Chiller 500 Ton-Purchased Water	Energy Production -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Chiller 550 Ton-Purchased Water	Energy Production -4	Purchased Water -4	Purchased Water Amount	0.00	0.00		
Heating Plant-Sewage	Energy Production -4	Sewage -4	Sewage Amount	1096480.65	1421799.08		
Chiller 500 Ton-Sewage	Energy Production -4	Sewage -4	Sewage Amount	0.00	0.00		
Chiller 550 Ton-Sewage	Energy Production -4	Sewage -4	Sewage Amount	0.00	0.00		
			TOTAL SEWAGE (gallons)	**1,096,480.65**	**1,421,799.08**		
WASTE (tonnes)							
MSW-MSW	Waste -4	MSW -4	Waste Amount	367.36	310.42		

D. Bemidji Campus Carbon Management Plan
- Campus Energy and Utilities

SUMMARY OF EXISTING SYSTEM

The energy infrastructure on the Bemidji Campus consists of steam for building heating and chilled water for building cooling. Electricity is provided by Ottertail Power Company. As is normal for college campuses there are exceptions to this generalization; however, they are minor. While the heating and electrical systems are adequate to meet the present needs of the campus, the chilled water system has performance problems.

In addition to what is often seen as the pragmatic nature of engineered systems, sustainable development and energy conservation are most likely realized through these systems by investing in them at a higher level to meet environmental goals in addition to their most basic functional goals. The University has a central plant, which offers the possibility of economy of scale when searching for renewable energy solutions and conservation opportunities. In the planning process we reviewed the possibility of using renewable energy such as wind turbines, photovoltaic solar photovoltaic, solar thermal biomass and geothermal systems. Each of these systems is more difficult to execute than existing systems and some present real challenges in a large community. Before entering into an analysis of renewable energy systems, it is best to survey the existing energy infrastructure and resources in the area to develop recommendations that maximize the value of existing systems and capitalize on local resources.

Bemidji State University Central Plant Capacity:

- The central steam heating system has three (3) boilers that have adequate, firm capacity to serve all projected loads. "Firm" capacity, also called N+1 redundancy, means the facility can lose the largest boiler and still have sufficient steam generation capacity from the remaining boilers to serve all loads on a design day. The boilers sizes are one (1) at 40,000 pounds per hour and two (2) at 20,000 pounds per hour.
- Industry standards generally considered 30-40 years as the expected service life for commercial boilers. Based on this information alone, boiler replacements should be programmed and completed between 2035-2045. The two (2) small boilers are older than the larger boiler.
- The boilers are capable of operation up to 200 psig and distribute steam at150 psig to the Bemidji campus.
- There is a central chilled water cooling system. It is made up of two (2) chillers, each having approximately 500 tons of capacity. Their ability to deliver 1000 tons of capacity to campus loads is constrained by the condenser water system.
- Steam and chilled water distribution piping has adequate capacity to meet current loads.

Natural Gas

- The main utility gas service feeds directly into the Central Plant. This service comprises over 80% of the total gas load for the main campus. There are numerous buildings which also have gas service. These gas services feed various miscellaneous loads (science buildings, Bunsen burners, appliance loads, etc.).
- The piping distribution system is utility owned and is routed underground across the campus.

Electrical service

- Provided by Otter Tail Power.

- Campus renewable energy is purchased from Otter Tail Power through the Tail Winds program.

Energy Consumption

- Consumption reports were erratic when comparing same month usage from year to year. This can be a sign that there is a conservation opportunity; however, the variation was attributed to randomness in the number of days in a billing period.
- It should also be noted that the campus has used less natural gas each of the last three (3) years. This is likely attributed to the improved efficiency of the boiler plant now that it has a new boiler in its operation. Bemidji's energy usage was provided for 2007 and 2008. The campus used 8% less electricity and 7% less gas in 2008 compared to 2007. (July to June.)

ENERGY RESOURCE PLANNING

The central utility systems are a vital part of keeping the campus operating effectively and efficiently. The following are key goals for the campus systems:

- Campus systems must be able to be operated safely and reliably.
- Systems should have adequate redundancy to protect against component failures.
- Systems must be serviceable and maintainable.
- Fuel diversity provides a hedge against market volatility in energy costs (particularly natural gas).
- In addition to meeting the criteria listed above, the nation and the world have begun the work of environmental stewardship. Conservation is a goal that garners wide support and carbon reductions, while controversial, are an excellent indicator of energy conserving solutions that also have low emissions of other criteria pollutants. However, greenhouse gas emissions are, for the most part, minimized within the limitations of the current heating plant's design. The boilers are new and conservation on campus is the only option that will significantly affect the plant's emissions.

The heating system uses steam boilers and a steam distribution system. The buildings are heated with hot water. This is a typical American design and has served the campus well. A trend in district energy is to use hot water distribution, reflecting a 50-year trend of moving away from using steam to heat buildings. Because water is less corrosive than steam condensate, the piping life improves and, if the hot water system is operated below 250° Fahrenheit, thermal losses associated with the piping system are reduced. For these two (2) reasons, we encourage the university to explore the use of water distribution in lieu of steam when the piping system needs to be replaced.

A common sense key to successful sustainability is to use local resources where possible. We anticipate that on-campus solar and wind energy on campus will not comprise a major part of the on-campus energy future due to its high capital cost. Two (2) other local renewable resources that could be made available in Bemidji are wood waste and municipal solid waste (MSW). There are MSW facilities in the region that already make use of this source of fuel and a small scale operation would be difficult to permit and operate at a practical cost. Wood fuel plants require regular deliveries of fuel and some level of on-site storage. Wood biomass fueled thermal systems should be reconsidered by BSU as a source of energy.

Heating Plant

In the quest for greater energy efficiency and carbon management in power and thermal energy generation, two (2) factors are frequently missing that limit the ability of a facility to move beyond conventional heating efficiencies in the range of 82% and electrical generation efficiency in the range of 30%. These factors are a coincident thermal load and a low grade heat sink. In electric generation plants, a coincident thermal load provides the opportunity to utilize some or all of the 70% of input energy that is rejected to the atmosphere, or a river or lake. A low grade heat sink is a place where energy that is otherwise wasted can be used at low temperatures. Building heating can be and is accomplished with low grade heat.

BSU has the components in place to provide both of these factors and become a more efficient generator of thermal and electric energy. There are a limited number of sites in the United States where all of these components can come together in a cost effective manner. Heating and cooling energy are produced in a single central plant and distributed to a large number of buildings. This creates opportunity through economy of scale to develop a distributed generation plant, where waste heat from the electric generating process can be put to useful purpose. As a country, state and community, our energy efficiency can be improved through the use of distributed generation. Distributed generation means making electricity in smaller plants, closer to the loads, where line losses are reduced and thermal loads are available to reduce the amount of waste.

Distributed generation is part of a plan that will allow campus source energy use to be reduced which, in turn, reduces the campus carbon footprint. Conservation efforts are important and improved efficiency is key among the tools to reduce our impact on the environment. When the campus reduces energy use, it affects the 10% to 20% of energy that the system can operate without. When the generation efficiency is improved, it affects the 80% of energy use needed to complete the University's mission.

With this in mind, we reiterate that the BSU heating and cooling plant has sufficient capacity to handle the planned campus expansion. While we recommend equipment replacement when the end of economic life is reached, the campus can continue to operate as usual. With federal and state government mandates and goals to increase the use of renewable energy, the campus can conserve energy and increase efficiency.

We evaluated local resources and a variety of engineered systems in our effort to identify the systems and resources that would be relied upon to meet the energy needs of the campus and the environmental goal of a smaller carbon footprint. We did not explore all of these options in depth; however, we did test for subjective and objective measures that could shape our recommendations. The following resources were considered:

- Lake Water
- Municipal Solid Waste
- Waste Wood
- Wind
- Solar
- Geothermal

In an effort to accomplish combined heat and power, we also evaluated two (2) ways to accomplish distributed generation of electricity. The two (2) options explored are the following:

1. A gas turbine with a heat recovery boiler. Appendix D describes the brief evaluation of this technology. Due to the size of the campus and the equipment available in the market, this option does not present a practical solution to meeting the campus energy requirements. The peak electrical load is well below the output of the commonly supported gas turbines in the market.
2. A biomass fired boiler system. This option was explored in some detail, considering both condensing and back-pressure turbines and the impact of adding an absorption water chiller as a means of meeting the campus cooling requirements with renewable energy.

Lake Water
BSU is on the shore of Lake Bemidji. The lake creates an opportunity to expand the use of lake water to bring efficiency to the heating system. This opportunity is significant. It offers a means of bringing renewable, solar energy captured by the lake to the campus for building heating. This approach uses conventional equipment that has been on the market for years and would reduce fuel consumption; however, it would not lower the carbon footprint of the campus unless the system also includes Combined Heat and Power (CHP) production to reduce the carbon emissions associated with making electricity.

Lake Bemidji is a viable local resource that is currently being utilized by others as a heat sink. Energy from Lake Bemidji may be considered geothermal, since it could act as a heat sink for BSU cooling loads, or as solar energy, since the sun contributes to lake water that could be used as a heat source. BSU may be able to obtain a permit to draw water from Lake Bemidji. (Previous discussion between the University and the Department of Natural Resources regarding the possibility of using the lake as either a heat sink or a heat source has been rejected. It is not clear that the environmental impact was assessed; however, the lake would likely reduce the amount of electricity required to air condition the campus.)

Municipal Solid Waste (MSW)
Bemidji has a population of approximately 13,000 people. Most populations generate approximately one (1) ton of MSW per person per year. The waste stream is considered renewable by many, including the federal government, and is a potential source of energy. (The waste stream may already be committed to other facilities.)

Waste Wood
Manufacturers and processors in the area have an abundant amount of waste wood; however, historically the supply of woody material has been dominated by bark, which also carries a large amount of dirt.

Wind
Wind energy options were also considered as part of the initial exploration of renewable energy sources available to BSU. Wind power could possibly reduce greenhouse gas emissions, provide a renewable resource and reduce fossil fuel consumption. Wind availability is not the only driving factor on a potential wind turbine project. Local and state codes, turbine siting issues, safety, connection configuration, power use and financing strategies must also be considered.

- **Large Scale Wind:** We have not developed a comprehensive list of issues for large scale wind on the BSU Campus but enough issues have been raised to paint a clear picture. A large wind turbine does not fit well on an urban campus such as BSU. If wind is to be used on the campus, it will have to be in the form of multiple smaller turbines that in general have poorer performance and a higher cost per kWh generated.
- **Small Scale Wind:** As with solar power, small demonstration projects can be coordinated with the existing electrical system. However, this will not make a significant impact on the campus renewable energy portfolio or in all likelihood be competitive with other mechanisms that can bring renewable energy to campus.
- **Renewable Energy Contracts (REC):** Some purchase agreements with utility companies has already taken place and BSU currently purchases about 10% of its electricity from renewable sources. These purchases, in the form of RECs, are managed by the campus and can be pursued as aggressively as the administration chooses.
- **Retail Wheeling:** An option for offsetting campus loads may be to construct wind turbines further away from campus. As part of a potential agreement with the state, the University could claim credit for the power provided by the turbines. This option is dependent on approval from the state Public Utility Commission (PUC), as it is not currently a process that can be executed under an existing tariff. If state laws change where retail wheeling were practical, there may be future opportunity for wind in the Bemidji energy picture.

Enough issues have been raised to demonstrate that a large wind turbine does not fit well on an urban campus. If wind is going to be used on the campus, it will have to be in the form of multiple smaller turbines that in general have poorer performance and a higher cost per kWh generated. Detail of the analysis is provided in Appendix A.

Solar Technologies
The use of photovoltaic technologies could be used to offset a small portion of the electrical loads on campus. Solar thermal strategies could be also be used in domestic hot water loops to alleviate the loads incurred by heating the water in cafeterias or other places of large water loads. The cost of implementing solar is very high and the benefits are relatively low, so these options will receive limited use. Solar will not make a significant impact as a carbon reduction strategy on campus. Details of the evaluation are found in Appendix B.

Geothermal Energy
Heat pump systems increase Scope 2 emissions because they trade on-site gas use for off-site electrical power. It is short sighted to only include Scope 1 emissions when considering the impact of heat pump addition. Including a CHP system is key to reducing emissions associated with electric production, as reflected in numbers such as the eCO_2 emissions. See Appendix C for the analysis that supports the conclusion.

Summary Conclusion
There are two (2) opportunities to make a real difference in carbon emissions on campus:
1. Energy conservation.
2. The use of biomass to produce thermal energy, electricity and chilled water. The analysis of this system is included in the description of the goals and strategies listed below.

For this campus, it is a return to the past. About two (2) decades ago the campus installed a wood fired boiler that did not have operational success. The system was abandoned a decade ago and removed to make way for a new gas/oil boiler. Despite the past failure, this plan encourages the development of both opportunities.

If the campus is interested in pursuing carbon neutrality, the third goal that we recommend is to use a combination of low value demonstration projects and Renewable Energy Credits (RECs) that fund the development of renewable resources in a more efficient market. An example is Otter Tail Power's wind energy program, Tail Winds.

GOAL – ENERGY CONSERVATION

BSU may see considerable energy savings from improvements that could be made within the buildings. They include the following strategies:

- Lighting improvements.
- Plumbing efficiency improvements.
- Building envelope improvements.
- Steam trap retrofits.
- Pipe and valve insulation.
- Retrofit of existing HVAC systems.
- Controls upgrades and retro-commissioning.
- PC power management.
- Metering of thermal energy and electricity at each building to support energy management through measurement.

GOAL – DEVELOP A BIOMASS SYSTEM

The proposed system configurations including boiler stack heat recovery, and combined heat and power, have the potential to meet these goals. The following strategies are recommended:

- Adopt a set of energy/environmental performance goals.
- Add an absorption chiller or replace an existing chiller with an absorption machine.
- Develop a biomass-fueled combined heat, power and cooling system. (Sometimes known as Trigeneration.)

Combined Heat and Power Production

The electric utility uses a combination of fuels to produce electricity. They are in the MAPP area and for each MWH of production, 0.73 MT eCO_2 is associated with the energy delivered to the campus under Climate Registry Protocols. The quantity of Scope 1 and Scope 2 emissions can be reduced on campus by using wood to fuel a steam boiler that drives a turbine generator. The campus could see reductions of emissions of as much as 15,000 MT eCO_2 per year by developing a combined heat and power plant.

MAPP is the Mid-Continent Area Power Pool and is a collection of utilities that coordinate their operation in the region. According to MAPP, on their web site www.mapp.org:

"The Mid-Continent Area Power Pool (MAPP) is an association of electric utilities and other electric industry

participants. MAPP was organized in 1972 for the purpose of pooling generation and transmission.

MAPP membership is voluntary and includes electric utilities and other industry participants who have interests in the Upper Midwest.

Its members are investor-owned utilities, cooperatives, municipals, public power districts, a power marketing agency, power marketers, regulatory agencies, and independent power producers from the following states and provinces: Minnesota, Nebraska, North Dakota, Manitoba, and parts of Wisconsin, Montana, Iowa and South Dakota. MAPP serves over 16 million people and covers nearly 1,000,000 square miles.

The MAPP organization has two primary functions: a regional transmission group, responsible for facilitating open access of the transmission system and a generation reserve sharing pool which provides efficient and available generation to meet regional demand. These functions assure efficient and economical power in the upper Midwest for the industry and the public interests."

Combined heat and power can take several configurations. One (1) of the most common forms is to generate superheated, high-pressure steam in a high pressure boiler and expand the steam through a turbine. In this configuration, steam is generated at a high pressure and temperature. A condensing or backpressure turbine would be used, exhausting steam from the turbine at the thermal distribution systems pressure. This allows the turbine discharge to be operated in parallel with existing boilers and meet the thermal energy requirements of the campus. (A desuperheater would be required.) A simplified schematic of this configuration is shown in Figure CHP-1.

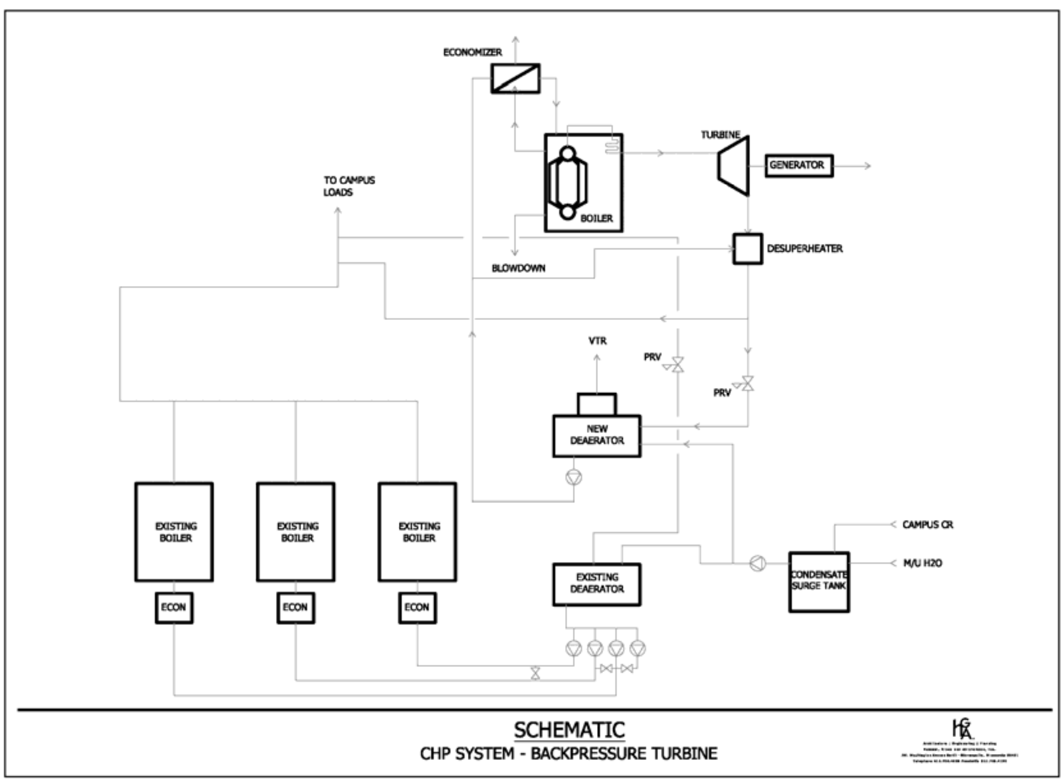


Figure CPH-1 *Basic Backpressure Turbine Schematic*

If a boiler produces 600 psig steam at 750° Fahrenheit, a back pressure turbine sized for about 700 kW matches well with a boiler in the 25-35,000 lbm/hours and could be used most of the year, but at a fraction of its rated capacity. A smaller system, at about 18,000 lbm/hour, could operate at or near capacity most of the year. Alternatively, a condensing turbine with an extraction port could be considered and would offer more operating hours and a greater reduction of CO_2 emissions. Turbine sizing is based on steam conditions and a steam flow slightly higher than base line steam flow. Turbine size should be fine tuned in a Schematic Design phase.

A CHP plant designed with a back pressure turbine would control turbine output with a bottom cycling strategy for the best system efficiency. A bottom-cycle control loop throttles steam flow to match the thermal load. Figure CHP-2 on the following page shows that system efficiency varies with steam flow. Steam generation efficiency remains constant with constant flue gas temperature but as electrical generation increases, system efficiency improves. Efficiency peaks when turbine capacity is reached and drops as additional steam is used beyond turbine capacity. The existing "Gas to Delivered Steam Efficiency" of 74.3% was calculated by using a combustion efficiency of 83.5%, with 7% of the steam going to the deaerator, 5% to boiler blow down and 3% system steam losses. Make-up water was assumed to be 50° Fahrenheit and condensate returned from the system at 180° Fahrenheit, so condensate return to the deaerator was about 170° Fahrenheit. CHP system efficiency adjusted the parameters to account for 600 psig / 750° Fahrenheit superheated steam and desuperheated turbine exhaust to slightly above saturation, based on a six (6) stage turbine selection received.

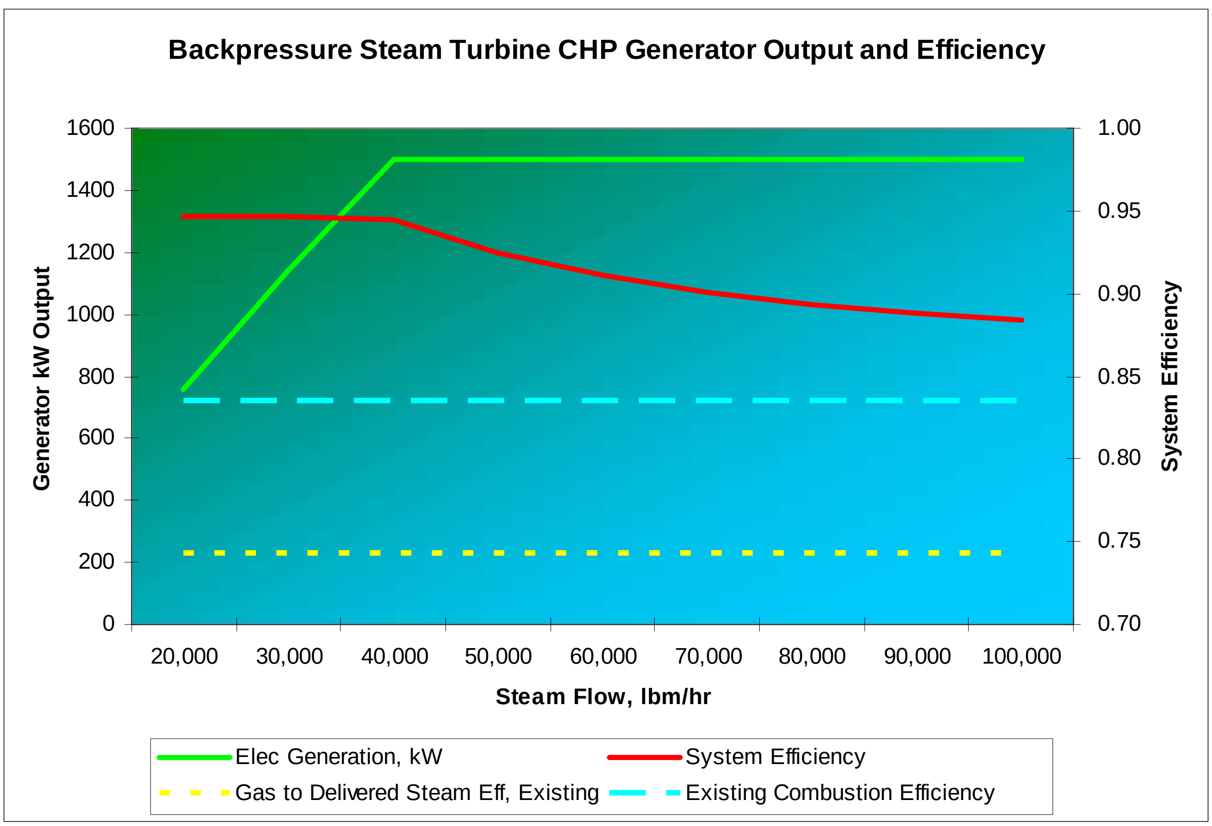


Figure CHP-2 *Plant Efficiency versus BPT Generator Output*

The likely size of a steam turbine would be 0.5-2 MW. This could have a significant impact on planning of boiler upgrades when the plant is scheduled for its next major overhaul in about 35 years. We recommend additional analysis to determine the cost and value of this option when the University is closer to executing the project.

More specifically, the following analysis breaks down BSU GHG emissions by scope for several scenarios. These categories are somewhat non-sequential but are chosen so the impact of key strategies becomes apparent. We modeled five (5) scenarios for a wood fueled boiler plant. The variations in the models included the size of the boilers and type of turbine that was part of a combined heat and power system. Energy Use and projected GHG emissions are summarized for the following five (5) scenarios:

1. 35,000 lb/hour boiler with a 2 MW condensing turbine and a 14,000 lb/hour extraction port.
2. Same as above with a 25,000 lb/hour boiler and a 1.2 MW turbine.
3. 35,000 lb/hour boiler with a matching back pressure turbine.
4. 25,000 lb/hour boiler with a matching back pressure turbine.
5. 18,000 lb/hour boiler with a matching back pressure turbine.

All of these system sizes are theoretical and have not been matched against equipment in the market. It is also important to note that the performance characteristics are generalized as well and have not been tested against actual equipment in the market. The models also assume operating characteristics in the plant and in the system that have not been verified by manufacturers or with the University's operating staff. The model will give you a sense of how energy production shifts from fossil fuels to renewable energy from wood and the resulting reductions in CO_2 emissions.

CHP Options	**Gross Steam Flow, lbm/hr**	**Extraction Flow, lbm/hr**	**Thermal Energy Delivered by Wood, MMBTU**	**Thermal Energy Delivered by Gas, MMBTU**	**Gas Purchased, MMBTU**	**Peak Generated kW**	**MWH Produced**	**MWH Purchased**	**GHG from Electricity, Metric Tons CO2**	**GHG from Gas, Metric Tons CO2**	**Total GHG Emitted, Metric Tons CO2**	**CO2 Reduction**
Existing Plant	-	-	-	-	120,583	-	-	13,127	9,806	6,391	16,196	-
Extraction Turbine*	35,000	14,000	67,703	11,380	15,589	1,892	11,475	1,651	1,234	826	2,060	14,137
Extraction Turbine*	25,000	14,000	67,767	11,316	15,502	1,171	9,698	3,429	2,561	822	3,383	12,814
Backpressure Turbine	35,000	-	60,231	18,852	25,825	846	1,575	11,552	8,629	1,369	9,998	6,198
Backpressure Turbine	25,000	-	67,508	11,575	15,857	604	1,739	11,388	8,506	840	9,347	6,850
Backpressure Turbine	18,000	-	66,766	12,318	16,874	435	1,715	11,411	8,524	894	9,419	6,778

** Condensing turbine with extraction port is part of this scenario.*

We estimated the current campus peak load at 35,000 lb_m/hour. Data from 2007 and 2008 show peak electrical consumption at 3.3 MW. We assumed we could condense to a 90 psig header to meet useful thermal loads. In the model, we used another campus load profile to establish hourly patterns for energy consumption. The campus was similar in size, but experiences somewhat milder winters and hotter summers. We converged the total consumption of theoretical model to within 2% of the monthly data that was provided. This does not mean that the model is within 2% accuracy, but it does indicate that it is reasonably close for strategic planning purposes.

Using a condensing turbine with an extraction port will allow the campus to reduce its carbon footprint related to Scope 1 and Scope 2 emissions related to building energy by 85%. This is a significant reduction, and also is the least efficient of the five systems evaluated. A system half the size with a back pressure turbine will reduce the same category of emissions by about 50%. See the table above for estimated quantities of thermal energy derived from renewable energy sources and fossil fuels for each case.

We evaluated the addition of an absorption chiller to the plant that would be base loaded to meet the cooling requirements when the campus is using 500 tons of cooling or less and it would operate at full capacity for the hot days during the summer. This scenario shifts more energy to a renewable energy source.

CHP Options with 500-Ton Absorption Chiller	Gross Steam Flow, lbm/hr	Extraction Flow, lbm/hr	Thermal Energy Delivered by Wood, MMBTU	Thermal Energy Delivered by Gas, MMBTU	Gas Purchased, MMBTU	Peak Generated kW	MWH Produced	MWH Purchased	GHG from Electricity, Metric Tons CO2	GHG from Gas, Metric Tons CO2	Total GHG Emitted, Metric Tons CO2	CO2 Reduction
Existing Plant	-	-	-	-	120,583	-	-	13,127	9,806	6,391	16,196	-
Extraction Turbine	35,000	14,000	67,703	11,380	15,589	1,892	11,868	960	717	826	1,544	14,653
Extraction Turbine	25,000	14,000	67,767	11,316	15,502	1,171	10,091	2,738	2,045	822	2,867	13,330
Backpressure Turbine	35,000	-	60,231	18,852	25,825	846	1,967	10,861	8,113	1,369	9,482	6,715
Backpressure Turbine	25,000	-	67,508	11,575	15,857	604	2,132	10,696	7,990	840	8,831	7,366
Backpressure Turbine	18,000	-	66,766	12,318	16,874	435	2,108	10,720	8,008	894	8,902	7,294

**Note the decrease in CO_2 emissions with the addition of steam derived water chilling when compared to the table above.*

GOAL – ACHIEVE CARBON NEUTRALITY IN THE RENEWABLE ENERGY CREDIT MARKET

Since it is difficult at best and expensive at its worst to develop grid free operations, the balance of the reductions could be obtained through the REC market and to the degree that the University wants to demonstrate technology with small scale solar and wind projects.

CHP Summary

The advantages of a CHP system for BSU include: increased efficiency, reduced carbon footprint, reduced fossil fuel used as source energy and on-site electrical generation reducing line losses. The disadvantages are additional equipment and increased operational complexity.

The backpressure steam turbine configuration uses equipment with which operators are both familiar and proficient at operating. Electrical generation is secondary in this configuration as only a fraction of the total energy used goes to electric production. The gas turbine generator option introduces new equipment, but is capable of producing more electricity while improving the steam production efficiency. In Figures CHP-1, we showed a CHP system retaining three (3) existing boilers. With the existing and projected loads, the existing level of redundancy could be maintained by replacing a boiler leaving BSU with two (2) dedicated gas and oil fired 150 psig rated steam boilers, and one (1) CHP boiler that would be base loaded. Using the existing boilers as a back-up and supplemental source, run hours on the older equipment is reduced, potentially extending service life of the boilers.

WIND ENERGY AS A RENEWABLE RESOURCE

The area surrounding Bemidji shows an average annual wind power density of about 100-200 W/m^2. Our experience is that mapped capacity factors overestimate the total wind production achievable in an area, so it is better to stay on the low end with first cut economic evaluations. Correcting the mapped value of 100 W/m^2 and correcting it for height of a 70 to 80 meter turbine, average annual wind power available is 110 W/m^2.

We also took Nation Renewable Energy Laboratory (NREL) maps to provide capacity factor estimates for a variety of turbines. These values are calculated with estimated wind speeds at 80 meters. The individual turbine performance curve affects the actual capacity factor.

Turbine Manufacturer/Model	Nordic	New Unite Wind FD77	Suzlon	Vestas V90
Nominal Capacity	1MW	1.5 MW	2 MW	3 MW
Capacity Factor	25.70%	34.30%	27.80%	24.70%

Table WT-1 *– Wind Turbine Performance*

The mean capacity factor from the table is about 28%, corresponding fairly well with a value of 110 W/m^2. A 1.65 MW turbine would produce about 4,000,000 kWh with this capacity factor. Exclusive of federal incentives available to a private partner and an installed cost of $2,400,000 / MW, this performance would require a value of electricity on the order of $0.084-$0.134 /kWh to cover debt, operation and maintenance costs of a large wind turbine.

Code and Siting Issues

Initial considerations of wind generation would site a turbine on campus where the interconnect issues are minimal and the value of the energy is maximized. To be a significant portion of the total energy portfolio, again assume a minimum value of 8-10% of the peak demand. A currently popular turbine size has a 1650 kW output, representing 50% of the campus peak demand and 30% of the total energy used on campus. A turbine or series of turbines of this size would operate in a net metering mode, as the maximum turbine output would never exceed minimum campus demand. Therefore, there would be little need for a Power Purchase Agreement (PPA) to cover the times excess wind energy would be sold to the grid.

Turbine siting has to be coordinated with the surroundings and with the prevailing winds. A wind rose such as those shown in the figure WI-1 shows the occurrence by direction, the wind speed by direction and the wind power produced by direction. Having minimal wind shading and interference in the direction of predominant production (in this case 270° to 330°) helps the on-site turbine to take advantage of the available wind.

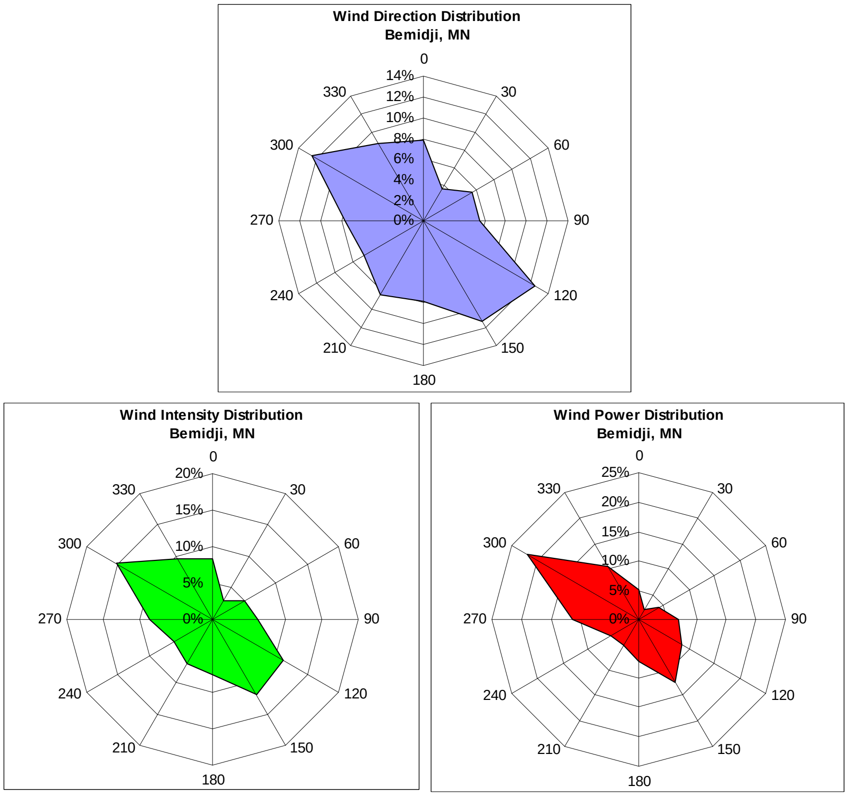


Figure WI-1 *– Modified Wind Rose for Bemidji.*

As noted above, hub heights for turbines in the 0.5-1.65 MW size range vary from 65 to 80 meters, with rotor diameters from 50 to 80 meters. Towering above the surrounding landscape and buildings, the turbine would potentially act as a detriment to University aesthetics. More importantly, there has to be room to erect the turbine; turbine fall areas must also be planned into the turbine siting, covering both turbine erection and the possibility of tower collapse.

There are no areas on campus where a 100 meter diameter circle of clear area can be found. Winter operations of a horizontal-axis turbine require clear area to prevent people from being hit by ice sloughing off the turbine. A 2005 Model Wind Energy Code, published by American Wind Energy Association (AWEA), mentions a setback for ice being thrown by turbine blades. This possibility is small as most turbines would shut down if ice caused an imbalance in the turbine. Noise and interference with local electronic transmissions for television and communications are also concerns when siting a turbine in a residential area.

These practical and code considerations suggest that a large wind turbine would not work well on the Bemidji Campus. A significant commitment to wind energy by Bemidji would require an off-site location with better wind resources and a Power Purchase Agreement (PPA).

Wind Financing Mechanisms

To complete the discussion of wind energy, while acknowledging any wind portfolio would be developed off-site, four (4) revenue approaches were considered to determine how wind energy might provide the greatest value to Bemidji. In each case, the physical configuration is similar, but how the University is paid for generated wind power would be different. These structures are a "behind the meter" connection, a PPA connection, an off-campus turbine tied into the existing transmission grid known as "retail wheeling," and selling directly to the grid.

- A "behind the meter" connection would site a wind turbine near the University and connect it to the campus electrical system via transformers and paralleling gear. The value of energy to BSU under this scenario would be somewhat less than the current average power costs shown in Table E-1 as $0.064 / kWh. A behind the meter connection typically yields the highest value for wind generated power. Because wind power typically reduces the campus load profile, average costs of the remaining energy purchased rise resulting in an avoided cost value on the order of $0.058 / kWh. This is short of the rough cut value of energy required to offset the operating and financing costs noted above ($0.06-$0.09 /kWh).

- The second option involving an on-campus wind turbine is to pursue financial incentives including a power purchase agreements (PPA) and/or renewable energy credits (REC). A PPA would create revenue from payments made from a utility provider to the University for turbine-generated power supplied directly to the grid. This could provide a hedge against future energy prices if its income is indexed to market prices.

- A third scheme is "retail wheeling." Currently, this is not accommodated in the state's tariffs and would require changes in state law to be possible. The main idea with retail wheeling is that the University would site a turbine in an area more favorable to wind, an area that has a better capacity factor and is not restricted by the residential area as is the BSU campus. Under this scenario, wind power generated off-site could be connected to the grid and BSU would receive credit for this power as if it were generated "behind the meter." There would be two (2) differences from the "behind the meter" case discussed above. First, a transportation charge would be paid, resulting in a lower value of electricity per kWh. Secondly, the turbine capacity factor would be higher, resulting in more energy generation and allowing the project to be successful at a lower average cost per kWh.

- Another option that often yields the highest value of wind produced energy is to sell wind power directly to the grid. This requires the cooperation of a power producer already on the grid (in Minnesota, the grid is managed by Midwest Independent Systems Operator, MISO) or for the entity to register as an Independent Power Producer. In this scenario, power is sold directly to the grid in the day ahead market, and if attempting to maximize kWh income, bidding for power production on an hourly basis. This requires a wind farm larger than necessary to simply serve campus loads as it would have to absorb significant management costs. Accurate wind and production projections for the following day and hours would also be required to mitigate risk associated with failure to produce as bid, and producing while the cost of power goes negative. This risk plus the management of the process could degrade income projections to less than the other options presented. Implementing this structure on an individual campus would make the campus a for-profit utility, selling power and possibly RECs and requiring investments that would divert educational funds to utility investments.

SOLAR

Solar – Photovoltaic

Photovoltaic (PV) systems consist of an array of flat-plate solar collectors mounted on rooftops or open land. Solar energy captured by solar cells is directly converted into electricity. Solar power is renewable, reduces greenhouse gas emissions and fossil fuel consumption. It can be used for a specific load or system using Direct Current (DC) power or converted to Alternating Current (AC) through an inverter. The Department of Energy's (DOE) Energy Information Administration (EIA) provides the following information on PV cell efficiency.

Average Energy Conversion Efficiency of Photovoltaic Cells and Modules Shipped in 2007

Year	Crystalline Silicon			Thin-Film Silicon		Concentrator Silicon
	Single Crystal	Cast	Ribbon	Amorphous Silicon	Other	
2007	17%	14%	12%	8%	12%	35%

***Table PV-1** – Average Energy Conversion Efficiency of Photovoltaic Cells and Modules*
**Data from Energy Information Administration (EIA)*

Using DC solar-generated electricity does not require an inverter and so delivers the power at a higher efficiency, The disadvantage with using DC power is that a separate distribution system must be set up to operate with DC power. Since solar energy is not dispatchable (available whenever it is needed), it must be stored or backed up on a DC system or the powered devices are simply not available when there is insufficient sunlight. Rectifiers would be required to convert AC power to DC power to provide a back-up when solar power is not available, or the energy must be stored in batteries. Both propositions are costly and result in additional system losses. At Bemidji, especially during the school year, a significant time will be spent without the sun available. These back-up system losses are taken over a longer period of time than the time spent with the benefit of more efficient solar power delivery.

Solar energy converted to AC electricity can be operated in parallel with the grid with the use of inverters and paralleling gear. The energy can be used when the sun is available, and the system operates relatively seamlessly when the energy is not available. Assuming a Concentrator Silicon technology is used, AC solar energy conversion efficiency is approximately 31% after the inverter. Campus peak electrical loads total 12.7 MW. Generating 8% of the peak electrical load, or about 1 MW, would require almost two (2) acres of collector surface, the area of almost two (2) soccer fields. Such an investment would not reduce the required size of any electrical systems. Annual generation from an array this size may be able to offset 3% of the campus electrical use. At present, solar photovoltaics are one (1) of the least cost effective ways to invest in renewable energy at Bemidji. With space at a premium at Bemidji, the most practical use of solar photovoltaics would be as a feature built onto roofs of selected buildings, contributing a small amount of energy as demonstration projects rather than trying to make solar energy the centerpiece of the Bemidji renewable portfolio. Solar PVs should be connected within selected buildings and will provide power to the campus "behind the meter," reducing energy purchased from the utility.

As a field of technology and research that is relatively new and rapidly changing photovoltaics, and its applications, come with very high equipment and installation costs. Current installed pricing of PV arrays are over $5,000 per kW delivered. Pricing obtained by HGA for another project use the most efficient conversion technology available and convert it to AC power. Projected costs were consistent with EIA data, at $5.65 to $7.00 per watt for a 1MW to 0.25 MW project size. Exclusive of federal and utility incentives, the value of electricity produced at this cost is approximately $0.304 per kWh, or four (4) to five (5) times the current average electrical rate. The economics of photovoltaics at Bemidji may change over time as energy prices rise and PV prices drop. Figure PV-1 below shows the EIA's projection of PV generating plant cost for the next 20 years.

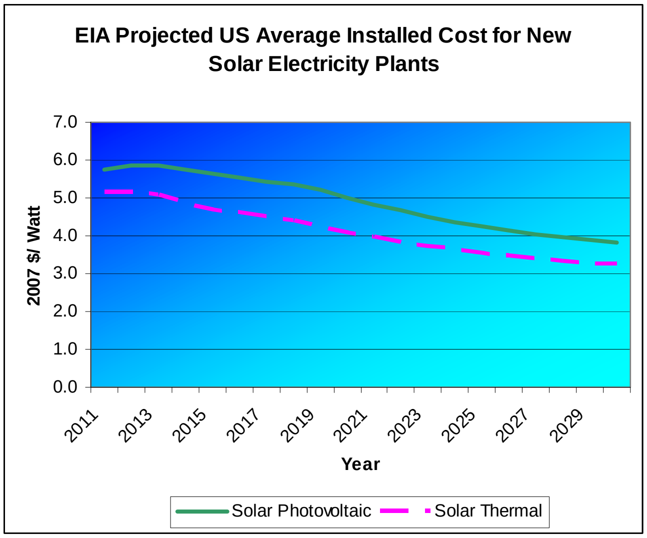


Figure PV-1 *– EIA PV Generating Plant Capital Cost Projections*

In efforts to encourage renewable energy project start-ups, Otter Tail Power does/does not offer a Rebate Program equal to a one-time payment of $0.75 per kWh of the expected first year AC output. The system size eligible for the rebate program is 1.5 kW to 100 kW. As part of this agreement, however, the utility will take ownership of all renewable energy credits (RECs) and other environmental attributes acquired during first 10 years of operation.

Federal financial incentives for renewable energy projects are available through the Investment Tax Credit (ITC). The American Recovery Act of 2009 allows taxpayers to receive a return of investment of up to 30% (no maximum credit) or to receive an equivalent grant from US Treasury Department. To qualify for the ITC, Bemidji would need to pursue a public-private partnership with a third party, as the ITC is only available to private businesses.

Solar – Thermal

Another possibility for the use of solar energy is to install solar thermal systems to serve as a heating source for domestic water, hydronic space heating, swimming pools or other heat sink. A typical solar thermal heating system suited for service at Bemidji would include an array of flat-plate solar collectors which collect and transfer radiant heat from the sun to a passing fluid. A thermal storage tank is used to store heated fluid for use when the sun is not available. One (1) special application is pool heating. The pool continuously loses heat, primarily through evaporation. The energy required to replace the evaporation is equal to the latent heat of the evaporated water plus the energy required to heat make-up water to the pool temperature. While evaporation rate varies with space temperature and humidity, the range of loads is not nearly as wide as a domestic water of heating hot water.

To modulate heating supplied from the solar collectors, a complex set of controls is utilized to ensure proper domestic hot water temperature, pool or desired space temperature. Solar thermal systems are most commonly found in residential type applications where thermal loads are low.

Because buildings on the BSU campus are generally much larger than a residential home, the size of solar collector plates required to adequately serve a building's hydronic heat load is also much greater. There is no requirement that the solar collector system be sized for the peak heating load. Such an approach would result in higher costs and reduced average output, eroding economic value of the project. An oversized unit would tend to overheat the system it served during less than peak times. A solar thermal project would have the best payback if it was sized to ensure that nearly all thermal energy collected can be used in the heat sink served.

In addition to space availability, the initial installed equipment costs should also be considered. As shown in Figure PV-1 above, solar thermal applications are 10-15% lower in cost per delivered kW than their PV counterparts. Solar thermal technology is also fairly well established. Table PV-2 below shows the relative performance of different types of solar thermal collectors. This should not be used as a design guide or as an estimate of how a collector would perform at Bemidji.

Average Thermal Performance Rating of Solar Thermal Collectors by Type Shipped in 2007 (Btu/ft^{2}day)

Year	Type						
	Low-Temperature	Medium-Temperature					High-Temperature
	Liquid/Air	Air	Liquid				Parabolic Dish/Trough
	Metallic and Nonmetallic		ICS/Thermosiphon	Flat-Plate (Pumped)	Evacuated Tube	Concentrator	
2007	1,248	918	926	979	851	2,150	1,000

Table PV-2 *- Solar Thermal Collector Performance*
**Data from Energy Information Administration (EIA)*

For simple flat plate systems, dramatic efficiency improvements are not expected. Although there are some initial investment incentives available for solar thermal projects, we are not aware of any production based incentives. Most federal programs sponsored by the DOE seem to focus on electrical generation rather than thermal energy use.

- Evaluation and implementation of future solar thermal projects should include the following:
- Carefully selected load controls to recover heat when possible and not overheat during low load periods.
- Allowance for system maintenance costs.
- Deduction of available solar energy when it cannot be used, such as summer time when the dorms are not occupied.
- DHW systems require large storage tanks to store energy from the time collected to the time it is used. Note that DHW storage tanks must generally be operated at 140° Fahrenheit to prevent the growth of harmful bacteria such as Legionella. This increases system thermal losses which should be included in the evaluation.

DISTRICT HEAT PUMP SYSTEM

We considered serving selected new buildings added to the Campus with an independent district heat pump loop. By "independent", we mean a central system separate from the existing steam and chilled water distribution system, but integrated with the central plant equipment in a way that will increase the efficiency of energy production for all existing buildings and provide an efficient means to distribute energy to future buildings.

A heat pump is a device that uses mechanical work to move energy in the form of heat from one place to another. The system can provide both heating and cooling. The recommended system will use a closed, re-circulated loop of direct buried HDPE piping to provide heating energy to, and remove heat rejected from, central heat pump systems located in new buildings.

When combined with the CHP options above, a heat pump system would reduce Scope 1 and Scope 2 eCO_2 (equivalent carbon dioxide) emissions. Without the CHP system, eCO_2 emission reductions are small because while the delivery of heating is significantly more efficient, cooling delivery is less efficient. Moreover, electrical energy use is increased, while on-site thermal energy production is reduced. Remote electrical energy is produced largely with coal without the benefit of CHP and is delivered with large line losses. Table HP-1 below can help provide an understanding of this impact. It shows that purchased power comes with a carbon footprint nearly four (4) times that of gas-generated heating, resulting in an eCO_2 emissions stalemate- more efficient energy delivery is offset by increased emissions. On-site generation helps the heat pump approach achieve reduced overall energy use, carbon footprint and operating costs by increasing energy generation efficiency, as well as energy delivery efficiency.

Emission Factors	Natural Gas	Purchased Electricity	Distallate Oil (#1-#4)
MT eCO_2 / MMBtu	0.0528	0.2547	0.0724
MT eCO_2 / kWh	0.00018	0.0009	0.00025

Table HP-1- *Equivalent Carbon Dioxide Emissions Factors for Gas and Electricity*

Only selected new buildings would be served by the heat pump system, which will be designed specifically to optimize loop and plant operations. Within each building, conventional but low temperature heating hot water and chilled water loops will be circulated. Low temperature heating hot water systems might re-circulate energy at 105° to 120° Fahrenheit, a temperature lower than is typically seen in building distribution systems. Coils not originally designed for these lower temperatures will have marked reduction in thermal output. This is one (1) reason we recommend a segregated system serving only new buildings. Another motivation for this recommendation is that the size of the heat pump loop appears to fit well with the quantity of waste heat available. Assuming the new buildings are more efficient than existing buildings, selected new buildings represent approximately 15% additional load on the central systems. The heating can be taken almost exclusively from the boiler exhaust stream, improving plant efficiency as load is added.

Future buildings would be on the heat pump loop, as well as those that would be served by the boiler and chiller plant. Under this scenario, ultimate Central Chiller Plant cooling peak load would rise to

6,500 tons, and steam load to 150,000 lbm/hr. Of that steam flow, about 140,000 lbm/hr of the steam load would be distributed to the campus. Heat pump loads would total about 1800 tons cooling, and heating peak load, 24,000 mbh heating. Distributed electrical load resulting from the heat pump system is on the order of 1,400 kW in summer and 1,600 kW in the winter before diversity is considered. Building identifiers are shown in Figure HP-1.

There is an opportunity unique to Bemidji to improve heat pump system efficiency by using a combination of waste heat and lake water. A simplified schematic of this configuration is shown in Figure HP-2. Ground source heat pumps typically operate at 90° Fahrenheit to 105° Fahrenheit in the cooling mode and 40° Fahrenheit to 50° Fahrenheit in the heating mode. By using waste heat from the existing central plant and lake water, heat pump loop temperatures can be raised in the heating mode and lowered in the cooling mode to increase the system performance. Table HP-2 below provides an example of how changing the operating temperatures can improve heat pump efficiency over typical geothermal heat pump systems. Based on performance runs using Trane's selection program for its large water-to-water heat pumps, cooling system improvements are projected at 26% and heating efficiency improvements at 18%. The efforts to achieve these or better results will take more detailed study, review of all operating conditions, and a well thought out design and control strategy.

	Loop Temperature	Delivery Temperature	Peak COP	Efficiency Increase
Summer - Ground Source	90-105	44-58	3.39	
Summer - UWM Proposed	65-80	44-58	4.61	26.4%
Winter - Ground Source	50-40	120-105	3.57	
Winter - UWM Proposed	80-65	120-105	4.38	18.5%

Table HP-2- *Heat Pump Improvement Potential by Changing Loop Temperatures*

The Coefficient of Performance (COP) shown in Table HP-3 is calculated as energy transferred divided by energy input. Thus, heat pump system with a COP of 4 will serve a heating load using one-quarter (¼) of the energy that is actually transferred to the load. The total energy transferred to the buildings must still be added to or removed from the heat pump loop. This is done with a combination of heat pumps in alternate modes, waste heat recovery and lake water cooling. On a central heat pump system net COPs will be slightly lower because of pumping energy required to distribute the loop water over longer distances.

It is envisioned that multiple buildings would be served with a 4-pipe hydronic distribution system fed from one (1) heat pump plant that will act as a heating and cooling module. Preliminary calculations show the system would conserve energy and reduce operating costs under some market conditions.

A heat pump system option offers efficiency, renewable energy and an opportunity for waste heat recovery. The three (3) are interdependent. Steam plant efficiency can be increased by the addition of direct contact or indirect waste heat recovery. Energy that is currently being exhausted through the stack can be used to heat the additional buildings planned for the campus. This provides a step change in system efficiency for the existing plant that cannot be achieved without the use of a low grade heat sink. Coupled with lake water for cooling (and supplemental heating if required), the heat pump system uses renewable energy directly from Lake Bemidji.

Figure HP-3 is a schematic diagram of a heat pumps module, piped so they can be operated in series or in parallel, providing simultaneous heating and cooling to the new buildings. Sizing, part load operation, and flow balances are critical factors in the system design.

The schematic drawing of Figure HP-3 on the following page shows the existing plant and how the proposed heat pump loop and stack waste heat recovery would interface with the existing system. Lake Michigan water provides cooling through a heat exchanger. In order to analyze the benefit of incorporating a heat pump within the campus cooling system, the performance of the direct-contact heat exchanger and heat pump should be modeled with an hourly profile of lake water temperature and building cooling loads. While this level of detail is beyond the scope of this document, a summary of approximate energy and cost performance is included in the last section of this report.

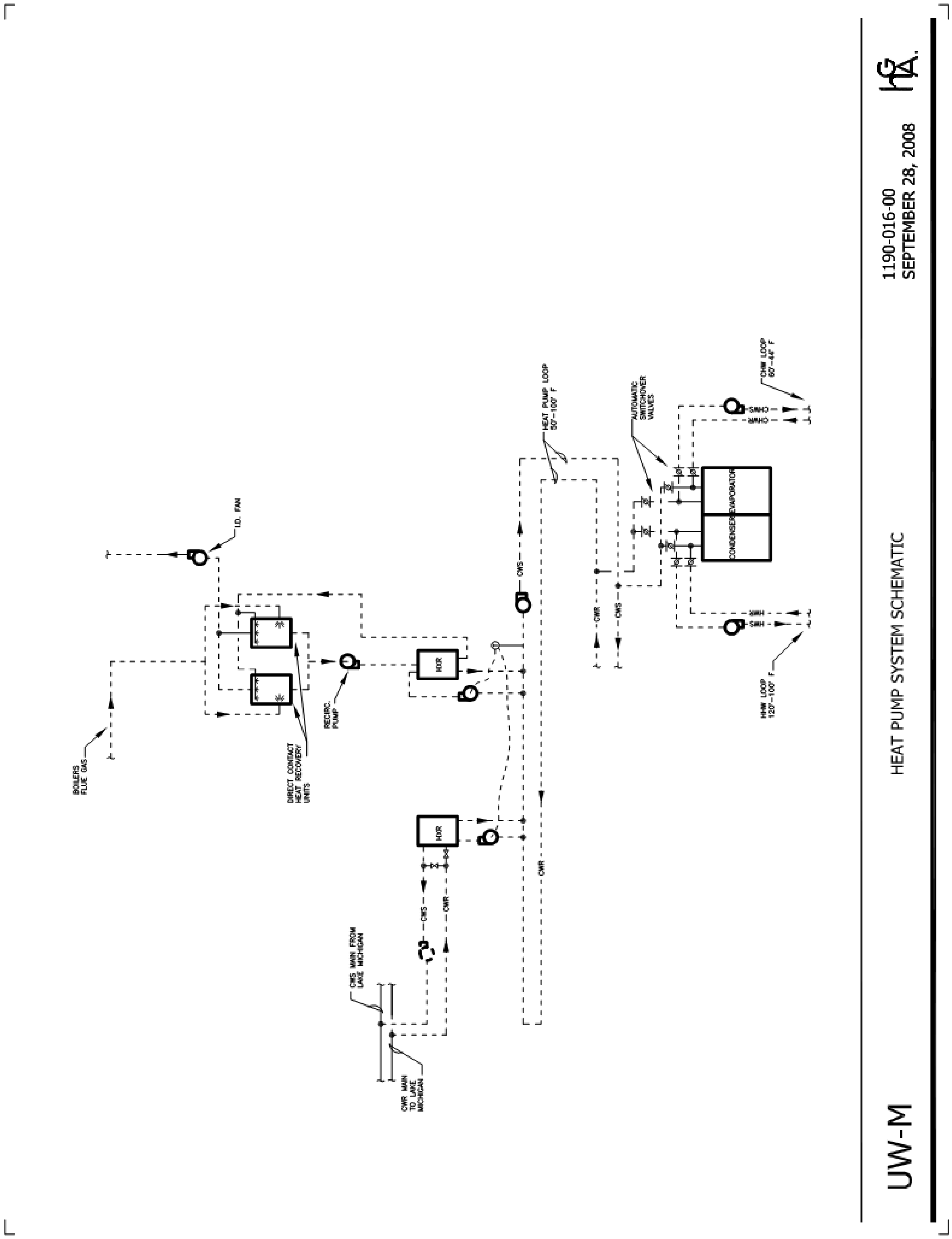


Figure HP-3 *Schematic Diagram of a Heat Pump Module*

Alternative Source of Heat for the Heat Pump Source Water

A heat pump loop together with a boiler heat recovery system can operate all year. This would use existing equipment and implement heat recovery with a smaller expenditure. While it is beyond the scope of this report to address the design in detail, the following issues are presented for design consideration. There are several considerations that should be incorporated into the design if this approach is used.

- The magnitude of energy available for recovery. A direct contact heat recovery loop may be able to recover 10%-15% of the boiler load. As system load increases, more total energy is available so a match of load and available energy is possible.
- Recovery efficiency depends on temperatures circulated. Circulated temperatures determine effectiveness of distribution and electrical energy required to distribute the heating water. Chilled water coils will in general be suitable for low temperature distribution, as coils typically have multiple rows.
- System temperatures should be kept low for several reasons: expansion/compression tank capacity (normally designed for a maximum of 100° Fahrenheit), pipe stress and pipe expansion which is not designed into a chilled water system, and possible component temperature limitations.
- Selection of coils to operate under this scenario. This approach requires systems with 100% outdoor air and reheat coils downstream of the chilled water coils. In this way, the preheat coil can be shut off to allow the chilled water coil, typically downstream of a preheat coil, to act as the preheat coil. If air was returned to the AHU, the economizer cycle would mix return and outdoor air, reducing or eliminating the opportunity to preheat the air.
- Operational window for this scheme would be from November to April, the times the chilled water system is typically shutdown. It would be very inefficient to raise and lower chilled water loop temperatures multiple times.
- AHUs to be served by this system require control modifications to modulate AHU leaving temperature with the chilled water coil when this system is in operation. Because the scheme would not be used when chilled water was required, the steam or heating hot water preheat coil would have to operate during shoulder months.
- ***Freeze protection. Preheat coils on 100% outdoor air units are sometimes drained to prevent freezing. If systems were shutdown at night, outdoor air damper leakage could result in coil freezing. Chilled water recirculation would need to be kept in operation*** during freezing weather or some other means provided to prevent unit freezing. This would reduce savings available from the heat recovery system.
- A schedule of transition of air handling units would be needed to ensure sufficient loads are placed on the system to make it worthwhile.

GAS TURBINE GENERATOR CHP CONFIGURATION

This approach follows steam load, and takes what electrical output can be achieved. An alternative approach to CHP is to generate electricity with a gas turbine generator (GTG) and produce steam from the GTG's waste heat. The GTG would be sized for the base electrical load. Corresponding steam produced only from the waste heat would be small; however, the system would use supplemental firing in a duct burner to generate as much energy as that of a boiler. The advantage here is there is more electrical production, and since the combustion air is already heated supplemental firing efficiency would be greater than 90%. The problem associated with this option is that the demand for electricity on campus 3.3 MW is less than most popular and supported gas turbine generators.

Figure CHP-3 shows a possible configuration integrating a GTG with the existing plant. In one (1) possible scenario, a 5 MW Recuperative GTG generates power at about 40% efficiency and can produce 12,000 lbm/hour of steam at the same time. Supplemental firing can produce up to eight (8) times the steam, matching the steam production of other boilers, only at an increased efficiency. If a strict average of monthly electrical energy used on campus was greater than 6 MW this could be a good option. This implies that hourly minimums below 5 MW would be infrequent. GTG sizing would have to be confirmed in a Schematic Design study, should this option be pursued.

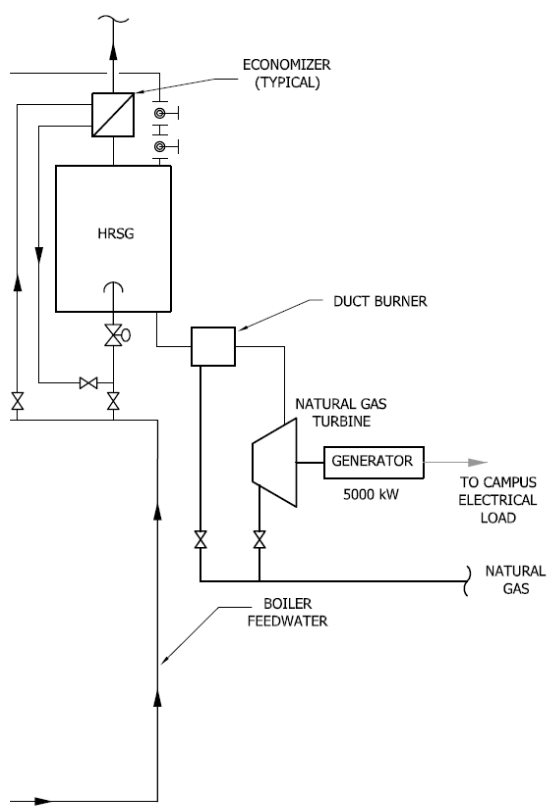


Figure CPH-3