Strategic Energy Management Plan

University of Northern British Columbia

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Table of Contents

1. INTRODUCTION

As Canada's Green University™, the University of Northern British Columbia is committed to "green" and sustainable activities in every aspect of our operations. Using energy efficiently and employing clean, renewable energy is considered by many to be a critical part of being green. With raised awareness of the environmental impacts of energy use, UNBC is committed to minimizing our environmental impact by reducing energy consumption through energy efficiency projects, student engagement, and awareness campaigns; and showcasing renewable and efficient energy systems that are of particular interest to northern and remote communities.

With the recent announcement of increasing electricity rates in British Columbia, the importance of the Energy Management Program at UNBC is highlighted. Without electricity reduction efforts, UNBC would see a 34% increase in electricity costs over the next five years, totalling 1 Million extra dollars spent. Continuing with the planned energy conservation projects, the cost of electricity is expected to remain constant over the next 5 years.

1.1 Energy Manager Program

The BC Hydro Energy Manager program provides funding to public sector organizations to hire or designate an Energy Manager. Funding covers up to 75% of the cost of the salary and is contingent upon meeting a number of requirements including meeting a specified energy savings target, submitting a Strategic Energy Management Plan, and completing quarterly presentations to UNBC and BC Hydro.

UNBC is currently in the 4th year of the Energy Manager program. The program covers UNBC owned and operated facilities including the Prince George Campus, Terrace Campus, Quesnel River Research Centre, and BMO Centre in downtown Prince George. Over the past three years in the Energy Manager Program has successfully brought in over $900,000 to UNBC including $205,000 in incentives, $161,000 in project savings, $271,000 in program enabled savings, and $303,000 in salary reimbursements.

1.2 Purpose Statement

In 2011 UNBC developed an Energy Policy outlining specific objectives related to energy reductions, renewable energy, and fossil fuel reductions. Compared to a 2009/2010 baseline, UNBC aims to:

1. Reduce electrical and thermal energy consumption by 10% by 2015
2. Provide 85% of core heating from renewable energy
3. Reduce fossil fuel consumption for heating by 80% by 2015

Reductions are measured using energy consumption per square meter of building space, and corrected for variations in weather. Based on the consumption in the 2009/2010 fiscal year, our conservation targets for FY2014 are 1,360,000 kWh for electricity and 9,000 GJ for heat. The two-year BC Hydro Power Smart base savings target is 1,482,000 kWh through implemented energy efficiency projects. Achieving these targets not only involves implementing energy efficiency projects, but requires the participation, engagement, and support of students, faculty, staff, and senior administration.

2. UNBC PROFILE

The University of Northern British Columbia was established in 1990 by the UNBC Act. The Prince George campus was constructed between1992-1994, and opened by Her Majesty Queen Elizabeth on August 15, 1994.

2.1 Facility Profile

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. In total, the energy management scope covers 22 buildings over four sites: the Prince George Campus, Terrace Campus, BMO Centre in downtown Prince George, and the Quesnel River Research Centre (QRRC). Of the 22 buildings, 16 are located at the Prince George Campus and account for 98% of the total energy consumption.

The Prince George Campus is supplied with electricity from BC Hydro through three accounts: the Power Plant which is distributed to the main campus, the Bioenergy Plant, and the Northern Sport Centre (NSC). Natural gas is supplied by Fortis BC to eight accounts on the Prince George Campus: the Power Plant, Agora/Conference Centre, Bioenergy Plant, Enhanced Forestry Lab (EFL), Keyoh Residence, Neyoh Residence, Daycare, and Northern Sports Centre (NSC).

Hog Fuel for the Bioenergy plant is supplied by Lakeland Mills and currently sourced from the Isle Pierre Sawmill, which is approximately 50 kilometres from the Prince George Campus. The hog fuel is gasified and combusted in the Bioenergy plant to provide the majority of the heating for the district heating system that serves the nine buildings of the core campus. The natural gas supplied to the power plant is used by the back-up boilers to provide peak and back-up heat to the district heating system. Sub-meters are installed at each building to record the distribution of electricity, heating, and cooling.

The other three sites are supplied with electricity from BC Hydro. Natural Gas is supplied by Fortis BC to the BMO Centre and by Pacific Northern Gas to the Terrace Campus. The QRRC only uses electricity.

2.2 Key Performance Indicators

Key performance indicators are the identified variables that drive energy consumption. 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 is 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 UNBC. 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				
	2013/2014	**2012/13**	**2011/12**	**2010/11**	**2009/10**
Floor Area (average gross, m^2)	98,827	98,827	98,827	97,404	98,129
Students (Headcount Nov 1)	3,456	3,588	3,625	3,622	3,675
Weather (Heating Degree Days)	3,642	3,975	3,918	4,208	3,909

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. A more detailed measure of building occupancy (such as student and faculty hours) is being examined for future energy reporting, but currently the level of detail is insufficient to develop a correlation between full time equivalent (FTE) enrolment and energy consumption.

In northern British Columbia, outdoor air temperature is a variable that changes significantly throughout the year and impacts the amount of energy consumed. Heating degree days (HDD) and Cooling Degree Days (CDD) are measures of the amount of heating and cooling required as the temperature changes. HDDs are calculated when the average daily temperature is below the reference temperature, and are calculated as the difference between the two temperatures. In the case of UNBC the reference temperature for HDD is 15.5°C where heating is required below this temperature. CDDs are calculated as the difference between the two temperatures when the average daily temperature is above the reference temperature. The reference temperature for CDD is 13.5°C, meaning cooling is required above this temperature.

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

2.3 Energy Management Budget

The Energy Management Program is funded through several different UNBC budgets including the Operations Budget, Energy Conservation Revolving Loan Fund, and Routine Capital Fund. BC Hydro provides funding for the Energy Manager salary and benefits, and incentivises energy efficiency projects through the Custom Program, Power Smart Express Program, and Continuous Optimization Program. Table 2 gives a breakdown of the Energy Management spending and income (denoted in red) for Fiscal Year 2014.

Table 2 Energy Management Budget Breakdown

Utilities	Operations Budget	$2,873,257
General Energy Management	Operations Budget	$12,600
EMIS (Energy Management Information System)	Operations Budget	$10,250
UDM (Utility Data Management)	Operations Budget	$5,000
Energy Efficiency Projects	Revolving Loan	$124,000
Energy Efficiency Projects	Routine Capital	$64,000
Energy Manager Salary and Benefits	BC Hydro	$50,000 - $75,000
Incentives	BC Hydro	$80,000
Revolving Loan Repayments	Operations Budget	$53,000
Total		$132,850 - $157,850

Recently the Routine Capital funding provided by the Provincial Government for capital improvements was reduced from $1.4 million to $241,000, which resulted in reduced funding for energy efficiency projects. UNBC responded by creating the Energy Conservation Revolving Loan in 2012 to fund energy efficiency projects where savings from the utilities budget are used to pay back capital investments and fund future energy efficiency projects.

The Operations budget of the University has been frozen for the current fiscal year. This constrains the Other Operating Expenditures, as labour costs include annual increases. All operating costs, including utilities, are being monitored very closely for any savings opportunities.

3. ENERGY COMMITMENTS AND TARGETS

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. In addition to the BC Hydro Energy Manager electricity savings target, UNBC has developed an Energy Policy outlining specific targets related to electricity reductions, thermal energy reductions, natural gas reductions, and renewable energy utilization.

3.1 Energy Policy Targets

To reduce the impact of increasing utility rates, and the impact on the environment, UNBC adopted an Energy Policy in 2011 that outlines targets related to reducing energy consumption, reducing fossil fuel consumption, and switching to renewable fuel sources.

3.1.1 Overall Consumption

The Energy Policy outlines a 10% reduction in electrical and thermal energy consumption by 2015 (relative to 2009/2010 baselines). Energy reductions are calculated based on the energy intensity in kWh per square meter of building space, and are normalized for variations in weather.

For FY2014, the policy targets for electricity and heat are 190 kWh/m^2 and 281 kWh/m^2, respectively.

3.1.2 Fossil Fuel Reduction

UNBC consumes fossil fuels (natural gas, propane and diesel) for space heating at a number of sites which represents the major source of greenhouse gas (GHG) emissions. The Policy target is an 80% reduction in fossil fuel consumption by 2015.

The baseline consumption is based on the 2009/2010 fiscal year, with consumption in subsequent years being corrected for weather 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 has already helped in reducing the fossil fuel consumption of the entire University by roughly 70%. 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.

3.1.3 Renewable Sources

UNBC aims to offset 85% of the natural gas for heating the core Prince George campus with renewable energy. The Bioenergy Plant, built in 2011, was designed to provide 85% of the core campus heating using renewable wood waste. In the past year, the Bioenergy Plant delivered 87% of the required heat to the campus.

3.2 BC Hydro Energy Manager Target

As part of the Energy Management program through BC Hydro, electricity reduction targets are set annually. The 2-year electricity conservation target for FY2014 and FY2015 is 1,482,000 kWh annual savings through incentive projects.

4. ENERGY CONSUMPTION AND COSTS

UNBC operates in a northern climate with cold winters and long hours of summer sun. The winter months are when campus occupancy is highest, and 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 and commissioned in early 2011 to provide most of the space heating for the main campus from waste wood. This resulted in a dramatic reduction in fossil fuel consumption by the university compared to the 2009/2010 baseline.

4.1 Overall Utility Consumption and Costs

Table 3 lists the actual consumption and cost for each of the University utilities, based on invoiced amounts.

Table 3 UNBC Utility Breakdown

	Feb 2013 - Jan 2014			FY2013 (Apr 2012 - Mar 2013)		
	Consumption		Cost	Consumption		Cost
Electricity	17,970,986	kWh	$1,289,971	18,480,910	kWh	$1,296,800
Bioenergy (Hog Fuel)	4,050	bdt	$270,297	4,023	bdt	$290,880
Natural Gas	33,951	GJ	$333,819	29,724	GJ	$289,141
Bioenergy (Pellets)	89	bdt	0	56	bdt	0
Water	81,894	m3	$163,603	79,112	m^3	$147,469
Propane	4,172	L	$3,535	4,222	L	$3,416
Diesel	1,344	L	n/a	1,773	L	n/a
Total			**$2,061,224**			**$2,027,706**

Figure 1 Utility Cost Breakdown for Apr 2012 - Mar 2013

Diesel and propane represent less than 1% of the total UNBC energy consumption and cost. 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.

The average costs of electricity, natural gas, and bioenergy are 7.1 ¢/kWh, 3.5 ¢/kWh, and 1.5 ¢/kWh, respectively. The differences in energy prices indicate that greater savings can be seen per kWh of electricity reduction compared to thermal reductions. In actuality, electricity savings for the majority of the UNBC accounts are valued at 9.56 ¢/kWh, the 2013/2014 marginal rate of electricity. The marginal rate of electricity is applied based on the actual electrical consumption compared to the historical three-year average electrical consumption. If electricity use is below the baseline, the difference in electricity is credited at the marginal rate. If more electricity is used compared to the baseline, the difference is charged at the marginal rate.

4.2 Historical Energy Consumption and Cost

Prior to the commissioning of the Bioenergy Plant in 2011, natural gas was used for the primary source of heating at UNBC. Bioenergy was first introduced to the UNBC utility mix in 2009 with the Wood Pellet Demonstration which heats a portion of the Enhanced Forestry Lab, but only represents 1-2% of the total UNBC heating load. Figure 2 shows the breakdown of primary energy use over time, and how the heating has been shifted from natural gas to bioenergy. In FY2014 natural gas consumption was reduced by 68% compared to FY2010. Overall energy

consumption has decreased by 3.3% since FY2010, which includes the addition of the Bioenergy Plant in 2011.

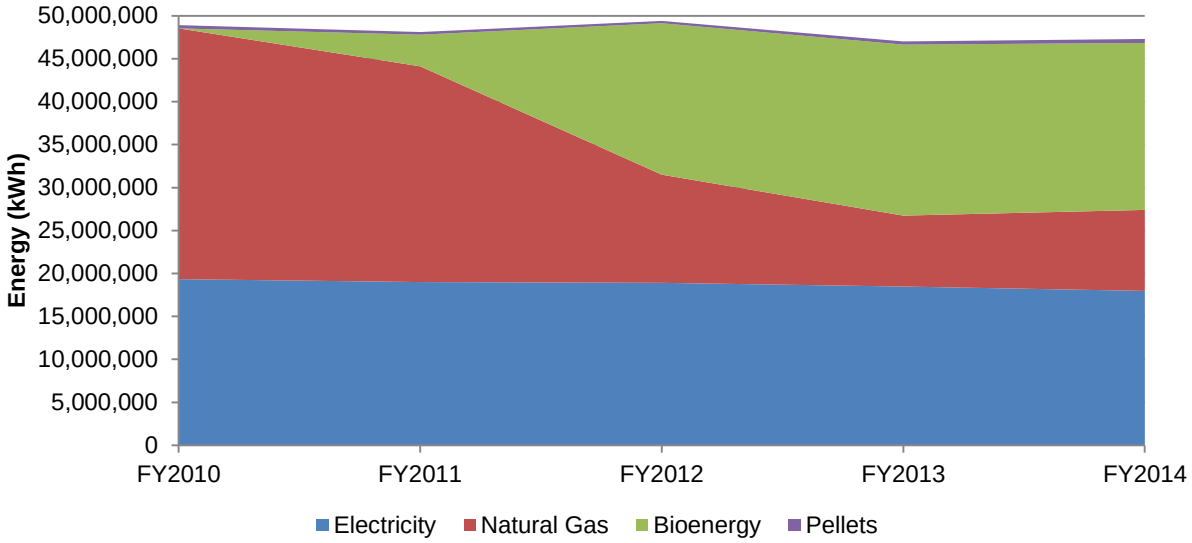

Figure 2 Historical Energy Consumption Breakdown

Figure 3 shows a decrease in energy costs of 12.8% from FY2010 to FY2014. The energy cost savings were primarily driven by the fuel switch from natural gas to hog fuel. Per unit of energy, hog fuel costs half as much as natural gas.

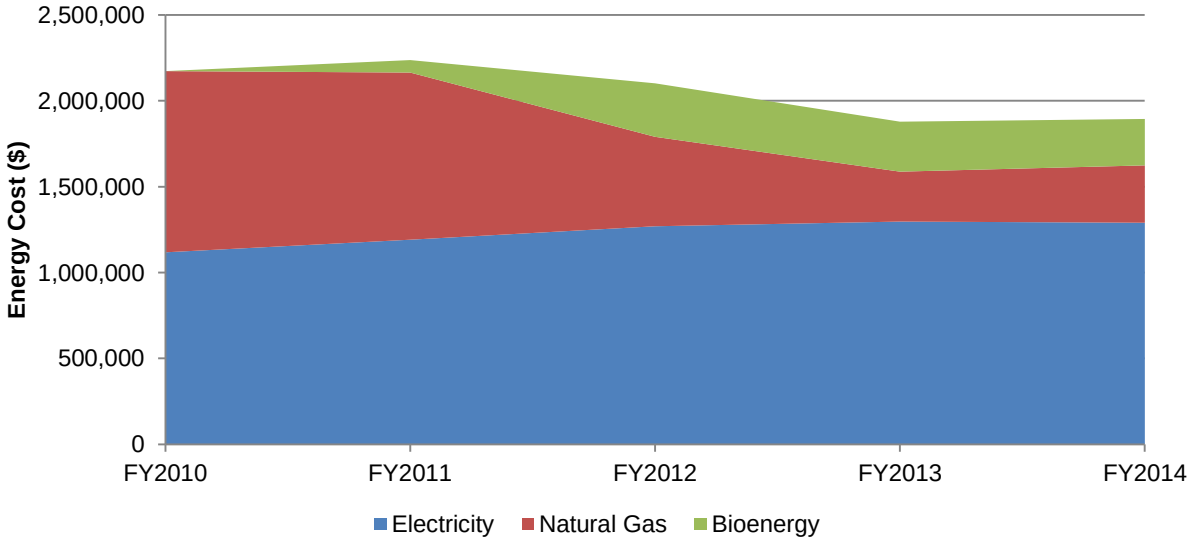

Figure 3 Historical Energy Cost Breakdown

4.3 Prince George Campus District Heating

The Prince George Main Campus of UNBC uses a piping system to distribute heat to nine (9) separate buildings. Prior to the Bioenergy Plant being built in 2010, this heat was supplied by four natural gas boilers located in the Power Plant. Since the opening of the Bioenergy Plant, the majority of the district heating is provided from the gasification of waste wood. The existing natural gas boilers are used to supplement the Bioenergy Plant on cold days, and to provide

backup during downtime.

The Bioenergy and Power Plant heat output to the district heating loop for FY2014 can be seen in Figure 4. Over the past year the Bioenergy plant produced 59,500 GJ of heat from hog fuel which is equal to offsetting 70,000 GJ of natural gas. The input of hog fuel was 4,050 BDT with an energy content of approximately 76,300 GJ for a conversion efficiency of 78%. The Bioenergy plant also requires electricity and a small amount of natural gas to operate leading to an overall energy conversion efficiency of 75%. Approximately 82% of the district heating energy was provided by biomass, and 18% was provided by natural gas. Figure 5 shows a simplified diagram of the energy inputs and outputs of the Bioenergy and Power Plant.

Gas consumption in the Power Plant was 15,100 GJ over the past year, approximately 51% greater than last year due to an emergency shut-down in December 2013 to remove a buildup of ash in the oxidizer and boiler. During the emergency shutdown an access door was installed at the bottom of the oxidizer such that future ash removal can be accomplished without a full system shutdown. This will result in shorter system downtimes and reduced natural gas consumption.

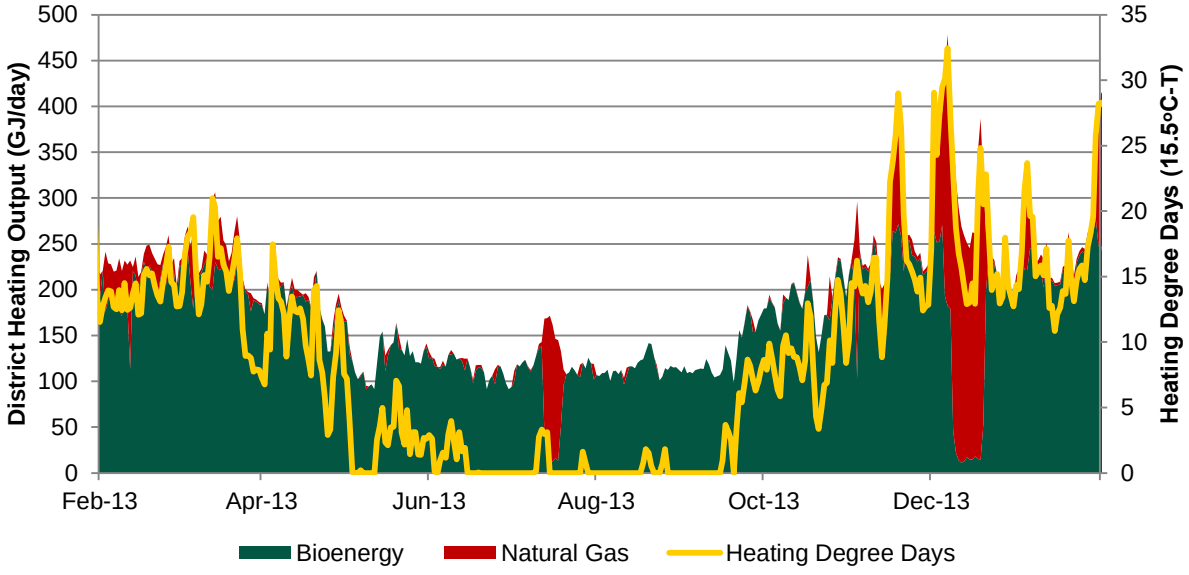

Figure 4 ***Bioenergy and Power Plant Heat Output***

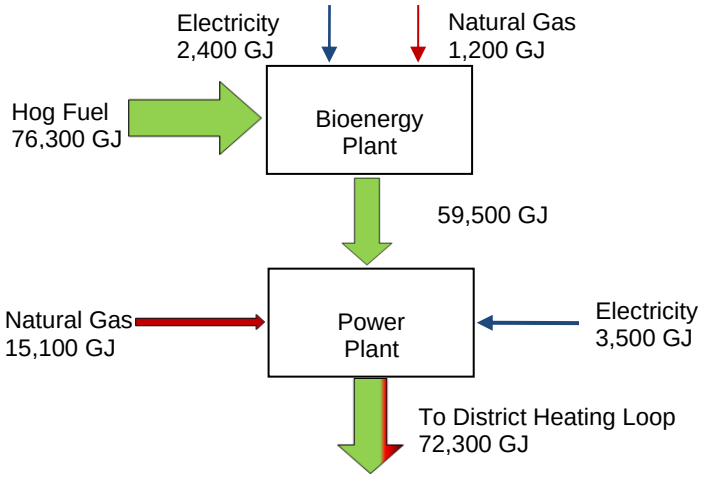

Figure 5 ***District Heating Flow Diagram***

The operating budget for the Bioenergy system is drawn from natural gas savings. The majority of emissions from bioenergy are considered carbon neutral and do not require the purchase of carbon offsets. By using bioenergy instead of natural gas, UNBC purchases over $80,000 less of carbon offsets per year. The Bioenergy expenses and savings are summarized in Table 4. Over the past three years UNBC has realized net savings of $518,000.

Table 4 Bioenergy Cost Breakdown

	2011/12	2012/13	2013/14	Total
Savings				
Gas Savings	617,705	787,633	415,109	1,820,446
Carbon Offset savings (SMARTTool)	81,027	84,512	54,856	220,394
Total Savings	**710,975**	**928,477**	**478,656**	**2,118,107**
Bioenergy Expenses				
Labour	164,500	155,222	128,993	448,715
O&M	94,974	70,904	44,699	210,577
Electricity	47,546	56,871	27,964	132,381
Natural Gas	7,136	15,225	2,667	25,028
Biofuel	210,279	348,567	147,239	706,085
Total Expenses	**524,435**	**646,789**	**351,562**	**1,522,786**
Net Savings	**174,297**	**225,355**	**118,403**	**518,055**

4.4 Energy & Cost Intensity

The energy intensity of each building is reported in Figure 6, and broken down into electricity, gas, and bioenergy intensity. Sub-meters were installed in 2012 at the Prince George Campus to measure electricity, gas, district heating, and district cooling loads at the building level.

The district heating demand for the 8 core buildings and the Power Plant was estimated to be 55,500 GJ using sub-metered data, representing a 4% reduction in district heating demand from last year. The heating intensities were adjusted to reflect the Bioenergy offset of natural gas and the Power Plant input of natural gas (83,200 GJ), where Bioenergy accounted for 87% and natural gas accounted for 13% of the district heating energy.

The vertical solid line in Figure 6 is the 2003 Natural Resources Canada average intensity value for universities and colleges in Canada. The dashed line shows the UNBC average intensity is well below the Canadian average at 479 kWh/m^2. It is important to note that each building has a different use, and should be compared to similar buildings (i.e. apartments, offices, recreational complex). Such baseline data is not always readily available, though it is anticipated that updated benchmarking information will be available through the Energy Star Portfolio Manager.

Figure 6 shows the four lab buildings as being the most energy intensive per square meter. This result is not surprising since lab buildings are not permitted to recirculate air flow resulting in a loss of heat as all of the heated air is exhausted. The Research Lab, Teaching Lab, and Medical building have undergone the Investigation Phase of Continuous Optimization where operational efficiencies were identified including night-time setbacks, weekend and holiday schedules, air exchange rate reductions, damper controls, and hot water pumping strategies. The recommended measures are estimated to save 817,000 kWh per year of electricity and 8,900 GJ per year of heat, and will be implemented by March 2015.

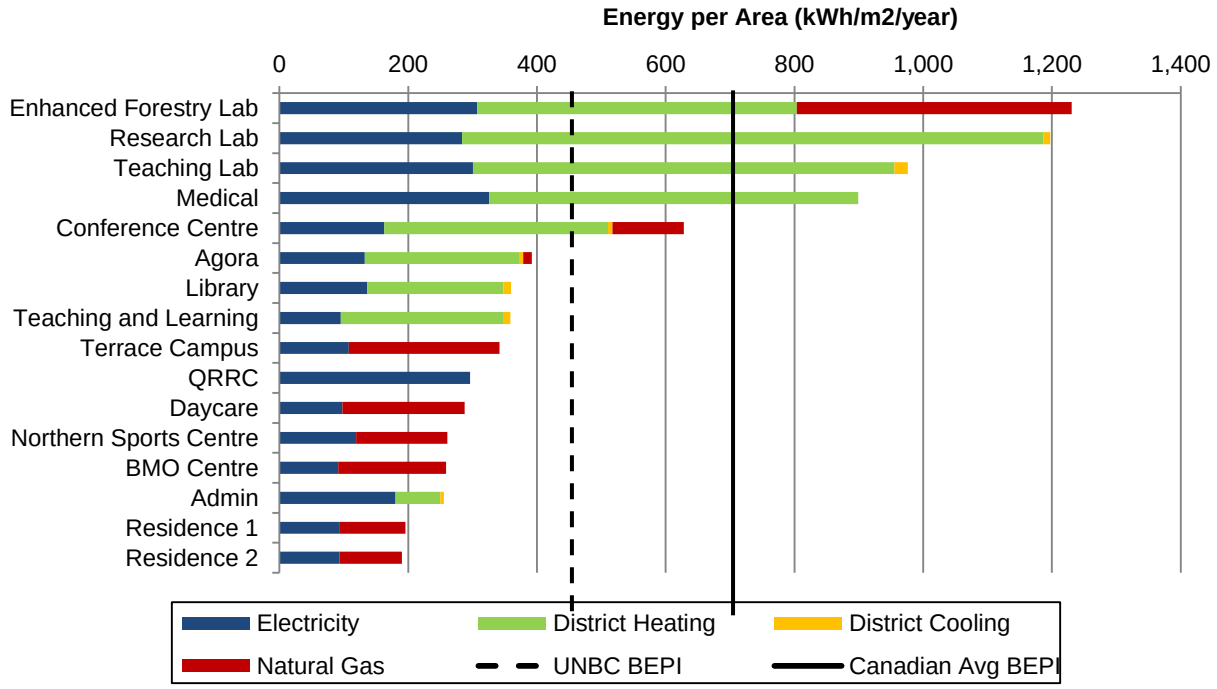

Figure 6 ***Energy Intensity by Building (Apr 2012 - Mar 2013)***

In terms of electricity intensity the Power Plant and Bioenergy Facility are using the most electricity per square meter (these are not shown in Figure 6, but are included in Table 5). This is because electrical equipment such as pumps, conveyors, and augers are required to produce heat from wood waste, and to distribute the heat in the form of hot water to the Prince George core campus. The Power Plant also chills water in the summer months using two 500 kW centrifugal chillers and pumps the chilled water to campus. The electricity required for chilling was added to the buildings that require cooling during the summer months factoring in the coefficient of performance of the chillers. The district heating distribution loop was studied by a pair of students in 2011, but opportunities to optimize the pumping systems will require further research and analysis.

Excluding the two industrial plants, the four laboratories and QRRC used the most electricity per square meter. QRRC is a former fish hatchery, and still operates much of the pumping equipment that the fish rearing process required. In addition, QRRC uses electrical heating and does not use any natural gas or bioenergy.

Similar to the electricity consumption, per square meter, the four lab buildings are the largest consumers of heat, followed by the Conference Centre. The Conference Centre used a surprisingly high amount of heat, however, compared to last year a 13% reduction in district heating, and a 7% reduction in natural gas consumption was observed. Further investigation is required to determine the interactions between the Conference Centre and the adjacent Administration Building which is seen to use the least heating per square meter on campus.

Table 5 summarizes the annual energy consumption, energy intensity and cost intensity for each building under the Energy Management program. Compared to last year, the overall energy intensity remained constant, though a 4.0% drop in heating demand was observed by the buildings on the district heating loop. This suggests that there are inefficiencies upstream of the district heating loop, and will require further investigation.

Table 5 Building Energy and Cost Intensity

	Building Area m2	Annual Consumption kWh/year	Annual Cost $/year	Energy Intensity kWh/m2/year	Cost Intensity $/m2/year
Enhanced Forestry Lab	931	1,145,892	33,521	1231	36
Research Lab	7,581	9,077,975	292,860	1197	39
Teaching Lab	7,921	7,731,765	281,944	976	36
BioEnergy Plant*	1,046	976,411	63,173	933	60
Power Plant	1,253	1,150,150	72,004	918	57
Medical	4,468	4,017,375	153,162	899	34
Conference Centre	3,253	2,044,295	74,568	628	23
Agora	8,556	3,352,692	128,192	392	15
Library	11,754	4,226,697	171,710	360	15
Teaching and Learning	10,130	3,634,785	127,019	359	13
Terrace Campus	1,314	449,187	34,554	342	26
QRRC	812	240,439	22,887	296	28
Daycare	639	183,760	8,964	288	14
Northern Sports Centre	13,485	3,519,720	191,680	261	14
BMO Centre	1,320	341,728	21,494	259	16
Admin	9,162	2,340,238	131,672	255	14
Residence 1	7,425	1,452,720	74,561	196	10
Residence 2	7,425	1,411,985	73,295	190	10
Maintenance Building	352	29,549	3,535	84	10
Total	**98,827**	**47,327,363**	**1,897,621**	**479**	**19**

5. ENERGY INITIATIVES

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 FY2014 Energy Projects

Energy reduction targets are outlined both in the UNBC Energy Policy and the BC Hydro Power Smart Energy Manager contract deliverables. The Energy Policy aims for a reduction of energy consumption by 10% over a 5-year period from 2010 to 2015. In order to meet the Energy Policy goals, energy efficiency projects must be implemented each year, with annual electricity savings of approximately 400,000 kWh. The Energy Manager contract with BC Hydro Power Smart requires project implementations totalling 1,482,000 kWh of annual electricity savings by March 2015.

As of January 2014 133,000 kWh worth of electricity reduction projects were implemented as summarized in Table 6. Three atriums on campus (Agora, Administration, and Teaching and Learning) were connected to a daylight sensor where all unessential lighting is turned off when daylight is sensed. These three atriums are expected to save 67,000 kWh of electricity per year, and will be submitted as a BC Hydro Program Enabled project. The Exterior Lighting project replaced the bollard and globe pathway lighting with efficient LED fixtures, and is anticipated to save 66,000 kWh per year. This project was completed under the BC Hydro Custom Incentive Program.

Table 6 FY2014 Energy Projects Summary

Projects in Progress	Annual Energy Savings (kWh)	Annual Heat Savings (GJ)	Capital Cost ($)	Estimated Incentive ($)	Annual Savings ($)	Completion Date	Payback (y)
Residence Low-flow Showerheads	0	1,400	1,000	0	22,000	May-13	0.0
QRRC Optimization	23,000	0	500	0	2,300	May-13	0.0
Daylight Harvesting - T&L	9,000	0	0	0	900	Jun-13	0.0
Daylight Harvesting - Agora	25,000	0	0	0	2,600	Jun-13	0.0
Daylight Harvesting - Admin	33,000	0	0	0	3,400	Jul-13	0.0
Exterior Lighting - Globes	59,000	0	54,000	16,270	6,000	Aug-13	6.3
C.Op Phase 1 Investigation	0	0	60,700	60,700	0	Sep-13	0.0
Exterior Lighting - Bollards	7,000	0	44,000	1,930	700	Oct-13	60.1
Power Factor Correction	0	0	?	0	10,700	Dec-13	0.0
Total	**133,000**	**1,400**	**160,200**	**78,900**	**46,300**		**2.3**

During the summer, the showerheads in both residences were replaced with low-flow models to reduce the water flow by half. The new showerheads are expected to reduce the hot water boiler natural gas consumption by 1,400 GJ per year.

The Phase 1 Investigation of BC Hydro Continuous Optimization (C.Op) was completed in September 2013 where Prism Engineering was contracted to identify energy conservation measures related to building operations for the Research Lab, Agora, Teaching Lab, and Medical

building. Over 1,000,000 kWh and 12,000 GJ of electrical and heat savings were identified, respectively, with an overall payback of 1.4 years. The Implementation Phase will see all of the measures implemented by March 2015.

A full list of completed projects and studies is included in the Appendix.

5.2 Planned Energy Projects and Initiatives

Over the next two fiscal years, a number of projects have been identified with estimated annual savings of $216,700 and an overall simple payback of 1.6 years. The majority of savings outlined in Table 7 will be realized from the implementation of Phase 1 C.Op which is discussed further in section 5.2.1.

Table 7 Planned Energy Projects for FY2014 and FY2015

Projects in Progress	Annual Energy Savings (kWh)	Annual Heat Savings (GJ)	Capital Cost ($)	Estimated Incentive ($)	Annual Savings ($)	Completion Date	Payback (y)
Exterior Lighting - Agora/Medical Wallpacks	20,000	0	7,000	945	2,100	Mar-14	2.3
Teaching Lab Pot Lights	40,000	0	20,800	1,990	8,300	Mar-14	1.8
Bentley Pot Lights	17,000	0	18,200	0	1,800	Mar-14	10.1
Primary Hot Water Loop BTU Meter Install	0	0	16,000	0	0	Jul-14	-
Admin Atrium Lighting	6,000	0	0	0	600	Jul-14	0.0
C.Op - Phase 2 Investigation	0	0	38,500	38,500	0	Aug-14	0.0
Medical Building Humidifier	521,000	400	100,000	20,000	57,300	Dec-14	1.4
C.Op - Research Lab Implementation	322,000	1,100	40,600	0	35,700	Mar-15	1.1
C.Op - Teaching Lab Implementation	254,000	3,100	68,700	0	36,000	Mar-15	1.9
C.Op - Agora Implementation	230,000	3,200	57,200	0	37,400	Mar-15	1.5
C.Op - Medical Implementation	125,000	700	16,300	0	15,100	Mar-15	1.1
C.Op - Lab Heat Recovery	22,000	4,000	26,400	0	22,500	Mar-15	1.2
TOTAL	**1,556,000**	**12,500**	**409,700**	**61,435**	**216,700**		**1.6**

A BC Hydro Custom Incentive project combining two smaller projects (Teaching Lab pot lights, and Agora/Medical exterior lighting) will also be completed in FY2014. In September 2013 a small fire broke out due to the overheating of a ballast of an old pot light fixture with no end of life protection. It became a priority to change the 265 2-pin compact fluorescent fixtures to fixtures that do not pose a fire and safety risk. This presented a perfect opportunity to upgrade the majority of lighting to LED fixtures in order to save energy and maintenance costs. A number of pot lights are located in wood panelling or ceiling with restricted access, and will be replaced with either screw in LED lamps or 4-pin CFL fixtures. Savings from these 110 retrofits will be claimed under the BC Hydro Program Enabled program. The Agora and Medical building exterior lighting project will replace 70W and 50W metal-halide wallpack lamps with 13.5W LED lamps. Two additional motion-sensing LED bollards will replace existing 70W fixtures. In total, the Custom Incentive project will save 60,000 kWh and the Program Enabled project will save 17,000 kWh annually.

A large project that is in the planning phase and to be completed in FY2015 is the Medical Humidifier upgrade. This project is based on preliminary work completed by a third-year Physics student for an Independent Study project in fall 2012. The current humidifier uses electricity to generate steam to humidify the air for the animal holding facility in the Medical Building. The cost of electricity exceeds the cost of bioenergy by approximately 350%, therefore cost savings can be

achieved by switching from electricity to bioenergy. To switch fuels, the new system would require a small high-pressure pump and a nozzle assembly to spray water into the air. Preheating the air with bioenergy would be required in order to reach the required temperature and humidity levels. The air exchange rate in the animal holding area is double the recommended rate, therefore the humidification and heating load can also be cut in half. This project is expected to save over 500,000 kWh per year in electricity, with a small amount of heat savings due to the reduction in air changes per hour.

A full list of potential projects is included in the Appendix.

5.2.1 Continuous Optimization Program

UNBC is enrolled in BC Hydro's Continuous Optimization (C.Op) program for energy monitoring and retro-commissioning of existing buildings. The program at UNBC includes 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. A program of re-commissioning represents a 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, so a tune up is warranted, rather than wholesale replacement of equipment.

UNBC contracted Prism Engineering to complete the Phase 1 Investigation of C.Op where energy conservation measures were identified for the Agora, Teaching Lab, Research Lab, and Medical Building in September 2013. Recommended measures included air handling and pumping optimizations including: weekly and holiday schedules; night-time setbacks; mixed air damper controls; pressure resets; unoccupied control; and primary hot water, glycol, and domestic hot water pumping strategies. In total, $221,600 worth of projects were identified with annual savings of $163,500. The measures were reviewed and $209,000 worth of projects were approved by the Facilities Department. These measure will be implemented by March 2015 and are expected to save $147,000 annually in utility costs.

The Investigation phase of Phase 2 C.Op examining the Administration Building and Charles Jago Northern Sport Centre commenced in August 2013. Phase 3 C.Op will focus on the Conference Centre, Teaching & Learning Building, and Library, and will begin in 2014.

5.3 Energy Conservation Revolving Loan

In 2012 UNBC created an Energy Conservation Revolving Loan Fund (Loan Fund) to provide the capital required for energy efficiency upgrade projects. UNBC has made $250,000 available for funding energy efficiency projects through the Loan Fund. A portion of the energy savings are used to repay the loan, and then used to provide a sustainable source of funding for the energy management program including future upgrade projects and balancing the Energy Manager budget.

5.3.1 Loan Projection

In order to help plan future energy conservation projects, project spending and savings were estimated for the next 5 years. To fund all of the planned projects and all of the recommended measures for the first phase of the C.Op program, an additional $130,000 of funds was required. These funds are being provided by the Medical program to cover the costs of the Medical Humidifier project and the implementation of C.Op measures in the Medical building.

Table 8 outlines the annual projected spending of the Loan Fund. Approximately $1,700,000 can be invested in energy projects over the next 5 years if loan spending is maximized. The projection includes an allocation for a portion of the Energy Manager salary. If BC Hydro Energy Manager funding continues, this allocation can be used to fund additional energy projects.

Table 8 ***Energy Conservation Revolving Loan Projected Annual Spending***

	Funds Committed				
Project	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19**
Teaching Lab Recessed Lighting	46,064				
Medical Humidifier	100,000				
Solar PV Project	1,000				
Continuous Optimization					
Phase 1					
Implementation	10,423				
Research Lab	44,112				
Agora	62,148				
Teaching Lab	74,643				
Medical	17,710				
Coaching		15,200			
Phase 2					
Investigation	19,162				
Implementation	2,800	4,800			
NSC		0			
Admin		32,595			
Coaching			9,616		
Phase 3					
Investigation	24,477	34,267			
Implementation		3,455	8,293		
Conference			11,952		
Library			41,287		
T&L			35,855		
Coaching				13,428	
Additional Projects	60,000	110,000	95,000	255,000	265,000
Energy Management Budget	0	50,000	75,000	100,000	100,000
Total Spending	**463,000**	**250,000**	**277,000**	**368,000**	**365,000**
Incentives	61,000	84,000	45,000	82,000	17,000
Revolving Loan Payments	69,000	169,000	231,000	286,000	350,000
Additional Funds	130,000	0	0	0	0
Total Funds Received	**260,000**	**253,000**	**276,000**	**368,000**	**367,000**
Loan Balance	**-250,000**	**-247,000**	**-248,000**	**-248,000**	**-246,000**

5.4 Sub-metering

UNBC has installed sub-meters in buildings throughout the Prince George campus to gain a better understanding of energy consumption at an individual building level. Electricity, hot water, cooling water, natural gas, and domestic water are being metered for most buildings on the Prince George Campus. Data from the sub-meters is logged every 15 minutes.

Sub-metering data is being used to develop energy baselines for each individual building in order to track energy performance, and help measure and verify energy savings from implemented energy savings projects. In addition, the sub-metering is being used for the billing of gas and water usage for ancillary buildings that are covered by the Main Campus accounts.

Pulse Energy has been contracted by UNBC to create a dashboard to display current and historical energy trends from the logged data. The dashboard can be viewed online via the

following link. Pulse Energy will also be developing baseline models using the metered data.

https://my.pulseenergy.com/UniversityofNorthernBC/dashboard#/overview

5.5 Energy Management Assessment

As part of the Energy Manager requirements, UNBC participated in an Energy Management Assessment on March 20, 2013. The EMA identified areas where UNBC should focus for a balanced Energy Management program. The areas and actions identified in the EMA are summarized below:

1. Policy

   Regular reporting to senior management on progress towards energy efficiency objectives and expectations

2. Targets/Reporting

   Establish protocols that require operations personnel to troubleshoot energy variations.

3. Plans/Actions

   Establish energy efficient guidelines to be used in the selection and procurement of equipment

4. Teams/Committees

   Improve baseline understanding of energy consumption and opportunities for each major utility with operations, maintenance, and behavioural issues. Instruct personnel to make appropriate adjustments in energy-using equipment to maintain proper conditioned space.

5. Employee Awareness/Training

   Improve communication of energy conservation initiative to the broader organization and use available energy usage data in a meaningful format to raise energy awareness. Incent participation in the energy conservation initiative by providing recognition to contributions.

UNBC is committed to continually improving the Energy Management program, and will address the recommended action items from the EMA session. Particular focus will be placed on employee awareness and student engagement, through improved communication and reporting.

5.6 Student and Employee Engagement

At UNBC we recognize that achieving our energy goals requires the participation and engagement of students, faculty, staff, and senior administration. During FY2013, we aimed to improve employee and student engagement through a variety of different avenues including: participation in the Green Coffee Hour with the President, leading Bioenergy tours, encouraging conservation over the winter break, participation in the Residence Energy Challenge, surveying Residence occupants on energy consumption habits, displaying energy information outside the Green Centre, and employee emails providing updates on energy initiatives and savings.

A major focus will be placed on student and employee engagement during FY2014, to highlight the successes of the Energy Management program, and to encourage the formation of healthy and sustainable habits with regards to energy consumption. The energy team is collaborating with the Communications Department to better publicize the successes of the Energy Management Program with the UNBC and local community.

6. ENERGY SAVINGS

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.

6.1 Electricity Savings

Over the past year, UNBC decreased electricity consumption by 510,000 kWh. At the marginal rate of electricity, these savings are worth $52,000, however, due to electricity rate increases and baseline adjustments, UNBC has only saved $1,200 compared to last year. A better estimation of savings considers both variations in rates and weather, and compares to historical baselines. Comparing the electricity consumption to the historical baseline consumption, approximately 1,997,000 kWh was saved over the past year, for avoided cost savings of $203,000. The actual and avoided costs for each electricity account are summarized in Table 9.

The Bioenergy Plant electricity consumption depends on the Bioenergy heat production rate, therefore the cost of electricity and any savings associated with the Bioenergy Plant are included in the total cost of the district heating. There currently is no baseline for the Bioenergy Plant since it was built after the baseline period. Baseline consumption is assumed to be equal to the current electricity consumption, with zero savings compared to the baseline.

Table 9 ***Actual and Avoided Electricity Savings***

	2013/2014		2012/2013	2009/2010	Compared to Baseline (Avoided)		Compared to Last Year (Actual)	
Account	Electricity Use	Electricity Cost	Electricity Use	Baseline Use	Electricity Savings	Cost Savings	Electricity Savings	
	kWh/year	$/year	kWh/year	kWh/year	kWh	$/year	kWh/year	$/year
Main Elec	15,209,054	$1,060,794	15,693,186	17,320,442	2,111,388	$225,326	484,133	$7,039
Terrace Elec	141,309	$15,298	142,266	167,297	25,988	$2,825	958	$119
QRRC Elec	240,439	$22,887	260,697	206,254	-34,185	-$3,932	20,258	$1,518
NSC	1,606,293	$126,595	1,562,251	1,609,987	3,694	$273	-44,042	-$7,394
BMO	120,883	$13,226	120,944	131,485	10,603	$1,065	62	-$126
Bio*	653,010	$51,171	701,566	653,010	0	$0	48,556	$5,673
TOTAL	***17,970,986***	***$1,289,971***	***18,480,910***	***20,088,474***	***2,117,488***	***$225,558***	***509,924***	***$6,829***

Figure 7 shows the monthly electricity consumption compared to the 2009/2010 baseline. Cumulative electricity savings were equivalent to 1.4 months worth of electricity, however due to the rate structure, the avoided cost savings were approximately 2.1 months worth of electricity cost.

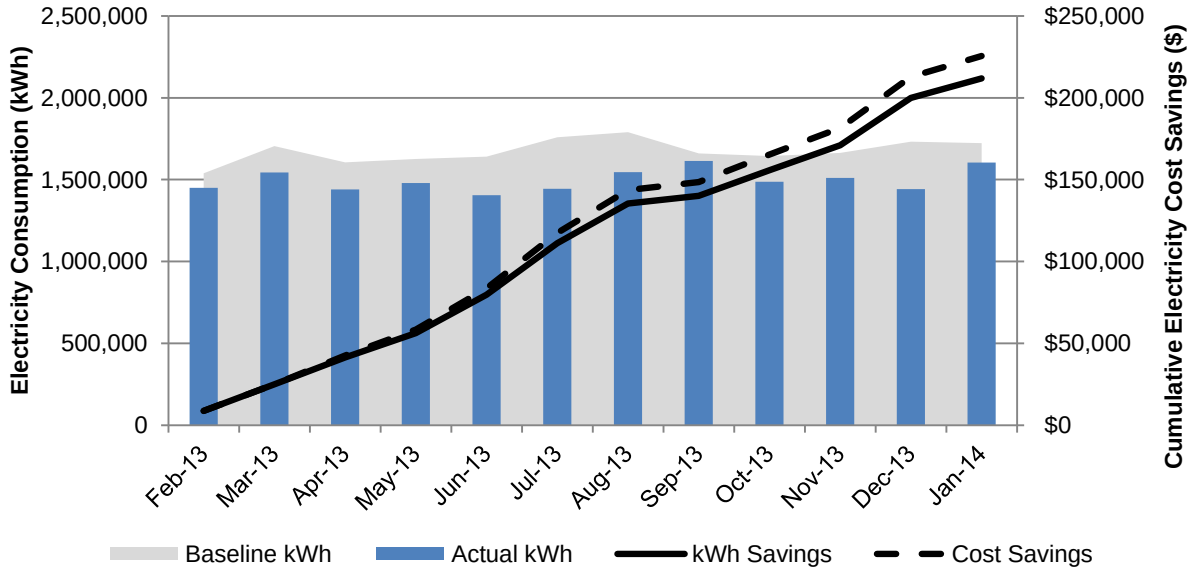

Figure 7 ***Annual Electrical Usage Compared to Baseline***

The UNBC Energy Policy outlines a 2% electricity consumption reduction per year corrected for variations in weather. Figure 8 demonstrates how UNBC has exceeded the electricity reduction targets each year. Currently the Policy target is being exceeded by 5%, and the FY2014 intensity is expected to exceed the FY2015 Policy target.

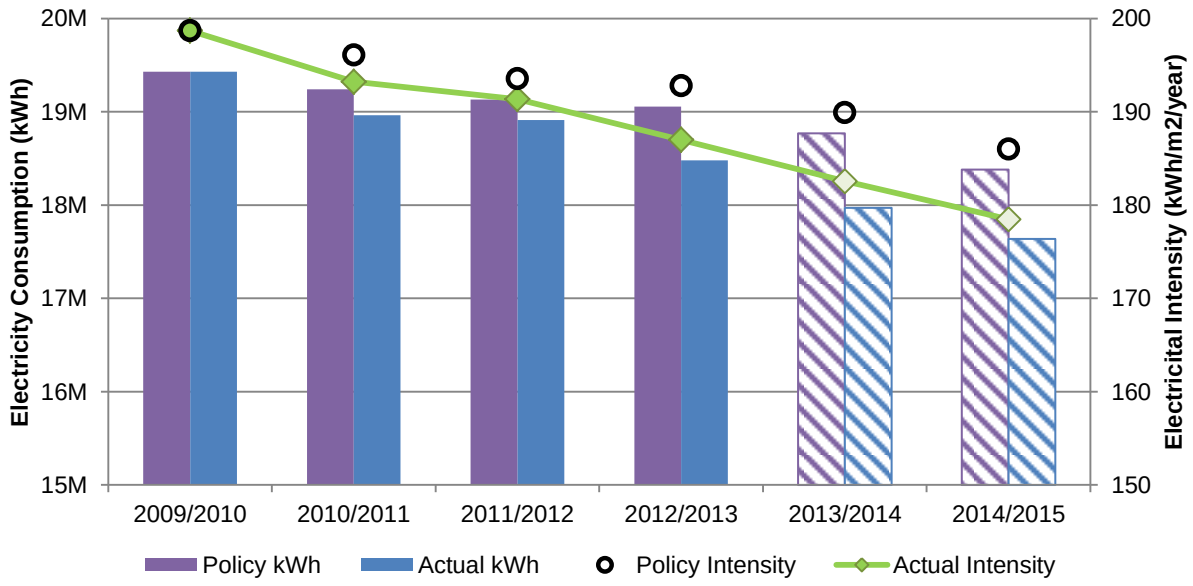

Figure 8 ***Electricity Intensity Compared to Target***

6.2 Bioenergy and Natural Gas Savings

The baseline for heating was developed before the Bioenergy facilities came online in 2009/10 and takes into account the natural gas consumption as is relates to HDDs. Table 10 summarizes the heat consumption, and savings for FY2014. Approximately 29,327,000 kWh of heat was consumed over the past year costing a total of $604,000. Hog fuel provided 66% of the total heating, however, only represented 45% of the total cost of heating.

2009/2010 baseline which takes into account weather variations. Billed consumption is often estimated by Fortis BC, leading to potential overbilling during certain time periods. Over the past year the gas consumption for the main account was estimated for 7 out of 12 bills. When comparing the billed consumption to the actual consumption recorded by the submeter at the Power Plant, UNBC was overbilled 3,700 GJ. A monthly breakdown of heat consumption compared to the 2009/2010 baseline, and cumulative savings can be seen in Figure 9. Figure 10 is based on billed data for all accounts except the main account where submetered data was used due to discrepancies between the billed and metered data.

In FY2014, UNBC is not expected to meet the Policy target. However, as seen in Figure 10, a significant reduction in heating consumption and intensity has been seen compared to FY2012 when an initial jump in intensity was observed due to the commissioning of the Bioenergy Plant. The district heating system operation is continually being optimized to avoid the waste of heating energy. With the implementation of the first phase of C.Op, the heating intensity will be closer to meeting the heating reduction Policy Target. Additionally, BTU meters will be installed on the Primary Hot Water distribution loops in order to better understand where heat losses are occurring.

Table 10 ***Actual and Avoided Heat Savings***

	2013/2014		2012/2013		2009/2010	Compared to Baseline	Compared to Last Year	
Account	Heat Use	Heat Cost	Heat Use	Heat Cost	Baseline Use	Cost Savings	Heat Savings	Cost Savings
	kWh/year	$/year	kWh/year	$/year	kWh/year	$/year	kWh/year	$/year
Main District Heat	23,624,607	$474,149	22,967,590	$466,122	22,225,218	-$36,005	-657,017	-$8,026
NSC Natural NG	1,913,427	$65,085	1,832,551	$61,307	1,708,510	-$7,058	-80,875	-$3,778
Residence 1 NG	762,500	$27,123	770,101	$26,845	818,290	$1,746	7,601	-$278
Residence 2 NG	717,184	$25,524	775,447	$27,033	864,699	$5,496	58,264	$1,509
Agora NG	475,718	$17,594	512,387	$18,856	973,736	$18,853	36,669	$1,263
EFL Bioenergy	462,426	$0	316,551	$0	462,426	$0	-145,875	$0
EFL NG	397,617	$13,586	460,084	$16,036	248,682	-$5,221	62,468	$2,450
Bio NG**	323,402	$12,002	455,181	$15,949	323,402	$0	131,779	$3,947
Terrace NG	307,878	$19,256	290,737	$18,122	373,468	$4,092	-17,142	-$1,134
BMO NG	220,846	$8,268	246,872	$9,116	190,806	-$628	26,026	$848
Daycare NG	121,226	$4,702	128,375	$4,896	113,153	-$327	7,149	$195
TOTAL	**29,326,829**	**$604,116**	**28,755,877**	**$591,492**	**28,302,389**	**-$19,053**	**-570,952**	**-$12,624**

**The cost and savings for the Main District Heating include the Bioenergy Plant electricity and natural gas cost and savings

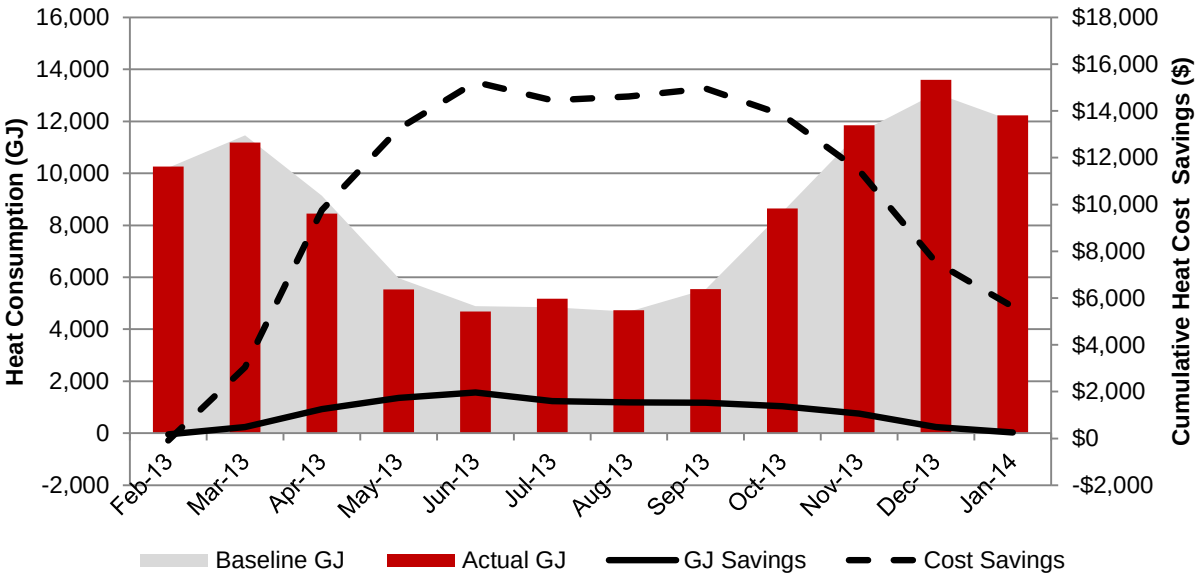

Figure 9 ***Annual Heating Demand Compared to Baseline***

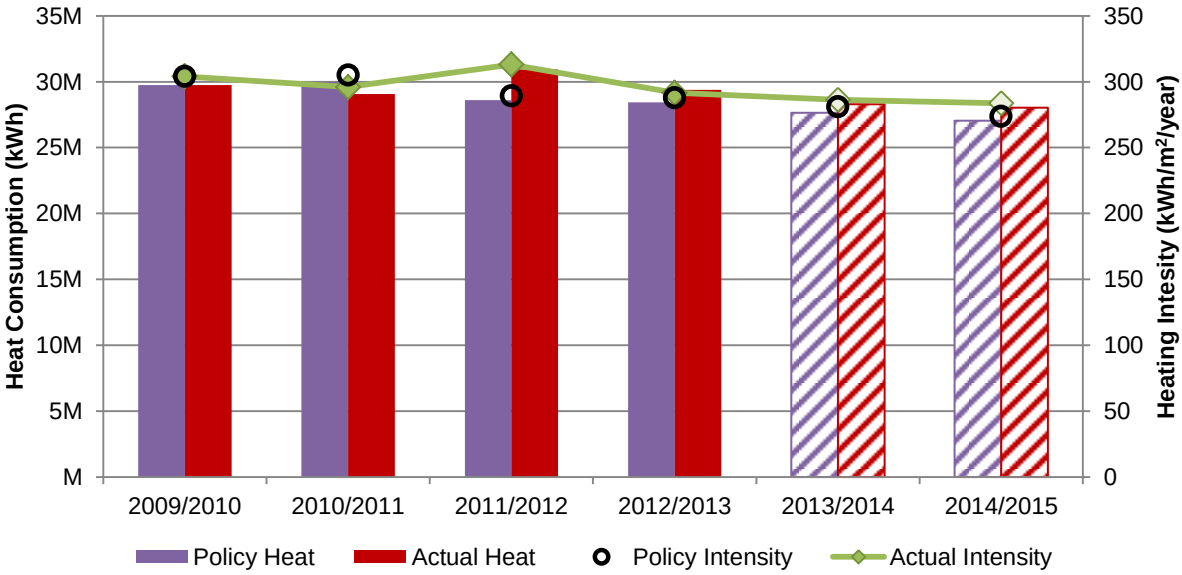

Figure 10 ***Heating Intensity Compared to Target***

6.3 Greenhouse Gas Reductions

As part of the public sector within the province of British Columbia, UNBC is required to be carbon neutral. The University measures and reports its greenhouse gas emissions using SmartTOOL, through an initiative of the provincial government. This captures direct emissions from fuel combustion, indirect emissions through purchased electricity, and office paper. The reporting period for SmartTOOL is per calendar year.

The University is required to purchase carbon offsets at a cost of $25 per tonne to reduce the net greenhouse gas emissions of the University to zero. These offsets were previously purchased from the Pacific Carbon Trust, however, will now be paid to a central fund for carbon emission reducing capital projects within the commercial sector.

A number of emission factors were changed in 2013: most notably the electricity emission factor was lowered from 0.0069 to 0.0040 tCO_2e/GJ; and the emission factor for wood combustion was doubled from 0.047 to 0.096 $tBioCO_2/GJ$. The change in wood emission factor results in a major increase in total emissions compared to 2012, however, since emissions from wood are considered carbon neutral, the net emissions requiring the purchase of carbon offsets decreased by 8%.

Table 11 Greenhouse Gas Emissions (t CO_2e)

	2013	2012	2011	2010
Scope 1 (Direct) Emissions				
Mobile Combustion (Fleet)	26	25	19	17
Stationary Combustion	8,094	5,182	5,363	5,186
Scope 2 (Indirect) Emissions				
Purchased Energy	260	461	470	470
Scope 3 (Business Travel and Office Paper) Emissions				
Office Paper	5	5	5	15
Total Emissions, Calendar Year	**8,385**	**5,673**	**5,857**	**5,689**
Carbon Neutral or Offset Exempt	**6,386**	**3,506**	**2,349**	**1**
Total for Offsets	**1,999**	**2,167**	**3,508**	**5,688**

7. ENERGY MANAGER RESULTS

Since the beginning of the Energy Management Program at UNBC in 2010, 23 energy projects have been completed for annual electricity savings of 1,200,000 kWh and annual natural gas savings of 1,700 GJ. To-date the electricity projects have saved $161,000, and have received incentive funding from BC Hydro totalling $205,000. Additional electricity savings of $271,000 have been observed compared to the historical baseline, and can be attributed to building operation modifications and behavioural changes associated with having a visible Energy Manager in the UNBC community. Figure 11 shows that the Energy Management Program has brought in more than $900,000 over the past three years.

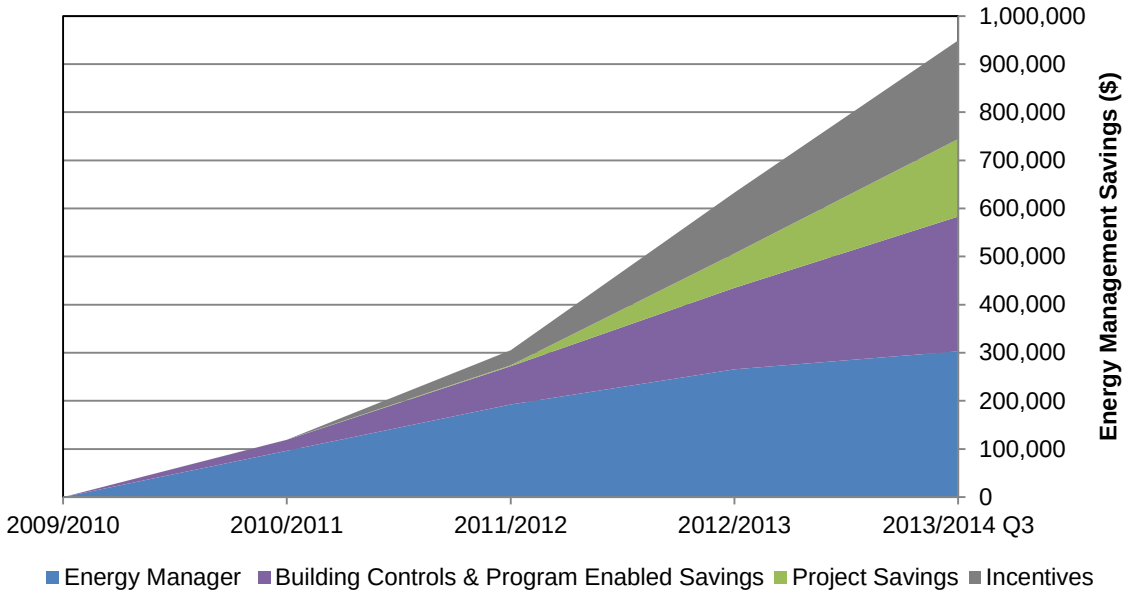

Figure 11 Energy Manager Results

With a major focus on electricity reduction projects, UNBC is exceeding the targets outlined in the Energy Policy, and in the BC Hydro Power Smart Energy Manager contract. There will be a continued focus on electricity reduction projects to take advantage of BC Hydro program funding. While there is little to no outside funding available for projects that reduce natural gas consumption, UNBC is still committed to reducing its carbon footprint which will require a major focus to be placed on educating and engaging students and employees on ways to reduce energy consumption.

APPENDIX A – COMPLETED PROJECT LIST

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
Power Factor Correction	Connect CT to capacitor bank	0	0	10700	200	0	0.0	Complete	Nov-13	100	Dec-13
Exterior Lighting (Bollards)	Replace exterior bollard lighting with LED/motion sensing models	7000	0	669	43,615	1,930	62.3	Complete	Oct-12	100	Nov-13
C.Op - Phase 1 Investigation	ECMs identified for Agora, Teaching Lab, Research Lab, and Medical Building	0	0	0	60,242	60,242	0.0	Invoices submitted for reimbursement	Sep-12	95	Sep-13
Agora Daylight Harvesting	Connect Agora lighting to daylight sensor to turn off all non-essential lighting during daylight	24600		2500	0	0	0.0	Complete	Oct-11	100	Jun-13
Admin Daylight Harvesting	Connect Admin atrium lighting to daylight sensor to turn off all non-essential lighting during daylight	33000		3400	0	0	0.0	Complete	Oct-11	100	Jun-13
Exterior Lighting (Globes)	Replace exterior globe lights with LED retrofit kits	59,000		6000	60000	16,270	7.3	Complete	Oct-12	100	Oct-13
Low-flow showerheads	Replace showerheads in Residence with low-flow models		1400 GJ	22,000	975	0	0.0	Complete	Dec-12	100	May-13
QRRC lighting upgrade	Replace T12 fluorescent lighting with T8	7,752	0	730	4960	1429	4.8	Complete	Nov-12	100	Mar-13
EFL Lighting Retrofit	Replace T12 fluorescent lighting with T8	1,181		111	578	139	4.0	Complete	Jan-13	100	Jan-13
Canfor Theatre lighting -second round	Revisit the lighting provision for the lecture space	55,239	0	5,204	45,845	18,339	5.3	Complete	Aug-12	100	Dec-12
Warehouse lighting	Replace MH high bay fixtures in warehouse	43511		4099	7201	2875	1.1	Complete	Aug-12	100	Dec-12
NSC Soccer field	Replace MH fixtures with impact resistant LED	130,598		12,302	125,188	40,000	6.9	Complete	Jul-12	100	Sep-12
Building energy displays	Install monitors outside Green Centre to display energy related data							Complete	Aug-11	100	Sep-12
NSC Field house relamp	New lamps for T5HO over field house	51,300		4,832	10,000	1,160	1.8	Complete	Aug-12	100	Aug-12
Coil Cleaning	Nalco coil cleaning initiative	224,610		21,158	23,523	9,684	0.7	Complete	Aug-12	100	Aug-12
NUSC Event Space LED	Replace incandescent lighting with LED	12,304	0	1,159	6,090	2,474	3.1	Complete	Aug-11	100	Jul-12
Terrace lighting upgrade	Replace T12 fluorescent lighting with T8	16,593		1,488	14,396	3,994	7.0	Complete	Aug-11	100	Apr-12
Utility meter installation	Install submeters for gas, electric, heat, cooling, domestic water							Complete	Jul-10	98	Jun-12
Utility Data Management	Prism Engineering to provide data analytics				9,000			Complete	Aug-11	100	May-12
Residence Lighting - Common Areas	Replace T12 fluorescent lighting in residences with T8	14,414		1,358	17,216	3,208	10.3	Complete	Aug-11		Mar-12
Residence Lighting - Suites	Replace T12 fluorescent lighting in residences with T8, Incandescents with CFLs	250,930	0	23,638	61,547	24,090	1.6	Complete	Aug-11	100	Mar-12
TLC Atrium Daylight Harvesting	Connect TLC atrium lighting to daylight sensor to turn off all non-essential lighting during daylight	9,519		897				Complete			Mar-12
Theatre lighting	Replace incandescent lighting with LED	78,705		7,414	22,811	11,988		Complete	Dec-11	100	Apr-12
Medical AV Cooling	Install fans to take advantage of free cooling overnight	22,950		2,162	11,000	0	5.1	Complete	Nov-11	100	Apr-12
Admin Chiller	Replace water cooled centrifugal chiller with air cooled model	98,600	9600 Gal	13,400	70,000	0	5	Complete	Sep-11	100	Mar-12
Ice Mountain	Store ice/snow for summer cooling							Students complete feasibility study	Sep-11	100	Nov-11
Canfor Theatre Lighting	Replace incandescent lighting in Canfor Theatre with LED	3,700	0	349	6,000	0	2	Complete	Aug-10	100	Aug-10
Terrace Boiler	Replace aging natural gas boiler for Terrace campus	0	300	300	45,000	0	150	Complete	Aug-10	100	Oct-10
Green Centre Lights	New Green University Center offices - LED lighting	1,240		117	640	0	5.5	Complete	Nov-10	100	Jan-11
Winter Garden Lights	Convert to Hi-Bay LED	2,630		248	640	0	2.6	Complete	Dec-10	100	Jan-11
District Energy Pump Study	Review system flow dynamics and pumping requirements for district energy water distribution loops							Complete - requires further attention	Jan-10	100	May-11
NUSC Event Space (Round 1)	Halogen to LED - testing 1 fixture	960		90	402	160	4.4	Complete			Mar-12
Rotunda Ramp	Halogen to LED	2,475		233	774	390	3.3	Complete			Aug-12
Rotunda Gallery	Halogen to LED	5,931		559	1,987	1,165	3.6	Complete			Aug-11
Agora North Entrance	Metal Halide to LED	999		94	476	244	5.1	Complete			Aug-11
Bookstore/Cafeteria Lighting	Replace halogen and incandescent lighting with LED	20,796		1,959	6,684	3,649		Complete		100	Aug-11
Thirsty Moose Lighting	Replace halogen and incandescent lighting with LED	6,034		568	2235	1582	1.1	Complete		100	Dec-10
Wind turbine	Preliminary investigation into installing wind generation on campus							Complete			Sep-11
Totals		**1,186,571**	**1,700 GJ**	**149,739**	**659,225**	**204,964**	**3.0**				

Behavioural/ Education Programs (If applicable)

Project Name	Description	Electrical Svgs (kWh)		Total Svgs	BC Hydro Incentive	Objectives	Date Started	% Complete	Projected Completion Date
Residence competition	Two residence buildings compete to lower electrical consumption	2,400		150	0	Raise conservation awareness in residences; reduce consumption	Oct-10	100	Apr-11
Residence competition	Two residence buildings compete to lower electrical consumption	4,300		405	0	“	Oct-11	100	Nov-11
Wintergreen 2011	Promote turning off computer and HVAC during winter holidays	41,200		3,100	0	Save energy and raise awareness	Dec-11	100	Jan-12
Wintergreen 2012	Promote turning off computer and HVAC during winter holidays	79,000	370	11,000	0	“	Dec-12	100	Jan-13
Wintergreen 2013	Promote turning off computer and HVAC during winter holidays	78,000	500	12,000	0	“	Dec-13	100	Jan-14
Totals		**204,900**	**870**	**26,655**	**0**				

APPENDIX B – POTENTIAL 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**			
NSC Wallpacks	Convert 150W wallpacks to LEDs	17,900		1711	12852		7.5				
2x4' 3xT8-mag LED retrofit	2x4' 3xT8(mag ballast) to linear LED	365000		34894	320000		9.2				
2x4' 3xT8-elec LED retrofit	2x4' 3xT8 (elect ballast) to linear LED	24000		2294	33000		14.4				
Power Plant Lighting retrofit	Power Plant	32850									
Flue Gas Heat recovery	Recover latent heat from Bioenergy flue gases		8,000 GJ	80,000				Currently being studied by Environmental Engineering Master's student			
Power Plant Study	Determine efficiency of natural gas boilers, and opportunities to reduce improve efficiency (damper control, boiler sequencing)							Data and operations analysis			
District Heating Network Study	Study the district heating network to improve heating efficiency and reduce heat waste							Data and operations analysis			
Chiller optimization	Review setpoints for chillers and cooling tower	50,000		3,275	2,000		0.6	Preliminary system review and scope definition			
Heating and Cooling Policy	Implement heating and cooling policy and control strategy to maintain temperature band and minimize heating and cooling waste							Draft policy written, requires occupant consultaton and review			
Building Systems Scheduling	Optimize night setback hours for all buildings on campus	450,000	2,900 GJ	71,570	124,300		1.7	Review current building schedules			
Ventilation Review	Review ventilation standards, and modify ventilation rates as appropriate							Review standards and current ventilation rates			
Essential Lighting Review	Review current essential lighting and switch excess lighting to non-essential							Review lighting requirements for essential lighting			
Utilidor Lighting Controls	Switch portion of lighting to non-essential, and add occupancy sensors							Develop project design			
Restroom Lighting Controls	Motion sensors in restrooms							Find suitable locations, and estimate savings			
Stairway Lighting Controls	Motion sensors in stairwells							Estimate savings			
Residence Occupancy	Install occupancy sensors to reduce heating when unoccupied	430,000		25,800	200,000		7.8	Review with Residence Life personnel			
Residence Remodeling	Replace suite electric baseboard heaters with more efficient electric heating during remodeling							Keep updated with remodeling plans			
T8 Magnetic Ballasts	Convert campus T8 magnetic ballasts to electronic	138,600		15,000	100,000	33,000	4.5	Identify scope and costs			
Residence Behavior	Community-based social marketing aimed at forming positive behaviors relating to energy and water use							Determine best way to engage residence occupants			
Conference Centre Investigation	Investigate why the Conference Centre is using so much heat							Data and operation analysis			
Conference Centre Air Handler	Convert natural gas air handler to district heating system		1,600 GJ					Review feasibility			
Daycare Eco Audit	Eco Audit as part of Green Fund project							Audit being performed by summer student.			
Lab Heat recovery	Recover heat from Medical Building and Lab 8							Independent Study course starting Jan 2013			
Totals		**1,508,350**	**12,500 GJ**	**234,544**	**792,152**	**33,000**	**3.2**				
Approved Projects											
Continuous Optimization - Phase 3	Optimize building systems for Conference, Library, T&L	410,000		41,000	163,160	82,000	2.0	Prepare BC Hydro application in early 2014	Jul-14		Mar-18
Totals		**410,000**	**0**	**41,000**	**163,160**	**82,000**	**2.0**				
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**
PHW BTU meter install	Install BTU meters on North and South hot water loops leaving Power Plant	0	0	0	16000	0	0	Material purchased, installation required	Aug-13		Jul-14
Exterior Lighting - Agora/Medical Wallpacks	Replace 50W and 70W MH wallpacks with 13.5W LEDs	20000	0	2100	7,000	2,100	2.3	Pending BC Hydro incentive application	Nov-13		May-14
Teaching Lab Pot lights	Replace CFL/incandescent pot lights with LEDs	40000	0	8300	20,800	6,240	1.8	Pending BC Hydro incentive application	Sep-13		May-14
Bentley Pot Lights	Replace 2-pin CFL with screw-in LED and 4-pin LEDs	17000	0	1800	18,200	0	10.1	Pending BC Hydro incentive application	Sep-13		May-14
Administration Atrium Lighting	Replace high bay lighting with LEDs	6000	0	600	0	0	0.0	Installation required	Sep-12	50	Jun-14
Botanical Gardens Pump Control	Add scheduler to pump, and tune VSD	8,000		800	500	0	0.6	Purchasing electrical equipment	Sep-12	60	Jul-14
Humidifier upgrade	Displace electric heating with hot water from Bioenergy	521,000	360 GJ	56,900	100,000	20,000	1.4	Student investigation complete	Sep-12	25	Dec-14
Continuous Optimization - Phase 1	Optimize building systems for Agora, Teaching Lab, Research Lab, and Medical Building	953,000	12,000 GJ	146,700	209,000	0	1.5	Investigation Phase complete, reviewing recommendations	Sep-12	20	Mar-16
Continuous Optimization - Phase 2	Optimize building systems for NSC and Administration	370,000		37,000	129,150	55,150	2.0	Investigation Phase started	Aug-13		Mar-17
Sustainable Communities Demonstration Project	Connect EFL, Residences and Daycare to Bioenergy plant, using either excess capacity from pellet boiler or flue gas heat recovery to provide hot water.		8,000 GJ	80,000	2,000,000		25.0	Initial design in progress. Next phases pending funding.	Oct-12		?

APPENDIX C – COMPLETED STUDIES BY BUILDING

Building	UNBC Energy Audit MCW Aug-09	Utility Data Management Prism Engineering May-12	Energy Management Information System Pulse Energy Jun-12	HVAC Coil Cleaning NALCO Aug-12	Continuous Optimization Phase 1 Prism Engineering Sep-12	Continuous Optimization Phase 2 Prism Engineering Aug-13	Continuous Optimization Phase 3 Jul-14	Student Studies/Projects
Administration	☐	☐	☐	☐		☐		
Agora	☐	☐	☐	☐	☐			
Bioenergy		☐	☐					Flue Gas Heat Recovery Study
Conference Centre	☐	☐	☐	☐			☐	
Daycare	☐	☐	☐					
EFL	☐	☐	☐					
Library	☐	☐	☐	☐			☐	
Maintenance	☐							
Medical	☐	☐	☐	☐	☐			Heat Recovery Study Humidifier Study
NSC		☐	☐			☐		
Power Plant	☐	☐	☐	☐				District Piping Network Study Renewable Energy Feasibility Study Ice Storage Study Thermal Storage Study
QRRC		☐						
Research Lab	☐	☐	☐	☐	☐			Heat Recovery Study
Residence	☐	☐	☐					Energy Use Survey
Teaching Lab	☐	☐	☐	☐	☐			Heat Recovery Study
Teaching & Learning	☐	☐	☐	☐			☐	
Terrace	☐	☐						

APPENDIX D – ENERGY TEAM AND STAKEHOLDERS

Name	Title	Email	Phone Number	Organization
David Claus	Assistant Director, Facilities Management, Energy Manager	david.claus@unbc.ca	250-960-5590	UNBC
Amanda Drew	Energy Technician	amanda.drew@unbc.ca	250-960-5790	UNBC
Shelley Rennick	Director, Facilities Management	shelley.rennick@unbc.ca	250-960-6413	UNBC
Kevin Ericsson	Chief Engineer	kevin.ericsson@unbc.ca	250-960-7059	UNBC
Dale Martens	Assistant Chief Engineer	dale.martens@unbc.ca	250-960-6449	UNBC
Aaron Olsen	Maintenance and Project Supervisor	aaron.olsen@unbc.ca	250-960-6411	UNBC
Kyle Aben	UNBC Pacific Institute for Climate Solutions	kyle.aben@unbc.ca	250-960-6378	UNBC/PICS

Stakeholder Name	Title	Organization
George Iwama	President	UNBC
Blanca Schorcht	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 Management	UNBC
UNBC Students		UNBC
Potential Professors		UNBC
UNBC Faculty		UNBC
UNBC Staff		UNBC
Ron Mastromonaco	Key Account Manager	BC Hydro
Vladimir Kostka	Commercial Account Manager	FortisBC
Greg Stewart	President	Sinclar Group Forest Products
Northern Residents		
General Public		

Energy Manager: Please complete appropriate year below

- Note: All areas (in your contract Year) must be covered in order to receive 4th quarter payment

Year 2 +: Strategic Energy Management Plan requirements

6 Critical Elements must be included in the Strategic Energy Management Plan	**Page number where the element is addressed in the SEMP**	**Energy Manager evaluation**	**PSE Agrees**
1) A purpose statement which answers the following questions:		☐	☐
☐ a) What is your kWh reduction target?	p.1		
☐ b) What is the Key Performance Indicator for your organization?	p.2,3		
☐ c) Who do you need to engage to make your plan successful?	p.1		
2) A table that compares all your building in your portfolio	p.10	☐	☐
☐ a) BEPI- updated to the current year	p.9		
☐ b) Explanation of Top 10 worst performing buildings	p.8-9		
3) Explain what the opportunities are to become more efficient.		☐	☐
☐ a) Project List	p. 11-12,22-23		
☐ b) Initiative List: Behavioural and Organisational	p.22-23		
☐ c) Studies: Outline which buildings have had studies completed.	p. 24		
4) Outline the budget to implement projects		☐	☐
☐ a) If No Budget? Can't forecast your budget? You must explain why not and what you intend to do about getting a budget.	p.3,13-15		
5) Conclusion: How is your plan doing?		☐	☐
☐ a) Outlined kWh saved	p.16-17		
☐ b) Outlined GHG tons saved	p.20		
☐ c) Outlined total dollars saved to the organisation	p.16-22		
☐ d) Outlined avoided cost	p.16,18		
☐ e) Outlined total dollars saved	p.22		
☐			
6) Senior Management Support		☐	☐
☐ a) Approval of the SEMP : Signature on the SEMP	Coverpage		

Tracking:

	2nd Q Draft SEMP Submitted Date	Date PSE Coaching Comments Returned to EM	4th Q SEMP submitted date	Reviewed and Coaching comments returned to EM: Date	*If EM needed to resubmit :date	If PSE reviewed: Date
Energy Manager						
PSE						