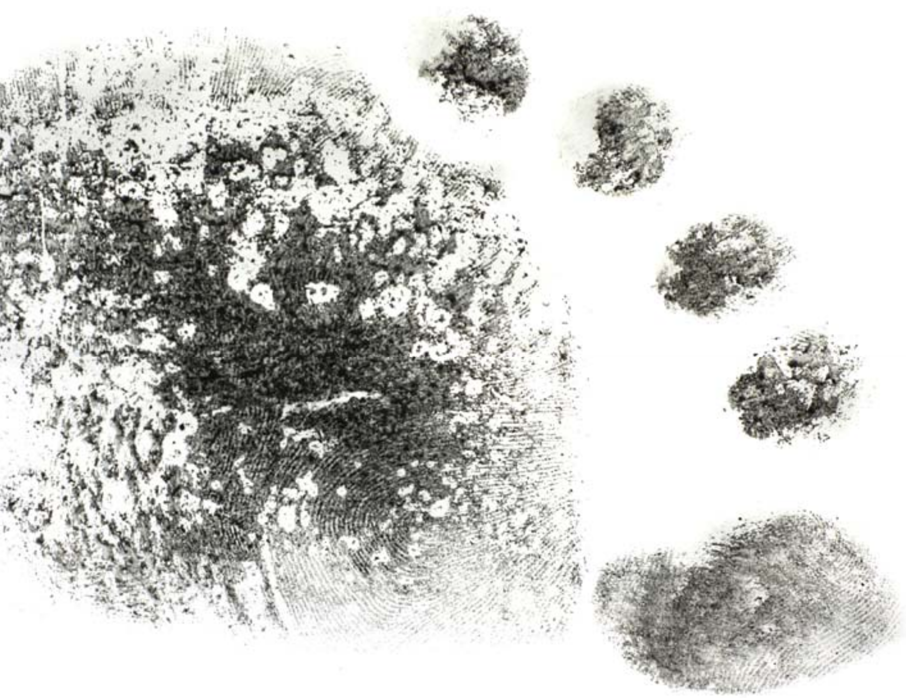
Carbon Footprint for UM-Crookston

Presented by:
McKinstry Co.
June 2008



1881 Station Parkway ▪ Andover, MN 55304 ▪ 763.767-0304 ▪ FAX 763.862.9111 ▪ CELL 763.354-8596
Minnesota ▪ Wisconsin ▪ Washington ▪ Oregon ▪ Idaho ▪ Colorado

Executive Summary

By establishing the carbon footprint of UM-Crookston it establishes a baseline against which progress and goals can be measured and communicated. Once the baseline has been established, we can begin the important work of energy conservation and efficiency, and the implementation of renewable energy sources. This report not only serves to establish that baseline for UM-Crookston, but also identifies potential Facility Improvement Measures (FIM's) that would directly impact either energy conservation and efficiency, renewable energy sources, or education and community outreach regarding carbon reduction solutions. This report also contains the first step in analyzing FIM's for implementation, and that is the inclusion of the Sustainability Energy Management Profiler (SEMP). As FIM's are further defined and scoped out, they will be included in the SEMP tool in order to determine what impact they will have on the carbon footprint, which ones act synergistically with each other, which ones act antagonistically towards each other, and which blend of FIM's provide the greatest impact and provide the greatest return on investment for the University.

Based upon the results of our preliminary walk through and utility bill analysis, we expect that a reduction of roughly 15% of utility consumption, and a reduction of over 20% of the carbon emissions which could all be achieved through a self funding project.

Carbon Footprint (GHG)

The Greenhouse Gas Protocol is a standard for collecting and reporting greenhouse gas (GHG) inventories. It is maintained by the Greenhouse Gas Protocol Initiative which is a partnership between businesses, Non-Government Organizations (NGO), and governments convened by the World Resources Institute (WRI) as well as the World Business Council for Sustainable Development. The purpose of the GHG Protocol is to assist those organizations wanting to implement an emissions reduction plan or participate in GHG reporting programs by increasing consistency and transparency in GHG accounting. Emissions recorded through the GHG Protocol are divided into 3 Scopes:

- Scope 1 includes direct emissions, which are emissions from energy conversion on site, such as emissions that are resulting from the coal consumed at the boiler plant to produce steam.
- Scope 2 emissions are those produced from electricity purchased from an offsite utility and consumed onsite.
- Scope 3 emissions include emissions from commuters as well as things such as emissions from food transportation. The GHG Protocol gives some direction for Scope 3 emissions but regards them as optional, largely due to concerns about accuracy, variation, and double counting of such intermittent and uncertain emissions.

The GHG Protocol is a standard, not a reporting or enforcement organization. The methodology put forth by the GHG Protocol is compatible with a number of GHG accounting programs including the Chicago Climate Exchange, the World Wildlife Fund Climate Savers, the UK Emissions Trading Scheme, as well as the European Union Greenhouse Gas Emissions Allowance Trading Scheme (EU ETS).

In examining energy use in identified facilities, McKinstry has complied with the GHG Protocol as pertaining to that energy use. Accounting for emissions from transportation, GHG other than CO_2, or any Scope 3 emissions is beyond the scope of this study.

GHG Protocol (Scope 1) - Emissions from Fuel Sources Used On-Site

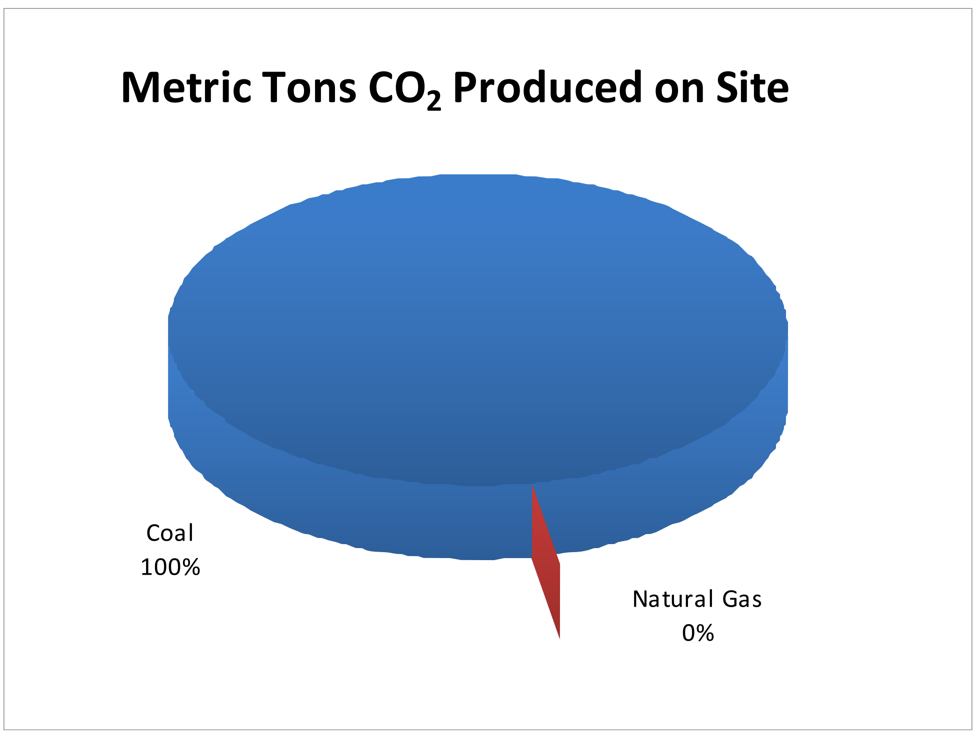
Base Year and Reporting Period
This data represents a base year from April 2006 - March 2007

Operational Boundary
In this study, emissions for the University of Minnesota Crookston were confined to those resulting from facility energy use in identified buildings, associated site(s) as measured by utility bill and fuel consumption.

Fuel Consumed by UM-Crookston

FUEL	Million Btu	Lbs CO2	Metric Tons CO2
Coal	65,325	13,411,282	6,083
Natural Gas	0	0	0
Totals	65,325	13,411,282	6,083

Graphical Representation of GHG Protocol Scope 1 for UM-Crookston



GHG Protocol (Scope 2) - Emissions from Purchased Electricity

Base Year and Reporting Period

This data represents a base year from January 2007 – December 2007

Operational Boundary

In this study, emissions for UM-Crookston were confined to those resulting from facility energy use in identified buildings, associated site(s) as measured by utility bill and fuel consumption.

Electrical Breakdown

Ottertail Power Company; the utility company providing electrical power for the UM-Crookston provided a 2007 breakdown of the various fuel components required to produce electricity. The total kWh consumption on the UM-Crookston was distributed proportionally based on the fuel source percentage. The following is a tabulated breakdown of the electricity (kWh) for UM-Crookston:

Fleet Totals - Otter Tail Power Company - MN 2007			kWh Breakdown
Fuel Source	Coal	69.13%	2,635,646
	Coke	0.00%	-
	Gas	0.76%	28,976
	Hydro	6.05%	230,662
	LFG	0.00%	-
	Nuclear	0.00%	-
	Oil	0.07%	2,669
	Purchases	21.57%	822,376
	RDF	0.00%	-
	Solid	0.71%	27,069
	Biomass	0.03%	1,144
	Wind	1.68%	64,052
	Wood	0.00%	-
			3,812,594

Further supporting documentation associated with the Electrical Breakdown and the associated CO_2 is located in the Appendix.

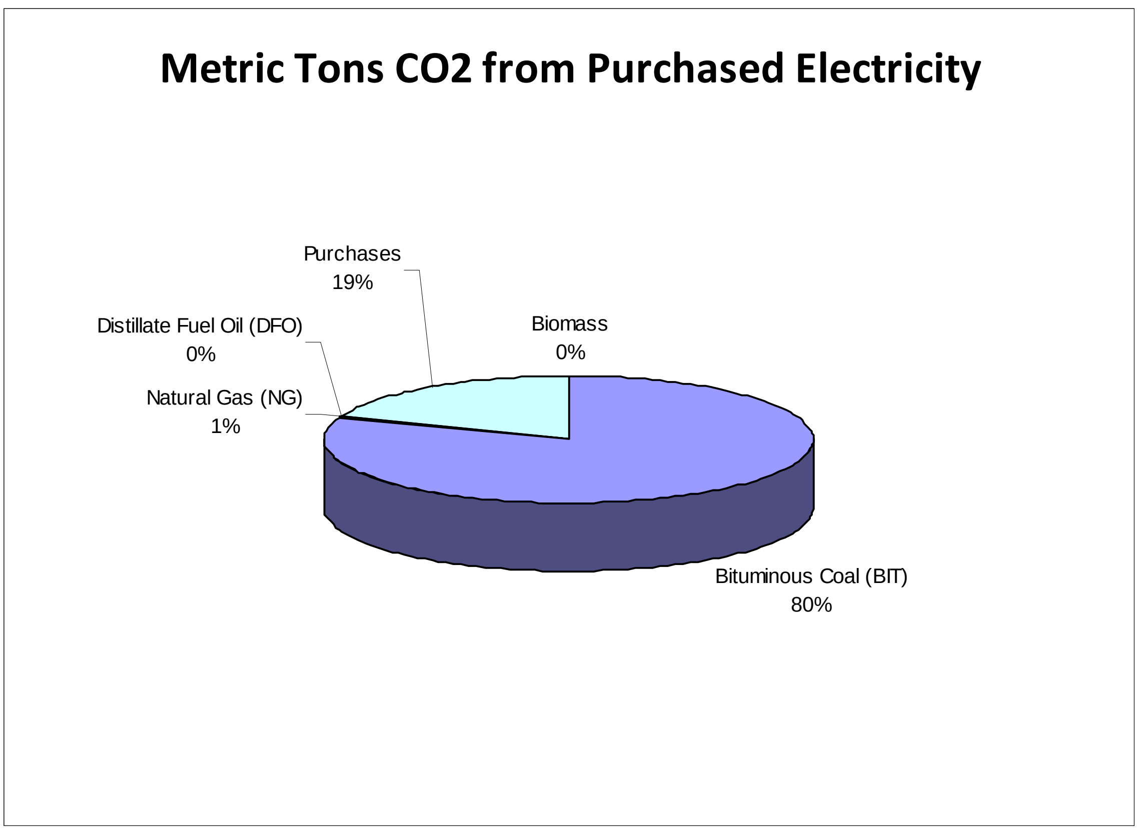
Applying the GHG Protocol (Scope 2) yields the associated CO_2:

Otter Tail Fuel Distribution for Electrical Production

FUEL	KWh	Lbs CO2	Metric Tons
Bituminous	2,635,646	6,496,412	2,946.72
Natural Gas	28,976	52,969	24.03
Petroleum	-	-	-
Hydro	230,662	-	-
LFG	-	-	-
Nuclear	-	-	-
Distillate Fuel	2,669	6,653	3.02
Purchases	822,376	1,512,325	685.98
Municipal	27,069	-	-
Biomass	1,144	4,023	1.82
Wind	64,052	-	-
Wood	-	-	-
	-	-	-
Totals	3,812,594	8,072,382	**3,662**

Fuel Sources Provided by Otter Tail Power Company for 2007

Graphical Representation of GHG Protocol Scope 2 for UM-Crookston



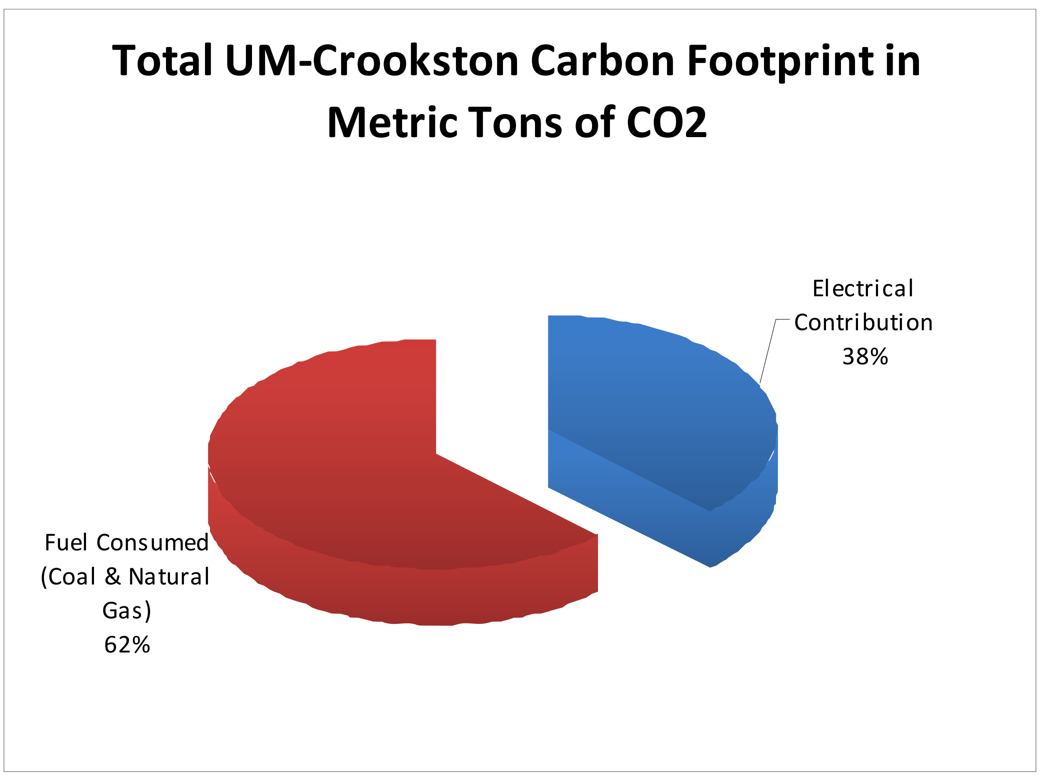
GHG Protocol (Scope 1 & 2) - TOTAL

Combining both Scope 1 & Scope 2 of the GHG Protocol results in the following Total Metric Tons of CO_2 associated with the UM-Crookston.

Total Metric Tons of CO2

Electrical Contribution		3,662
Fuel Consumed (Coal & Natural Gas)	6,083	
Total CO2 Footprint (Metric Tons)	**9,745**	

Graphical Representation of GHG Protocol Scope 1 & 2 for UM-Crookston



Sustainable Energy Management Profiler (SEMP)

UM-Crookston

Ver 2.1 / April 2008

Sustainable Energy Management Profiler

Facility Improvement Measure (FIM) #1	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #2	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #3	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #4	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #5	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #6	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #7	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #8	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #9	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #10	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #11	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #12	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #13	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #14	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #15	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #16	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #17	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #18	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #19	0	(1 = On / 0 = Off)
Facility Improvement Measure (FIM) #20	0	(1 = On / 0 = Off)

EXISTING

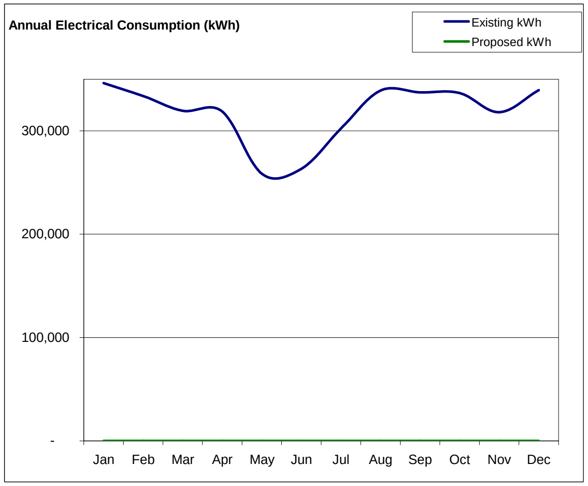
Coal Used	**65,325**	Annual MMBTU
Natural Gas Used	**-**	Annual MMBTU
Electricity Used	**3,812,594**	Annual kWh
CO2 Emissions	**9,745**	Metric Tons

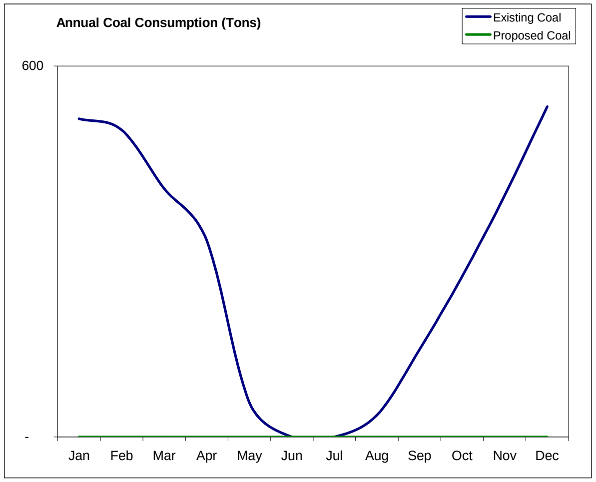
PROPOSED

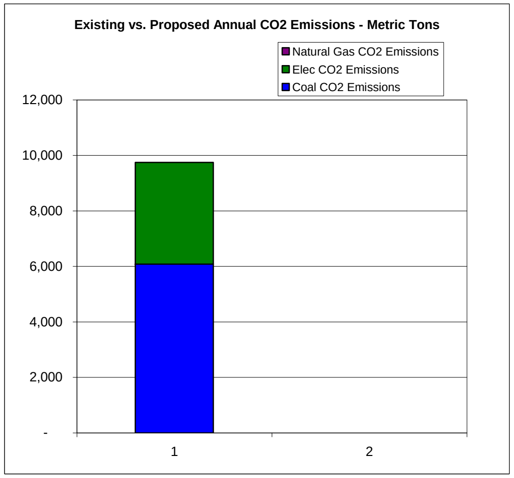
Natural Gas Used	**-**	Annual MMBTU
Natural Gas Used	**-**	Annual MMBTU
Electricity Used	**-**	Annual kWh
CO2 Emissions	**-**	Metric Tons

Aggregate Annual Savings	**$**	**-**	
Annual CO_2 Reduction		-	Metric Tons
Equivalent Reduction in Annual Barrels of Oil Produced		-	Barrels of Oil

Source: http://www.usctcgateway.net/tool/







Potential Facility Improvement Measures (FIM's)

A preliminary energy audit was performed on the UM-Crookston in conjunction with evaluating the existing carbon footprint and the ability to help reduce it. There major components make up this preliminary energy audit:

- Site Visits
- Identification of Facility Improvement Measures (FIM's)
- Sustainable Energy Management Profiler

Site Visits
A site visit occurred during the month of May to both identify potential FIM's and to start the inventory process of the various FIM components.

Identification of Facility Improvement Measures (FIM's)
During the site visits a variety of potential FIM's were identified. This list of FIM's, starting on the next page is not intended to be an exhaustive list; it contains measures or components that typically result in energy savings, operational improvements and carbon footprint reductions.

Sustainable Energy Management Profiler
The framework for combining and illustrating the impact that the individual FIM's have on the overall carbon footprint has been developed (see previous page for the Sustainable Energy Management Profiler). Once the FIM list has been finalized and the individual FIM's have been completely developed and imported into the Profiler tool, the various interactions that occur between the FIM's and their impact on carbon footprint can then be performed.

Interior Lighting Improvements

- Solution:
  - Perform a comprehensive lighting survey to determine which areas would benefit from a lighting upgrade
  - Evaluate efficacy of campus wide conversion to T5 versus industry standard T8 lamps.
  - Upgrade any remaining T12 lamps with magnetic ballasts to T5 or T8 25watt lamps with Electronic Ballasts
  - Replace T8 32 watt lamps with T5 or T8 25 watt lamps
  - Replace metal halide fixtures in the Sports Center Gym, UTOC and other miscellaneous areas with fluorescent or LED high-bay fixtures

- Benefits:
  - Reduce electrical use
  - Improved light levels
  - Improved light distribution
  - Improved light control

Exterior LED Lighting Improvements

- Solution:
  - Perform a comprehensive lighting survey to determine which fixtures would benefit from a lighting upgrade
  - Upgrade existing exterior high intensity discharge (HID) lighting with newer LED technology.
  - Upgrade pathway lighting to LED bollards or solar LED fixtures
  -
- Benefits:
  - Reduce electrical use
  - Improved light levels
  - Significantly improved life-cycle performance

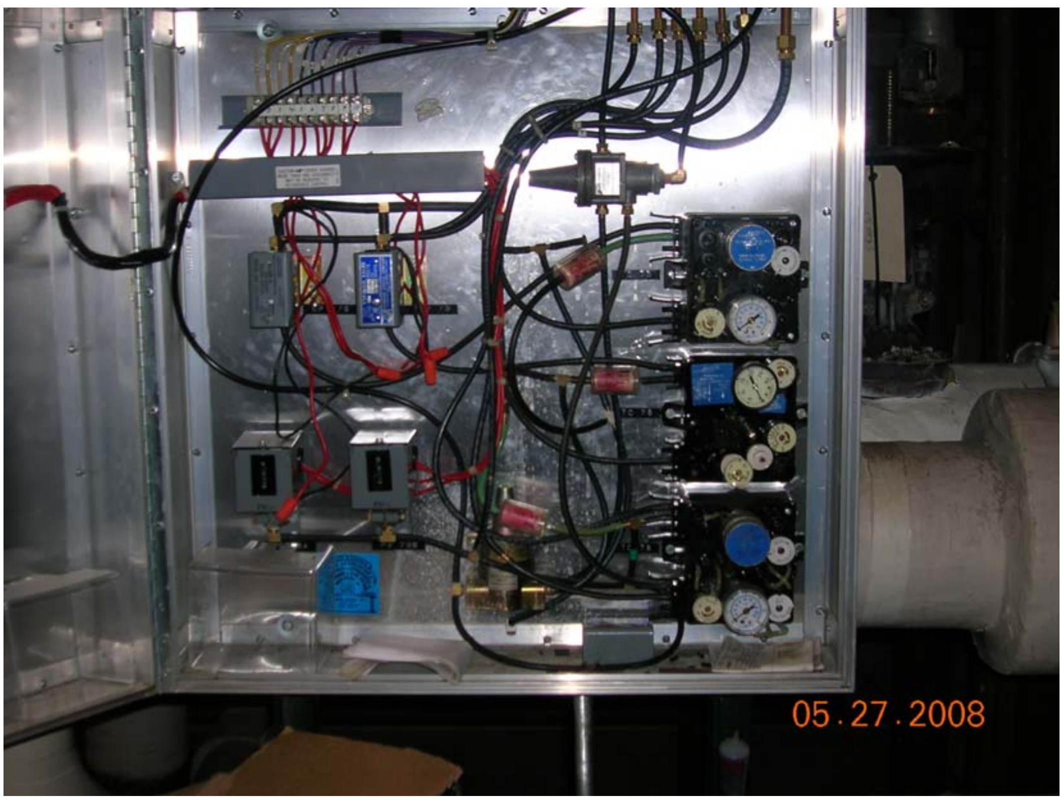
Lighting Controls

- Solution:
  - Perform a comprehensive lighting survey to determine where occupancy sensors, photo sensors or time of day controls would save energy
  - Install occupancy sensors or smart switches in classrooms, restrooms and general areas of limited use.
  - Install photovoltaic controls where daylight is, or may be, adequate to provide at least partial illumination in order to take advantage of natural daylighting.
  - Extend Distributed Digital Control (DDC) to lighting systems that require lighting at certain times where scheduling would be most effective.

- Benefits:
  - Reduce energy consumption
  - Increased lamp life
  - Increased harvesting of natural daylight
  - Visible demonstration of conservation effort

Building Automation System

- Solution:
  - Replace existing pneumatic control system and standalone thermostats with new electronic Direct Digital Control (DDC) in specific buildings.
  -
- Benefits:
  - Reduce energy consumption
  - Schedule heating & cooling in remote buildings
  - Perform Demand Control Ventilation (CO_2) and other enhanced building operation sequences
  - Reduce run-time/extend life of equipment
  - Remote monitoring from central location
  - Reduced response time
  - Reduce maintenance issues



Campus Wide Air Conditioning Master Plan

- Issue
  - Building air conditioning consists of several distributed air-cooled water chillers and numerous direct-expansion split-system air conditioning units. Control of these units is difficult, energy use and peak electrical demand is high and maintenance costs are significant.

- Solution:
  - Conduct a campus-wide air conditioning study to identify loads, current equipment sizes and potential alternatives.
  - Determine the potential to create a central campus chilled water plant or some number of centralized building plants.
  - Develop a master plan to install distribution chilled water piping and replace existing cooling units as they reach the end of their useful life.

- Benefits:
  - Reduced electrical energy use and peak demand charges
  - Improved cooling control
  - Reduced system maintenance requirements


Add Biomass Gasifier to Central Plant

- Solution:
  - Evaluate retrofitting the Cleaver-Brooks Boiler for biomass gasification fuel sources.
  - Identify potential fuel sources for gasification
- Benefits:
  - Reduce carbon footprint
  - Reduce or eliminate propane use
  - Maximize use of existing campus infrastructure
  - Cutting edge technology application in real time
- Disadvantage
  - Biomass fuel sources will be significantly more expensive than coal, which currently provides the great majority of campus heat

Solar Photovoltaic Application

- Solution:
  - Investigate the opportunity to leverage the use of Clean Renewable Energy Bonds (CREB) to install a solar array application on campus.

- Benefits:
  - Reduce energy consumption
  - Reduce heat loads
  - Environmentally conscious
  - Highly visible commitment to sustainability

Thermal Solar

- Solution:
  - Evaluate feasibility of installing thermal solar collectors for helping to heat domestic water
- Benefits:
  - Reduce coal and natural gas costs
  - Environmental
  - Highly visible commitment to sustainability
  - Domestic water applications are typically mounted near residence halls, further enhancing their visibility

Solar Wall Application

- Solution:
  - We will investigate the opportunity of a solar wall application on the south facing wall of all mechanical penthouses. These solar walls can capture heat from the sun and preheat required ventilation air entering the facilities air handling units. This in turn significantly reduces the building overall heating load.

  **** Example: On a sunny day the temperature outside may be 0 degrees, these solar panels can heat the outside air up between 30 & 76 degrees, thus reducing your heat load.

- Benefits:
  - Reduce energy consumption
  - Reduce heat loads
  - Environmentally conscious

Large Scale Wind Turbine

- Solution:
  - Evaluate feasibility of installing a large scale (over 1.0 MegaWatt) wind turbine near campus

- Benefits:
  - Reduce electricity costs
  - Environmentally conscious
  - Highly visible commitment to sustainability
  - Ability to couple wind turbine output with electric thermal storage for reductions in boiler plant fuel costs

Sub-Metering Plan

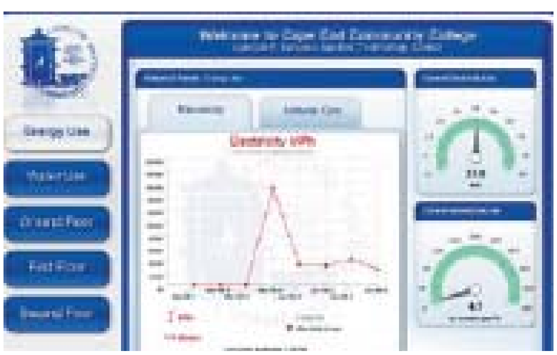
- Solution:
  - Implement a sub-metering program for electricity and steam so that the actual energy consumption of each facility can be determined.

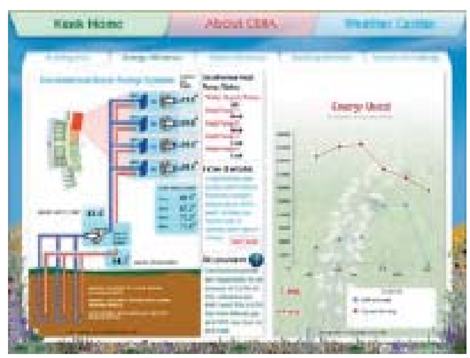
- Benefits:
  - Actual information will be utilized for determining anomalies and individual building performance.
  - Detailed energy use data enables more effective student energy wars and other behavioral modifications on campus.

Kiosk / Web-Base Information

- Solution:
  - In conjunction with an energy efficiency project install public accessible Kiosks in select locations on campus
  - This same information can also be accessed through a website from any computer
  - The information on this system can include real time and historical data about the campus energy consumption, as well as data on any renewable energy sources and can ultimately be incorporated into curriculum and for student research
  - Standardize on the same system as the UM Morris campus will be installing for better purchasing and support as well as the ability to more easily share data between campuses if desired

- Benefits:
  - Communicate to the public benefits of energy efficiency
  - Communicate the efforts undertaken by the University of Minnesota Crookston
  - Enable campus energy wars and potential data sharing more easily with the UM Morris campus





Appendix

GHG - SCOPE 2 EMISSIONS DATA

Electrical Breakdown - EXISTING

FUEL	kWh	Btu	Million Btu	Lbs CO2 per Million BTU **	Lbs CO2	Metric Tons CO2	Source
Bituminous Coal (BIT)	2,635,646	8.99E+09	31,643.51	205.30	6,496,412	2,946.72	From NREL "Power Technologies Energy Data BooK" available at http://www.nrel.gov/analysis/power_databook/
Lignite Coal (LIG)	-	0	0.00	215.40	0	0.00	
Sub bituminous Coal (SUB)	-	0	0.00	212.70	0	0.00	
Petroleum Coke (PC)	-	0.00E+00	0.00	225.13	0	0.00	
Waste Coal (WC)	-	0	0.00	205.30	0	0.00	
Synthetic Coal (SC)	-	0	0.00	205.30	0	0.00	
Natural Gas (NG)	28,976	9.89E+07	452.42	117.08	52,969	24.03	
Hydro	230,662	7.87E+08	787.02	0.00	0	0.00	
LFG	-	0.00E+00	0.00	115.26	0	0.00	CO2 EF from EIA Voluntary Reporting Program
Nuclear	-	0.00E+00	0.00	0.00	0	0.00	
Distillate Fuel Oil (DFO)	2,669	9.11E+06	41.23	161.39	6,653	3.02	From NREL "Power Technologies Energy Data BooK" available at http://www.nrel.gov/analysis/power_databook/
Residual Fuel Oil (RFO)	-	0	0.00	173.91	0	0.00	
Waste Oil (WO)	-	0	0.00	210.00	0	0.00	
Purchases	822,376	2.81E+09	691,823.05	2.19	1,512,325	685.98	From Leonardo Academy Report available at http://www.cleanerandgreener.org/download/efactors.pdf
Propane	-	0	0.00	0.00	0	0.00	
RDF	-	0	0.00		0	0.00	From NREL "Power Technologies Energy Data Book" available at http://www.nrel.gov/analysis/power_databook/
Solid Waste	27,069	9.24E+07	4,411.00	14.63	64,533	29.27	From NREL "Power Technologies Energy Data Book" available at http://www.nrel.gov/analysis/power_databook/
Biomass	1,144	3.90E+06	34.95	115.11	4,023	1.82	From NREL "Power Technologies Energy Data Book" available at http://www.nrel.gov/analysis/power_databook/
Wind	64,052	2.19E+08	218.54	0.00	0	0.00	
Wood	-	0.00E+00	0.00	0.00	0	0.00	
Distillate Fuel Oil (DFO)	-	0	0.00	161.39	0	0.00	From NREL "Power Technologies Energy Data Book" available at http://www.nrel.gov/analysis/power_databook/
Geothermal (GEO)	-	0	0.00	16.60	0	0.00	
Jet Fuel (JF)	-	0	0.00	156.26	0	0.00	
Kerosene (KER)	-	0	0.00	159.54	0	0.00	
Municipal Solid Waste (MSW)	-	0.00E+00	0.00	91.90	0	0.00	
TOTALS	3,812,594				8,136,915	3,690.84	

**** NOTE:** Lbs CO2 per Million BTU does NOT include any transmission or distribution losses, which by some estimates would incorporate an additional 7% to 8%.
Overall Efficiency for BIT is assumed at 20% and Overall Efficiency for NG is assumed at 30%