Strategic Energy Management Plan

UNBC

University of Northern British Columbia

June 6, 2011
Revision 1

Energy Manager:
David Claus, P.Eng, D.Phil

Partnering with:

BC hydro

powersmart

Table of Contents

1. INTRODUCTION

UNBC is Canada's Green University™. The continued relevance of this branding requires that the university engage in "green" and sustainable activities in every aspect of our operations. Energy use is readily identified as an aspect of being green. The student community, faculty and wider public all equate energy use with sustainability. Furthermore, public education campaigns have addressed the environmental impacts of energy use, and the need to curtail energy waste. News media coverage of the oil sands, and electrical generation options (nuclear, coal fired plants, large scale hydro-electric, wind, run-of-river etc.) has raised the level of public awareness regarding energy sources. There is a growing lobby for green or renewable energy sourcing, to which the university is also subjected.

The university has set leadership in renewable energy as a key part of the University Plan. The BioEnergy system currently being commissioned is an important part of this plan. It is designed to offset 85% of the natural gas used for heating the core campus buildings. This addresses the majority of the university heating requirement; the next steps will address the remaining heating needs, and electrical supply.

In March of 2008 the University of Northern British Columbia participated in an Energy Management Assessment sponsored by BC Hydro. This was a review of university policies, procedures and practices related to energy usage and conservation. One of the identified action items was to designate a staff person to be responsible for energy management issues and coordinating conservation initiatives. This eventually became a job posting for a full time Energy Manager, with funding for the position provided by BC Hydro. The position was filled in June 2010.

Energy management is an important part of the shift towards renewable energy. Demonstrating leadership in the renewable field will only happen through concerted effort, and execution of a well structured plan. The Energy Manager will be instrumental in developing that plan. Accurate data on current and historical consumption patterns is required to size and design renewable energy infrastructure. The Energy Manager will facilitate the collection and reporting of energy performance data.

Energy management is important to help keep costs at a minimum and ensure that every available dollar goes into education.

1.1 Energy Manager Program

The BC Hydro Energy Manager program provides funding to public sector organizations to hire or designate someone as an Energy Manager. This funding is available for up to five years, and covers the full cost of the salary. Annual renewal of the funding is contingent upon meeting the following requirements:

- Submit a Strategic Energy Management Plan
- Complete quarterly presentations to both UNBC and BC Hydro

This report fulfills the requirements of BC Hydro Energy Manager program, while providing background and context for the energy conservation activities at UNBC.

2. OUR ORGANIZATION

The Univesity of Northern British Columbia was established in 1990 by the UNBC Act. The Prince George campus was constructed between 1992-1994, and opened by Her Majesty Queen Elizabeth on August 15, 1994. The Bank of Montreal donated a downtown building to the University in 2005. A Terrace campus building was added in 2006, and the Quesnel River Research Centre came under the UNBC banner in 2002.

2.1 Organizational Profile

People

Sector	Post-Secondary Education
Number of People	886 Faculty and Staff 4332 Occupants (students, daycare participants)
Campus Sites	Prince George (16 buildings) Downtown Bank of Montreal Building Terrace Campus Quesnel River Research Centre (4 buildings)

Operations

Energy Management Issues / Obstacles

- Organizational capacity – staff to carry out work scope
- Lack of building level metering
- First year of program

Core Business Metrics

- Full Time Equivalent Students
- Gross Square Meters
- Classroom Hours
- Research Dollars

Annual Cycle

Business Year	April 1 - March 31
Budget Cycle	April 1 - March 31
Maintenance Cycle	April 1 - March 31

	2010/11	2011/12	2012/13*	2013/14*
Maintenance Budget [1]	$1,280,060	$1,372,059	$1,454,000	$1,541,000
Energy Efficiency Projects Budget	$38,200	$243,000	$310,000	$229,000
Utilities Budget [2]	$2,681,814	$2,893,131	$3,125,000	$3,312,500
Operations Budget [3]	$62,502,014	$62,773,519	$62,845,000	$62,908,000
Other Incentives				
Capital Budget [4]	$91,350	$91,350	$91,350	$91,350

** Denotes projected budget amounts.*

The Energy Efficiency Projects budget is the actual amount spent in 2010/11. The amount listed for subsequent years is based on the projected spend from the Energy Conservation Revolving Loan described in section 5.3.

[1] "Building Renovations/Maintenance & Grounds" in the University budget
[2] "Utilities" in the University budget
[3] Total of "Labour" and "Other Operating Expenditures"
[4] "Annual Capital Allowance"

The capital budget listed above is the Annual Capital Allowance provided by the Provincial Government. It is used for capital improvements to extend the life of the physical plant, increase campus life safety and security, and for projects to reduce greenhouse gas emissions. This has been drastically reduced in recent years, from $1.4 million to $91,350 for this year. This is a challenge for funding energy efficiency projects; the University has responded by creating the Energy Conservation Revolving Loan, and will allocate savings from the utilities budget towards future projects.

2.2 Energy Management Scope

The energy management portfolio includes all facilities where UNBC has direct operational control. This permits changes to the operating procedures, equipment upgrades, and other capital expenditures. Many of the regional operations of UNBC are housed at facilities operated by other institutions; while behaviour based conservation initiatives may be addressed to the staff at these sites, the facilities do not fall within the scope of the energy management program.

2.3 Facility Profile

The Prince George campus includes the majority of the UNBC facilities. Only three other sites are included in the energy management scope: the Terrace campus, the BMO Centre in downtown Prince George, and the Quesnel River Research Centre near Likely.

The Prince George campus is supplied with electrical and natural gas accounts at the Power Plant. Distribution within the core campus is handled internally, without separate billing meters for each building. This is advantageous from a rate perspective (bulk purchasing power), but is a disadvantage when trying to compare between buildings (no consumption data is recorded). Several facilities within the Prince George campus served with separate utility accounts, as identified in the table below. In the absence of sub-metering this is the only means to differentiate within the campus.

A meter installation project is nearing completion (June 2011) and will permit differentiation between individual buildings for subsequent updates to this report.

Facility Profile (Apr 2010 – Mar 2011)

	Number of People	Size Gross m^2	Annual Energy Consumption kWh	Annual Energy Cost	Energy Intensity kWh/ m^2	Energy Intensity per Employee kWh/person
Main Campus	4,290	65,360	37,871,000	1,765,000	579	8,828
Residences	465	14,850	3,419,000	175,000	230	7,353
Daycare	70	639	125,000	5,000	195	1,780
Northern Sports Centre	330	13,485	3,652,000	191,000	271	11,065
Downtown BMO Building	40	1,320	369,000	23,000	280	9,228
Terrace Campus	130	1,314	497,000	39,000	379	3,826
Quesnel River Research Centre	4	812	241,000	20,000	297	60,360
Bioenergy	2	1,042	234,000	12,000	225	117,145
Total	**5,325**	**98,822**	**46,408,846**	**2,229,504**	**465**	**8,626**

Note that the energy values in the above table include both natural gas and electricity.
When evaluated on the basis of energy intensity per square meter, most UNBC facilities fall into the 200-250 kWh/m^2 range. Terrace is one exception to this, where the building age, construction methods, and long hours of operation result in higher energy consumption. The main campus has a very high energy intensity (by area), but this is heavily influenced by the laboratory buildings. Buildings that include laboratory spaces are not permited to recirculate indoor air for safety reasons, so 100% outdoor air is drawn in and conditioned (heated or cooled) year round. This rasises the energy intensity of these buildings significantly.

Energy use per person varies considerably between UNBC facilities, but is not viewed as a significant measure of building performance and will therefore not be examined further in this report.

2.4 Key Performance Indicators

Key performance indicators are the variables identified as the drivers of energy consumption. Typically there is some overalp between the energy consumption indicators and the measures used to gauge the success or growth of the organization. Floor area is one way of quantifying the size of the University, and it also directly relates to the amount of energy we consume. The number of students the prime measure of the size of an institution, but it has less of an impact on the energy use. The annual weather (as measured by heating degree days) is the single largest driver of energy use for a northern campus such as ours. This is not a key performance indicator in the traditional sense as we do not have any direct control over it, but it is an important factor when reviewing energy consumption.

Table 1 Key Performance Indicators

	Totals			
	2010/11	**2009/10**	**2008/09**	**2007/08**
Floor Area (average gross, m^2)	97,404	96,968	96,968	87,128
Students (FTE Nov 1)	3,717	3,762	3,779	3,690
Weather (Heating Degree Days)	4,208	3,909	4,433	4,148

Floor area is computed as the average across all months of the gross campus area. Adjusting energy use for floor area yields a measure of the efficiency of the campus buildings; as new buildings are constructed the energy intensity in kWh/m^2 can still be compared against historical consumption levels.

Student numbers are based on the enrolment on November 1 of each year. An increase in enrolment would be expected to cause an increase in energy consumption. This is particularly the case when additional courses cause the normal operating hours of campus buildings to be extended. Measuring full time equivalent (FTE) enrolment does not account for differences in energy intensity of various programs or disciplines. The level of detail is insufficient to identify changes in energy usage between buildings. A more detailed measure of building occupancy (such as student/faculty contact hours) is being examined for future energy reporting.

Heating degree days are a measure of the amount of heating required as the weather changes. An average daily temperature that is one degree cooler than the reference temperature results in one heating degree day. The reference temperature used for UNBC is 15.5° C, implying that this is the temperature at which no heating would be required by the campuses.

UNBC is a research intensive university, and our facilities include a research laboratory building, a teaching laboratory, and building for the Northern Medical program. Research activity is a key measure of University performance, and research dollars awarded would be the natural performance measure. However, this does not take into account the wide range of energy intensity across research programs.

3. OUR COMMITMENT

The University of Northern British Columbia is committed to responsible energy use for all University owned and operated facilities while supporting its mandate of teaching and research. We acknowledge that students, staff and faculty all have a role to play in fostering a culture of energy conservation. To control costs and reduce the impact on the environment, UNBC will aim to reduce energy consumption and switch to renewable fuel sources.

3.1 Energy Policy

UNBC has developed an Energy Policy to reinforce our commitment to responsible energy use. The full text of this policy is included in the Appendix; the vision and goals are articulated here in more detail.

Once adopted this policy will be included on the University website Policies and Procedures page, and highlighted to all faculty and staff via broadcast e-mail.

The vision stems from our Green University strategy, as described below.

- **To maximize energy efficiencies of present UNBC energy systems**

  As a relatively new campus, built with energy efficiency in mind, UNBC has highly efficient systems. Not content to rest on our laurels, we will continue to optimize our operating practices, and seek out opportunities to increase the energy efficiency of our systems.

- **To replace fossil fuel sources with renewable energy sources**

  Renewable energy sources available to all of our campuses will be harnassed to support the research and teaching activities for which the University exists.

- **To develop sustainable energy demonstration and research facilities of particular value to northern and rural communities**

  The research activites of this University place a special emphasis on relevance to the wider community of which we are a part. Northern and rural communities face unique challenges, but are also often provided with significant renewable energy opportunities. UNBC will build on our history of integrating research, education and facility operations.

3.1.1 Reduction Targets

UNBC recognizes that utility rates are likely to increase, and that fossil fuel energy sources have a significant greenhouse gas contribution. To control costs and reduce the impact on the environment, UNBC will reduce energy consumption, and switch to renewable fuel sources wherever possible.

3.1.1.1 Overall Consumption

The electrical and thermal energy consumption of all UNBC campuses will be reduced by 10% by 2015 (relative to 2009/10).

Both electrical consumption and natural gas consumption will be reduced by 10%. Electrical reduction will be calculated based on the energy intensity in kWh per square meter of building space. Any campus expansion will only influence this reduction by the amount that the new space is above or below the average energy intensity for the overall campus. Energy intensity values will also be normalized for variations in enrolment and weather.

3.1.1.2 Fossil Fuel Reduction

UNBC consumes fossil fuels (natural gas, propane and diesel) for space heating at a number of sites. Fossil fuel consumption is not deemed to be sustainable, so we will reduce their consumption by 80% by 2015.

The baseline consumption will be the 2009/2010 fiscal year, with consumption in subsequent years being corrected for weather, enrolment and campus square footage.

The aim is to reduce fossil fuel consumption at all campuses, but the performance will be measured on an aggregate basis. The BioEnergy facility at the Prince George campus is expected to reduce the fossil fuel consumption of the entire University by 69%. Conservation projects that reduce the amount of thermal energy required will contribute to both this reduction target and the overall energy reduction target listed above.

The combustion of fossil fuels represents the major source of greenhouse gas (GHG) emissions for the University. By switching our thermal energy needs to non-fossil based energy sources we will dramatically reduce our GHG emissions.

3.1.2 Renewable Sources

UNBC aims to supply all of the Prince George campus energy needs through renewable sources. Wherever practical, this will involve on-site generation or conversion so that a high degree of monitoring and oversight can be maintained.

Renewable energy sources will be explored at all campuses, as each site has unique opportunities.

As we progress towards being a leader in renewable energy, we recognize that the first steps on this journey involve sub-metering metering to understand our current energy picture, and the application of conservation initiatives to reduce our energy requirements such that they can match the available renewable energy.

3.2 Sustainability Policy

The vision, objectives, and strategies contained in the UNBC Green Strategy, Phase 1 (2009-2011) are designed to guide all UNBC activities relative to sustainability over the two-year period from 1 July 2009 to 30 June 2011. The full text of this policy is included in the Appendix.

UNBC is located in one of the world's most magnificent natural settings – naturally beautiful British Columbia. It is also situated in the midst of one of Canada's major centers of resource extraction – timber, minerals, oil & gas, and fish. It is also situated in an area experiencing environmental degradation – local air quality, water pollution, solid waste disposal, ecosystem degradation, and climate change.

As a result of the confluence of natural setting, resource extraction, and environmental degradation, UNBC has naturally emerged as a small but powerful leader in teaching and researching the full scope of human-environment interaction, and putting what we learn into practice to achieve sustainability. This is the foundation upon which we, as Canada's Green University, will continue to build.

3.2.1 UNBC's Green University Vision

Our vision is:

- To make UNBC a sustainable campus
- To engender a 'spirit of sustainability' in the UNBC community
- To make the UNBC campuses models of sustainability for communities and organizations in Northern British Columbia
- To improve on our national and international reputation for excellence in teaching and research in the area of sustainability.

4. UNDERSTANDING OUR SITUATION

UNBC operates in a northern climate with cold winters and long hours of summer sun. The winter months are when campus occupancy is highest, it is also when the heating and lighting loads are greatest.

Campus facilities are mainly served with both electrical and natural gas from the provincial grids. A new Bioenergy facility was completed at the Prince George campus; this will provide most of the space heating for the main campus from waste wood. This will result in a dramatic reduction in fossil fuel consumption by the university.

4.1 Energy Consumption and Costs

The table below lists the actual consumption and cost for each of the University utilities, based on invoiced amounts.

Utility *(Apr 2010 – Mar 2011)*	Consumption	Unit	Costs $	Costs %
Electricity	18,961,000	kWh	1,184,000	49%
Natural Gas	99,000	GJ	1,045,000	43%
Bio Fuel	720	BDT	74,000	3%
Water and Sewer	86,000	m^3	125,000	5%
Propane	8,100	L	5,900	
Diesel (Plant)	4,700	L	N/A	
Total			**2,433,900**	

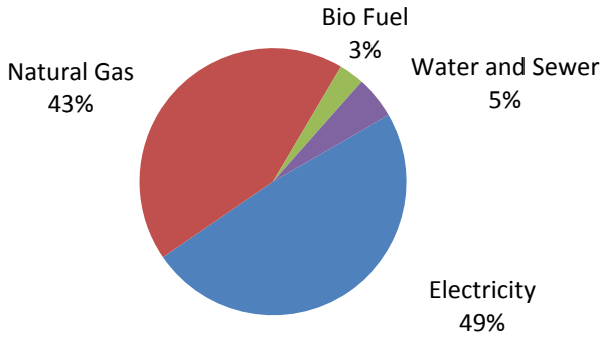

Figure 1 Utility Cost Breadown for Apr 2010 - Mar 2011

Diesel is used for the emergency electrical generators, and as a back-up fuel for the natural gas boilers in the Power Plant. Propane is used to heat the Maintenance Shop on the Prince George campus. Fuel for vehicles and mobile equipment is not included within the scope of the energy management program.

Bio fuel was added to the utility mix in November 2010 when the new BioEnergy facility came online. Waste wood (hog fuel) is purchased from a local sawmill, and trucked to the campus. The moisture content of the fuel varies with wood species, beetle killed wood, and percentage of bark; the billing is based on the theoretical dry weight of wood delivered, measured in Bone Dry Tonnes (BDT).

Figure 2 shows the monthly breakdown of consumption and demand charges for electrical billing. The cost is relatively constant throughout the year, with air conditioning load bringing up the consumption in what would otherwise be the lower summer months. This is aggregate electrical data, and includes all of the utility accounts that fall within the scope of energy management at UNBC.

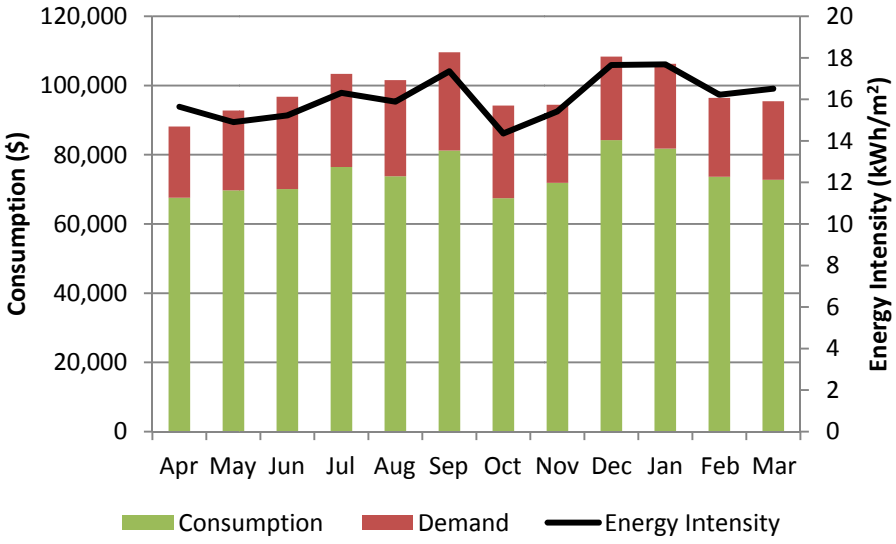

Figure 2 Aggregate Electrical Billing Summary

Figure 3 shows the monthly natural gas consumption and demand cost breakdown. The cost for this utility follows the amount of heating required throught he months of the year. The drop in consumption observed for January of this past year is due to the operation ofhte BioEnergy facility. It is expected that the consumption for the coming year will follow a different pattern as that system offsets the amount of gas required for heating. An aggregate billing summary for bio fuel will be included in future editions of this report.

The natural gas demand charges are s small percentage of the total, primarily because they are only broken out separately on the main boiler account.

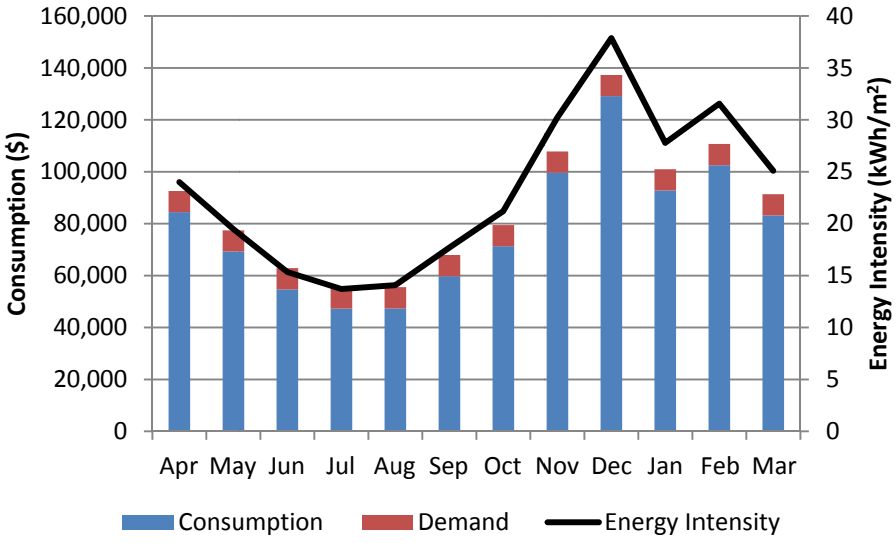

Figure 3 Aggregate Natural Gas Billing Summary

4.2 Savings Opportunity Assessment - Energy Consumption & Cost Intensity

The energy intensity of each building is reported in the figure below. Note that the Main campus account includes all buildings that are supplied with electrical power and heating/cooling water from the Power Plant. Future sub-metering will permit a breakdown of energy use by specific building.

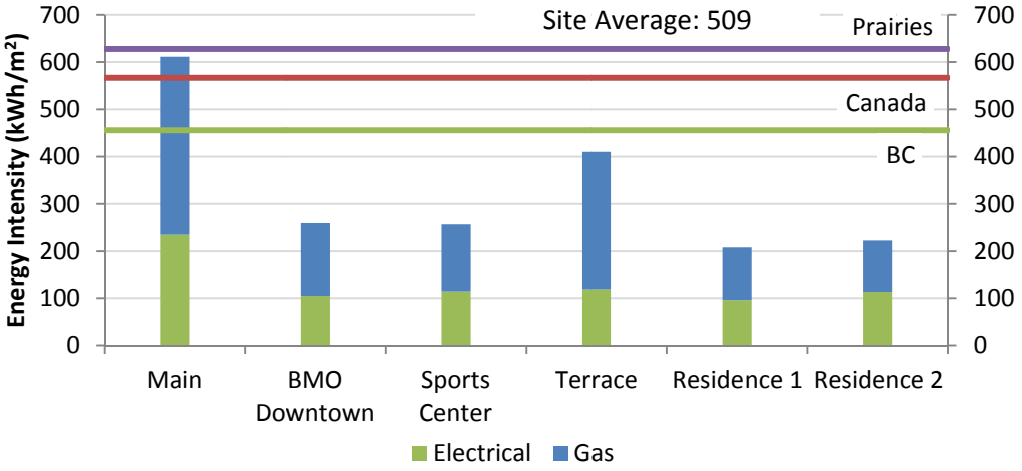

Figure 4 Energy Intensity by Building

The Terrace campus building has high gas consumption; a new and more efficient boiler was installed in October 2010 to address this.

The horizontal lines in the above figure are the Natural Resources Canada average intensity values for universities and colleges in each of the three regions listed. Each of these buildings have different uses, and should be compared against separate baselines based on usage (i.e. apartments, offices, recreational complex). Such baseline data is not always readily available, though it is anticipated that an updated Statistics Canada survey conducted in 2010 will yield more current and specific baseline information.

4.2.1 Heating Intensity

Figure 5 below indicates the estimated heating intensity (energy per unit floor area) for the majority of the UNBC facilities. The three builings with siginificant laboratory space (Research Lab, Teaching Lab and Health Sciences) have high heating demand due to the outdoor air make-up requirements. The Power Plant also requires a high volume of make-up air for the boiler combustion.

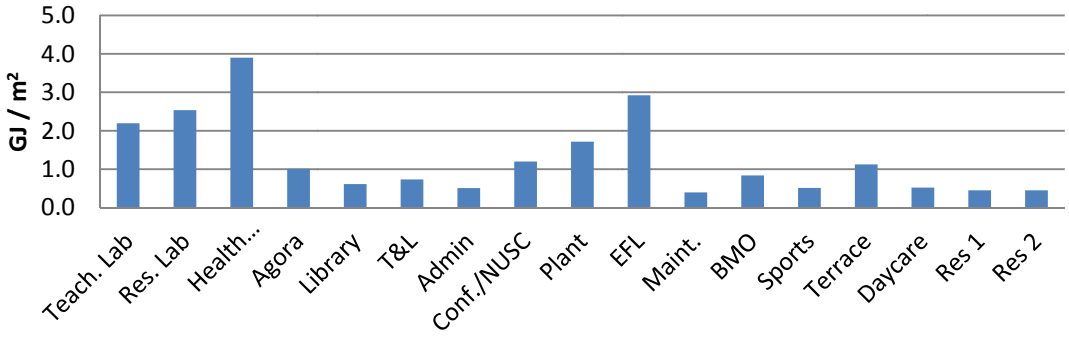

Figure 5 Heating Intensity for UNBC Buildings

5. OUR ACTIONS

UNBC has a history of responsible energy use. Facilities staff involved in plant operations and renovation projects are well versed in efficient operating practices and in the evolving energy efficient equipment landscape. The Energy Manager position was filled in June 2010; this has resulted in a renewed focus on tracking of energy use, developing an energy policy and conservation procedures, and planning efficiency upgrade projects.

5.1 Sub-metering

The first step in managing energy use is to understand where the current consumption is. To this end UNBC is installing sub-meters in buildings throughout the Prince George campus. Regional campuses are typically housed in a single building with independent utility accounts. Historical consumption can be measured from the billing history. The Prince George campus has main electrical and natural gas accounts that supply the Power Plant. This does not provide any consumption data for the individual buildings within the campus. The sub-meter installation will provide consumption data for:

- Electrical use (includes consumption, demand, and power factor)
- Heating water (a hot water district energy network heats the buildings)
- Cooling water (a chilled water district energy network cools the buildings)
- Natural gas (for the Agora cafeteria, and NUSC/Conference buildings)
- Domestic water

These sub-meters will all be connected to the campus control system for automatic data logging. Consumption readings will be taken on fifteen minute intervals to provide sufficient resolution for building performance dashboards and to support prompt detection of abnormal consumption patterns.

5.2 Energy Policy

The Energy Policy (outlined in section 3.1and included in the Appendix) articulates the vision, goals and commitment of the University to responsible energy use. The long term goal is to obtain energy intensity reduction of 10% by the year 2015 (5 years) by implementing cost-effective energy management initiatives at all of our facilities.

Energy conservation procedures will be developed in support of the Energy Policy. These include:

- Lighting, heating and air conditioning procedures;
- Energy efficient purchasing procedures.

5.3 Energy Conservation Revolving Loan

UNBC has created a revolving loan fund to provide the capital required for energy efficiency upgrade projects. The aim is to establish a sustainable source of funding for the energy management program: upgrade projects and the Energy Manager salary (once the BC Hydro funding runs out) will be supported by this fund.

Project spending is expected to average $200,000 per year. The Energy Manager wages will be paid from the fund (costs over and above the BC Hydro contribution until the funding round ends, then the full cost thereafter). The average project payback is expected to be 4.8 years for the first five year window, with projected energy reductions of 12.5% in that time.

Initial funding consists of a $250,000 one-time investment in April 2011. The Continuous Optimization program funding (refer to section 5.4 below) would not be drawn from this fund, but the energy savings and cost reimbursements would be added to the initial fund investment. In this way the total investment would be $405,000 over the first three years.

Electrical energy cost savings will be re-invested into the Energy Conservation Revolving Loan Fund. The difference between the budget allocation for electrical and the actual amount spent will be transferred into the fund at fiscal year end. This will capture the savings from all electrical

efficiency projects, as well as behaviour based initiatives to reduce consumption. The budget allocation in future years will be based on the current allocation plus an adjustment based on expected utility rate changes. Incentives from BC Hydro or FortisBC will also be returned to the revolving loan fund.

Projected spending, savings and rebates are listed in table Table 2.

Table 2 Energy Conservation Revolving Loan Budget

Year	Investment	Project Budget	Savings	Reimbursement
2011/2012	291,000	243,000	17,000	46,000
2012/2013	62,000	310,000	81,000	137,000
2013/2014	52,000	229,000	168,000	92,000
	405,000	**782,000**	**266,000**	**275,000**

5.4 Continuous Optimization Program

UNBC intends to participate in BC Hydro's Continuous Optimization program for energy monitoring and retro-commissioning of existing buildings. The program at UNBC would include nine buildings over a period of six years. It provides a reference against which to measure energy savings, and focuses primarily on low cost operational improvements to a building's HVAC and lighting control systems.

Major elements of the program include:

- Energy management software: This system would aggregate campus meter data and display actual and predicted energy usage for each building;
- Re-commissioning consultant: A consultant conducts an audit of each building and identifies low cost changes that will improve the efficiency of the systems;
- Upgrade projects: Identified projects with less than two year simple payback will be implemented, with assistance from the consultant;
- Monitored savings: The energy software permits the actual energy savings to be computed, and the consultant returns to provide coaching on ensuring that the energy savings persist.

A program of re-commissioning represents the major opportunity for UNBC to reduce its energy consumption. The main campus infrastructure is reasonably efficient, and not yet nearing the end of its life.

The intention is to have the building commissioning consultant consider all of the core buildings as a group. These were previously commissioned separately as each building was completed; their connected nature links the heating and air handling systems, and necessitates balancing as an entire system.

The energy management software includes dashboards for occupant engagement, summary reports for management, and anomaly detection to notify facility operators. These analytics and reporting functions build on the metering that is being installed with the Infrastructure Upgrade project and will provide the data to drive UNBC energy management moving forward.

The upgrade projects to be implemented under this program must have less than two year simple payback. These represent the truly "low hanging fruit" and are projects that should be considered for implementation whether UNBC participates in C.OP or not. Participation in the program provides a fully funded consultant to identify and develop these projects, and the verification required to ensure that the savings are realized.

5.5 Quarterly Goals and Objectives

The energy management goals are two-fold: to reduce energy consumption, and to save money on utilities. The two are linked, but the amount spent on utilities is dependent on both consumption and utility rates.

This past year UNBC realized a 2.4% reduction in electricity consumption (over the previous year). However, an 8% increase in electrical rates resulted in a net cost increase of $66,647 for electricity purchases. It is necessary to take into account weather variations, rate changes and historical consumption levels to compare actual costs against what we would have sent had we not reduced our consumption. This is what is reported as avoided costs in Table 3 below.

Table 3 Quarterly Electrical Savings

	Previous Years Quarterly Consumption (kWh)		Actual Savings					Total Savings
Quarter	2009/10	2010/11	kWh	% Reduction	$ †	Actual Cumulative Savings	Avoided Costs	Total Cumulative Savings
Q1 Apr-Jun	4,561,480	4,475,320	86,160	1.9%	$ (16,307)	$ (16,307)	$ 6,417	$ 6,417
Q2 Jul-Sep	5,129,560	4,845,640	283,920	5.5%	$ (14,957)	$ (31,265)	$ 122	$ 6,538
Q3 Oct-Nov	4,784,600	4,657,000	127,600	2.7%	$ (20,041)	$ (51,305)	$ 4,400	$ 10,938
Q4 Jan-Mar	4,952,480	4,983,440	(30,960)	-0.6%	$ (18,437)	$ (69,742)	$ 12,961	$ 23,899
TOTAL	19,428,120	18,961,400	466,720	2.4%	$ (69,742)	$ (69,742)	$ 23,899	$ 23,899

† *Actual savings are measured against the same time period in the previous year. A significant rate increase in April 2011 resulted in a higher electricity cost (negative savings) despite a reduction in actual energy consumption.*

Actual savings represents the actual dollar impact on the budget, but does not account for variations in weather or campus utilization.

Avoided cost takes into account the primary drivers of energy consumption, and is therefore a measure of the dollars saved through conservation efforts.

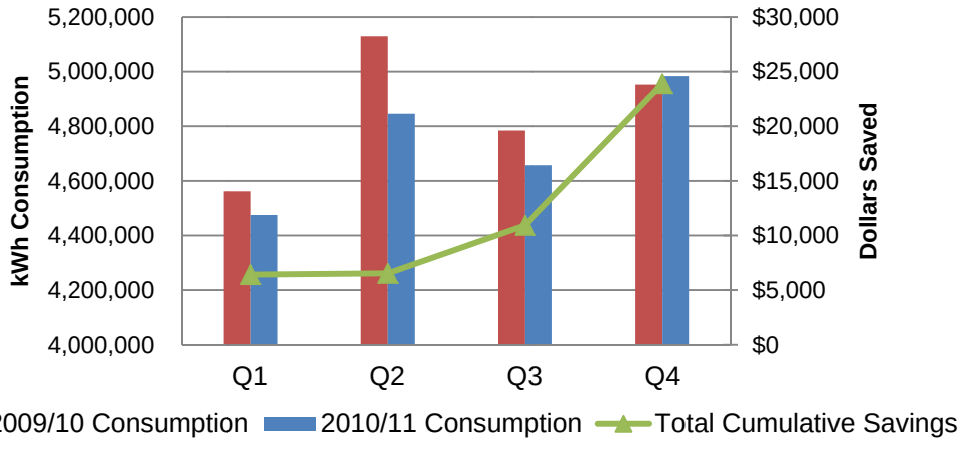

Figure 6 Annual Electrical Utility Summary Electrical Savings over 1 year

It is possible to model the university's energy consumption: energy use is primarily driven by the weather, but also influenced by the key performance indicators listed in Table 1. A baseline predictor of energy use is such a model fit against historical data from a period of "normal"

operations. A baseline model for each energy utility account provides a prediction of how much energy would have been consumed had there been no conservation efforts. This permits a calculation of the energy savings that takes into account variations in the weather, enrolment and other factors. The energy savings multiplied by the marginal cost of additional energy yields the value of the costs avoided through the conservation measure.

5.5.1 BioEnergy and Natural Gas Savings

UNBC has undertaken two biomass heating projects in recent years. The first was a wood pellet boiler to heat the Enhanced Forestry Laboratory, and the second is a BioEnergy facility to offset the campus heating load. The BioEnergy system gasifies hog fuel and uses a flue gas boiler to transfer heat to hot water, and on to the existing Power Plant. The campus district energy loop then distributes hot water to the core campus buildings.

The BioEnergy system is designed to offset 85% of the natural gas consumed for campus heating. The system was first brought online in November 2010, and has undergone commissioning since then. Figure 7 compares the actual gas consumption over the past two years against the baseline predicted by heating degree days.

Natural gas consumption was 14% lower than baseline for the 2010/2011 year. The solid line shows actual consumption, with a marked deviation from the baseline starting in November 2010. Due to the repeated starting and stopping involved in the commissioning process, the full natural gas offset has not yet been realized.

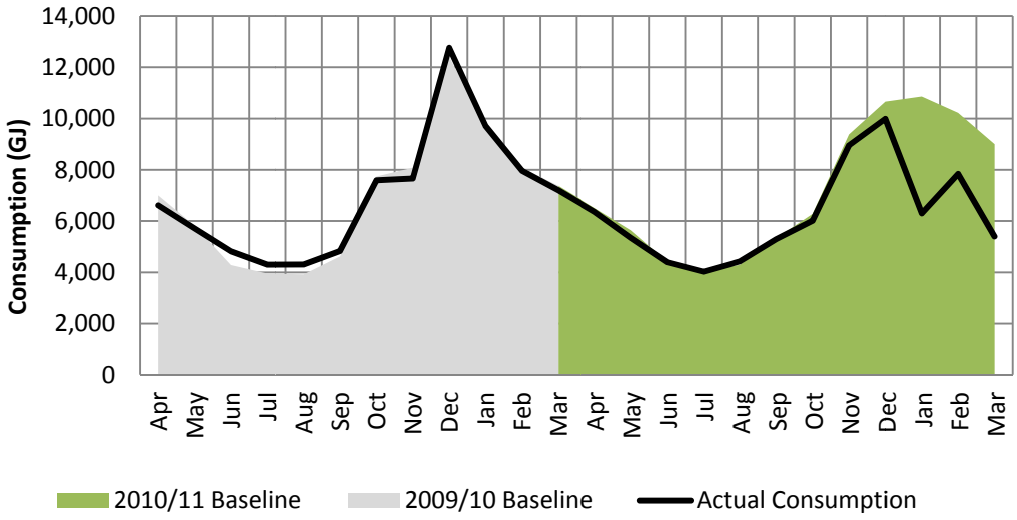

Figure 7 Annual Natural Gas Consumption by the Power Plant Boilers

The operating budget for the BioEnergy system will be drawn from natural gas savings. Costs that must be covered include hog fuel, operator salaries, building utilities and maintenance. This project is in the final stages of wrap-up; the processes for tracking these savings and costs are still under development. Tabulation of natural gas (and hog fuel) consumption by quarter will be included in next year's version of this report.

Energy Manager Program Results

5.6 Annual Goals and Objectives

The 2009/2010 fiscal year was selected as the baseline training period for all of the UNBC energy accounts. Energy savings and avoided costs will be measured against the baseline consumption predicted by this model.

Figure 8 below shows the cumulative difference between actual electricity costs and the costs which would have been incurred had consumption been equivalent to the baseline 2009/2010 year.

This is a cumulative savings chart, so it is the slope of the line that indicates whether energy consumption is above or below average. A positive slope indicates actual energy costs that are above normal, while a negative slope indicates avoided costs. For fiscal year 2008/2009 the costs were higher than baseline (positive slope to the curve), while fiscal year 2010/2011 has reversed that trend.

Table 4 Annual Electrical Savings

		Actual Savings					Total Savings
	Total kWh Consumption	kWh Comparison from previous year	% Reduction	$ Saved	Actual Cumulative Savings	Avoided Costs	Total Cumulative Savings
2007/08	18,728,400	(506,800)	-3%	$(139,462)	$(139,462)	$(745)	$(745)
2008/09	19,583,640	(855,240)	-5%	$(104,894)	$(244,356)	$(11,828)	$(12,573)
2009/10	19,428,120	155,520	0.8%	$(46,335)	$(290,690)	$(12)	$(12,585)
2010/11	18,961,400	466,720	2.4%	$(69,742)	$(360,432)	$23,899	$11,313

Electricity utility costs have increased for each of the past four years. This is due to increased energy rates in each of the years, and consumption increases in the first two years. Thus the actual dollars saved is negative in Table 4.

For the 2010/2011 fiscal year (first year with an Energy Manager in place) the overall consumption decreased by 2.4%, but a rate increase of over 8% resulted in a slightly higher overall electrical expenditure ($69,742 higher than the previous year).

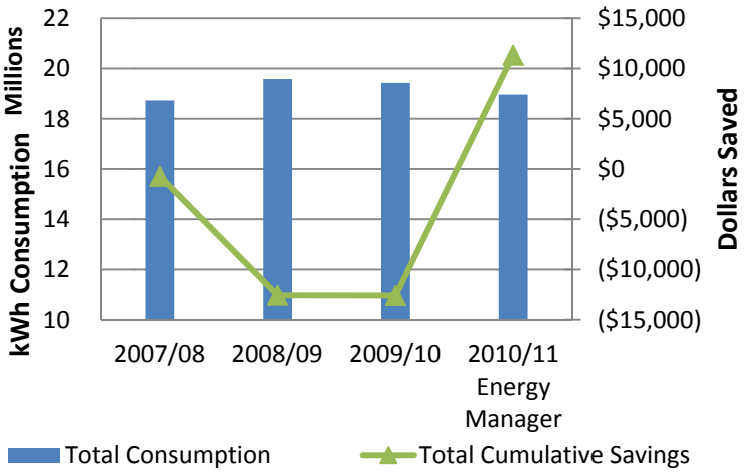

Figure 8 Energy Manager Results

5.7 Annual Energy Intensity by Key Performance Indicators

Our energy reduction target is an intensity target: it is based on energy consumption per square meter, with corrections for weather and enrolment. The policy intensity identified in the table below is what our performance will be measured against.

	Total kWh Consumption	Energy Intensity (kWh/m^2)	Policy Intensity (kWh/m^2)	Notes
2007/08	18,728,400	19.5		
2008/09	19,583,640	16.7		Completed T&L Building and Northern Sports Centre
2009/10	19,428,120	16.6		
2010/11 Energy Manager	18,961,400	16.1	16.14	Policy is 10% reduction by 2015
2011/12			15.7	
2012/13			15.3	

Figure 9 provides a graphical representation of the same data. The bars indicate consumption in million kWh. The baseline year of 2009/2010 has identical target and actual consumption amounts; the target consumption in 2010/2011 accounts for the specific weather of that year. Target consumption amounts for future years are based on the average weather over the past three years, and assume no significant changes in enrolment or increase in campus area.

The actual energy consumption in 2007/2008 was much higher than target, if the 2009/2010 consumption is used as a baseline. This indicates that the operating mode of the campus has increased in efficiency in the intervening years.

The significant drop in energy intensity between 2007/2008 and 2008/2009 is due to the completion of the Teaching and Learning Building and the Northern Sports Centre. These two buildings increased the energy consumption of the campus, but the additional area caused a reduction in the overall energy use per square meter. This illustrates how new construction with a lower energy use per square meter than the existing campus average will reduce the overall campus energy intensity and help in achieving our reduction targets.

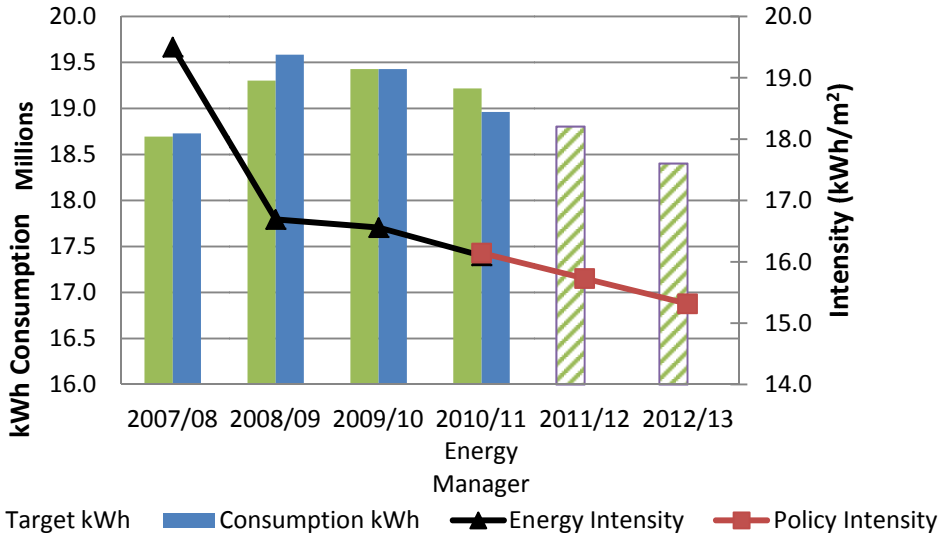

Figure 9 Annual Energy Target

5.8 Communication Plan

This Strategic Energy Management Plan has been developed primarily for the purpose of documenting and reporting on the energy management program at the University of Northern British Columbia. The initial version is for submission to BC Hydro as part of the requirements for their continued funding of the Energy Manager.

However, it is recognised that the information in this report could be useful to a much wider audience. The initial version will be circulated to the UNBC President's Executive Council for information. It is anticipated that the document will then be re-published as an UNBC Energy Management Update. This version will be posted to the University website and made available to all stakeholders and the general public.

A plan such as this one is never truly complete, and this document will be revised and updated for subsequent years of the UNBC Energy Management Program.

5.9 Planned Actions (Project List)

Energy Management Assessment (EMA) - Technical Projects

Potential Projects

Project Name	Description	Potential Electrical Svgs (kWh)	Potential Other Fuel Svgs	Potential Total Svgs (Energy + Operational)	Projected Total Cost	Potential BC Hydro Incentive	Projected Simple Pay Back	Next Steps
Residence Lighting	Replace T12 fluorescent lighting in residences with T8	76,000	0	11,440	43,400	28,000	1.1	Select fixture, evaluate scope re: other lighting within the suites
Lab Fume Hood Review	Turn off fume hoods when not required - consolidate off-hours use	32,600	365	12,640	16,200		1.3	Discuss with lab personnel, review HVAC code requirements
Building Systems Scheduling (C.Op)	Optimize night setback hours for all buildings on campus	450,000	2,855	38,800	124,300		3.2	Review current building schedules, will likely be included in Continuous Optimization project scope
Wind turbine	Preliminary investigation into installing wind generation on campus	80,000		5,600	375,000		67.0	Project development will not proceed
Residence Occupancy	Occupancy sensors to reduce heat when unoccupied	430,000		25,800	200,000		7.8	Review with Residence Life personnel
Ice Mountain	Store ice/snow for summer cooling							Promote as ENSC 417 group project in 2011
District Energy Pump Study	Review system flow dynamics and pumping requirements for district energy distribution loops	10,000		800	0			Mechanical engineering exchange student will commence this in January 2011
NSC Soccer Lighting – I	Replace MH hi-bay lighting with robust LED	7,300		1,500	46,000	29,900	11	Obtain project approval from Northern Sports Centre
NSC Soccer Lighting – II	Replace MH hi-bay lighting with robust T5HO	8,800		1,800	52,000	33,800	10	Specify replacement luminaire, obtain project approval
Terrace T12 Lighting	Replace T12 fluorescent lighting with T8	13,800		1,400	11,100	7,200	3	Site review of existing lighting, detailed budget preparation
LED Streetlights	Upgrade to LED streetlights	400,000		33,000	100,000		3	Review costs and savings, develop project proposal
T8 Magnetic Ballasts	Replace magnetic ballasts with electronic for core campus lighting	500,000		74,000	350,000	200,000	2	Identify funding, develop project plan
Totals		**1,998,500**	**3,220**	**205,980**	**1,318,000**	**298,900**		

Approved Projects

Project Name	Description	Est Electrical Svgs (kWh)	Est Other Fuel Svgs	Est Total Svgs (Energy + Operational)	Est Total Cost	Est BC Hydro Incentive	Simple Pay Back	Next Steps	Est Start Date
Admin Chiller	Replace water cooled centrifugal chiller with air cooled model	64,700	9600 Gal	13,400	35,000	0	2.6	Review design then tender installation	Apr-11
Thirsty Moose Lighting	Replace halogen and incandescent lighting with LED	5,500		400	3200	2000	3.0	Purchase and install lamps	Aug-11
Medical AV Cooling	Cooling for AV booth, independent of building chiller					0		Prepare options analysis, then detailed design	Oct-11
Totals		**70,200**	**9,600**	**13,800**	**38,200**	**2,000**			

Projects In Progress

Project Name	Description	Electrical Svgs (kWh)	Other Fuel Svgs	Total Svgs (Energy + Operational)	Total Cost	BC Hydro Incentive	Simple Pay Back	Status	Date Started	% Complete	Projected Completion Date
Atrium Daylight Harvesting	Install daylight sensor and turn off atrium lighting during daylight hours	76,200	0	11,440	17,200		1.5	Sensor installed, review switching capabilities	Sep-10	15	Jun-11
Infrastructure Upgrade	Additional piping and metering for campus district energy system	0	0	To come	5,000,000	0		Finalizing energy sub-meter installation	Apr-10	90	Aug-11
Totals		**76,200**	**0**	**11,440**	**5,017,200**	**0**					

Past/Completed Projects											
Project Name	**Description**	**Electrical Svgs (kWh)**	**Other Fuel Svgs**	**Total Svgs (Energy + Operational)**	**Total Cost**	**BC Hydro Incentive**	**Simple Pay Back**	**Status**	**Date Started**	**% Complete**	**Projected Completion Date**
Bio Energy Plant	Waste wood gasifier to replace natural gas boilers for campus heat	-1,243,200	80,000	To come	15,700,000	0		Equipment installed, building under construction	Apr-10	95	Jan-11
Canfor Theatre Lighting	Replace Canfor Theatre incandescent lighting with LED	3,700	0	3,600	6,000	0	1.7	Complete	Aug-10	100	Aug-10
Ring Road Streetlights	Preliminary Study of street lighting options							Review complete - need to evaluate options			
Terrace Boiler	Replace aging natural gas boiler for Terrace campus	0	300	300	45,000	0	150		Aug-10	100	Oct-10
Green Centre Lights	New Green University Center offices - LED lighting	1,240		80	640		8.0		Nov-10	100	Jan-11
Winter Garden Lights	Convert to Hi-Bay LED	2,630		170	640	0	3.8		Dec-10	100	Jan-11
Totals		**-1,235,630**	**80,300**	**4,150**	**52,280**	**0**					

Behavioural/ Education Programs (If applicable)								
Project Name	**Description**	**Electrical Svgs (kWh)**	**Total Svgs (Energy + Operational)**	**BC Hydro Incentive**	**Objectives**	**Date Started**	**% Complete**	**Projected Completion Date**
Residence competition	Two residence buildings compete to lower electrical consumption	2400	150	0	Raise conservation awareness in residences; reduce consumption	1-Oct-10	100	Apr-11
Totals		**2400**	**150**					

Descriptions
Project Name – An identifier of the project, possibly a project name, number or location
Date – The date the project was identified or listed on the table
Energy Conservation Measures – The type of technology, whether it be lighting, HVAC, motors, etc
Type of Activity – Describe the type of project, whether it be retrofit, Recommissioning, operational, etc

Projects in Progress
Project Start Up Date – The date of the study or audit
Estimated Project Cost – Total capital or operational cost of the project
BC Hydro Incentive – If applicable, total incentives received by BC Hydro
Other Applicable Incentives – If applicable, total incentives received from others (provincial government, NRCan, etc)
Total Net Project Costs – Total capital or operational costs after incentives

6. APPENDIX

Number of stakeholders	18 individual groups identified	
Energy Manager	David Claus	
Executive Support	George Iwama	(President)
	Mark Dale	(Provost)
	Eileen Bray	(VP Finance)
	Rob van Adrichem	(VP External Relations)
Energy Committee	Energy Sub-Committee of the Green University Planning Committee	

6.1 List of Stakeholders:

Groups		
Name	Title	Organization
George Iwama	President	UNBC
John Young	Dean of CASHS	UNBC
Daniel Ryan	Dean of CSAM	UNBC
Eileen Bray	Vice President Admin and Finance	UNBC
Rob van Adrichem	Vice President External Relations	UNBC
Shelley Rennick	Director, Facilities Managment	UNBC
Doug Carter	Assistant Director of Physical Plant, Sustainability, and Capital Projects	UNBC
UNBC Students		UNBC
Potential Professors		UNBC
Ron Mastromonaco	Key Account Manager	BC Hydro
Denis Light	Commercial Account Manager	FortisBC
Greg Stewart	President	Sinclar Group Forest Products
John Yap	Minister of State for Climate Action	BC Government
Maomi Yamamoto	Minister of Advanced Education	BC Government
Scott MacDonald	Chief Executive Officer	Pacific Carbon Trust
UNBC Faculty		
UNBC Staff		
Northern Residents		
General Public		

6.2 List of Energy Volunteers

Individuals		
Name	Title	Organization
Shelley Rennick	Director, Facilities Managment	UNBC
Doug Carter	Assistant Director of Physical Plant, Sustainability, and Capital Projects	UNBC
Aaron Olsen	Maintenance and Project Supervisor	UNBC
Kyle Aben	UNBC Pacific Institute for Climate Solutions Site Coordinator	UNBC/PICS

6.3 Baseline Energy Use: Account Histories

Main Campus Account

Month	Energy Charge $	Demand Charge $	Power Factor Charge $	Other $	Taxes $	Total Charges $
Mar-11	50,354.95	19873.06	0	-28.95	8,423.89	78,622.95
Feb-11	51,198.10	20137.72	0	-27.92	8,556.95	79,864.85
Jan-11	58,452.60	21004.01	0	901.10	9,642.93	90,000.64
Dec-10	60,613.56	20217.92	0	1,299.06	9,855.66	91,986.20
Nov-10	53,445.24	18557.78	0	1,137.11	8,776.82	81,916.95
Oct-10	49,106.52	22022.42	0	1,003.10	8,655.84	80,787.88
Sep-10	59,481.72	23145.22	0	1,248.13	10,065.01	93,940.08
Aug-10	54,954.36	22639.96	0	1,141.02	9,448.24	88,183.58
Jul-10	56,840.76	22214.9	0	1,428.88	9,629.58	90,114.12
Jun-10	53,633.88	21717.66	0	1,422.42	9,176.17	85,950.13
May-10	51,558.84	18445.5	0	1,376.19	8,531.54	79,912.07
Apr-10	52,598.88	17485.25	0	-101.33	8,364.47	78,347.27

6.4 Current Business Practice Gaps

The Energy Management Assessment for this year was conducted on May 20, 2011. This was an opportunity to review progress made to date and identify areas for future action within the context of Energy Management at UNBC. The original EMA was performed in March 2008.

The action items identified in the original EMA, and progress made to date are outlined below.

1. Demonstrated Corporate Commitment
   - UNBC is strong in this area (Bioenergy, Renewable Energy in Action Plan)
   - Energy Policy is a key part of this
2. Understanding of Performance and Opportunities
   - Baseline energy consumption models have been assembled for each of our utility accounts (see attached consumption report for electrical)
   - Comprehensive Energy Study (May 2009) identified many opportunities, and summarized performance
   - Energy meter installation (currently underway) will result in more detailed understanding of relative energy consumption between buildings
3. Accountabilities
   - Filled the Energy Manager role (also PICS Coordinator and Sustainability Manager)
   - In the process of creating an Energy Sub-Committee of the Green University Planning Committee
   - More work can be done in this area, specifically around identifying individuals to be kept informed of energy consumption trends for university "sub-groups" (i.e. NSC, residence, NUSC, retail services)
4. Resourcing
   - Energy Manager provides some of this
   - The Facilities Department has had some vacant positions over the past year, but these positions are now (mostly) filled, which will address some of the resourcing requirements
   - Outside contractors have assisted with implementation of some initiatives (particularly energy meter installations)
5. Reporting, Feedback and Control Systems
   - Periodic reports on energy consumption have been prepared (see attached electrical consumption chart), though these are manually compiled and based on monthly data only
   - Enrollment in the Continuous Optimization program will result in much more detailed reporting (for operations personnel)
   - Currently installing 79 energy and utility meters