Strategic Energy Management Plan

UNBC

University of Northern British Columbia

April 13, 2015

Energy Manager:

David Claus, P.Eng, D.Phil

Partnering with:

BC hydro

powersmart

Senior Management Support:

Table of Contents

1. INTRODUCTION 1

1.1 Energy Management at UNBC 1
1.2 Energy Commitments and Targets 1

2. ENERGY MANAGEMENT AT UNBC 2

2.1 Total Energy Consumption and Cost 2
2.2 Key Performance Indicators 2
2.3 Energy & Cost Intensity 3

3. ENERGY INITIATIVES 6

3.1 FY2015 Energy Projects 6
3.1.1 Continuous Optimization Program 7
3.1.2 Medical Humidifier Upgrade 7
3.1.3 Power Plant Air Handling Unit Upgrade 7
3.2 Energy Project Budget 7
3.3 Energy Management Assessment 8
3.4 Student and Employee Engagement 8

4. ENERGY SAVINGS 9

4.1 Electricity Savings 9
4.2 Bioenergy and Natural Gas Savings 10
4.3 Greenhouse Gas Reductions 11

5. ENERGY MANAGER TOTAL SAVINGS 13

6. ENERGY MANAGEMENT GOING FORWARD 14

APPENDIX A – COMPLETED PROJECT LIST 15

APPENDIX B – POTENTIAL PROJECTS 16

APPENDIX C – COMPLETED STUDIES BY BUILDING 17

APPENDIX D – ENERGY TEAM AND STAKEHOLDERS 18

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 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 impact of the rate increase will be minimized over the next 5 years.

1.1 Energy Management at UNBC

UNBC recently completed its 5th year of the BC Hydro Energy Manager program. The 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 Energy Manager salary and benefits, 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.

The UNBC energy portfolio covers all UNBC owned and operated facilities including the Prince George Campus, Terrace Campus, Quesnel River Research Centre, and BMO Centre in downtown Prince George, a total of 22 buildings. Over the past three years, the Energy Manager Program has been valued at over $1,400,000, bringing in $376,000 in incentives and $373,000 in salary reimbursements, and saving $680,000 in electricity costs through project and program implementation.

1.2 Energy Commitments and Targets

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 aimed to:

1. Reduce electrical and thermal energy consumption by 10% by 2015
2. Reduce fossil fuel consumption for heating by 80% by 2015

The baselines are corrected for building floor space and variations in weather. Based on the consumption in the 2009/2010 fiscal year, our conservation targets for FY2015 were 1,966,000 kWh for electricity and 12,300 GJ for heat. The two-year BC Hydro Power Smart base savings target was 1,547,000 kWh through energy efficiency projects implemented by March 2015. Target achievement not only involves implementing energy efficiency projects, but requires the participation, engagement, and support of students, faculty, staff, and senior administration.

2. ENERGY MANAGEMENT AT UNBC

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 and house roughly 95% of the population.

2.1 Total Energy Consumption and Cost

UNBC uses a mix of different energy sources, primarily electricity, bioenergy, and natural gas. Table 1 lists the actual consumption and cost for each utility based on invoiced amounts.

Table 1 UNBC Utility Breakdown

	FY2015		
	Consumption		Cost
Electricity	17,547,400	kWh	$1,329,200
BioEnergy (Hog Fuel)	4,522	bdt	$296,733
Natural Gas	31,608	GJ	$323,753
BioEnergy (Pellets)	46	bdt	$0
Water	76,359	m^3	$191,132
Propane	5,822	L	$4,728
Diesel	3,396	L	n/a

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.

Electricity accounts for 38% of our total energy consumption, and 68% of our total energy cost. Since electricity costs roughly twice as much as natural gas, and three times as much as bioenergy, UNBC has focused primarily on electricity-reduction projects.

2.2 Key Performance Indicators

Key performance indicators (KPI) 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 annual weather, as measured by heating degree days (HDD) and cooling degree days (CDD), is the single largest driver of energy use for a northern campus such as UNBC.

Table 2 Key Performance Indicators

	2014/15	2013/14	2012/13	2011/12	2010/11	2009/10
Floor Area (average gross, m^2)	98,827	98,827	98,827	98,827	98,129	97,780
Weather (Heating Degree Days)	4,007	4,018	3,975	3,918	4,208	3,909

Occupancy has been included in setting energy baselines for specific buildings such as the Residences where occupancy data is readily available.

2.3 Energy & Cost Intensity

Building Energy Performance Index (BEPI) is defined as the annual energy consumption of a building per square floor area, and is used to compare or benchmark the energy use of buildings. In 2012, sub-meters were installed at the Prince George campus to measure electricity, gas, district heating, and district cooling loads for individual buildings. This has allowed us to: rank buildings based on energy performance; compare buildings against national averages; identify buildings with higher than normal energy use; and monitor building performance over time. The energy intensity of each building is reported in Figure 1, broken down into electricity, gas, chilled water, and bioenergy intensity.

Figure 1 shows our 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 resulting in a loss of heat as all of the heated air is exhausted. In March 2015, the Research Lab, and Teaching Lab completed the Implementation Phase of Continuous Optimization (C.Op) where operational efficiencies such as night-time setbacks, weekend and holiday schedules, air exchange rate reductions, damper controls, and hot water pumping strategies were instituted. The implemented measures are estimated to save 818,000 kWh of electricity and 6,300 GJ of heat over the next fiscal year. In addition, the Medical building will see a significant reduction in electricity intensity over the next year with the replacement of the humidifier system which is expected to save 500,000 kWh per year.

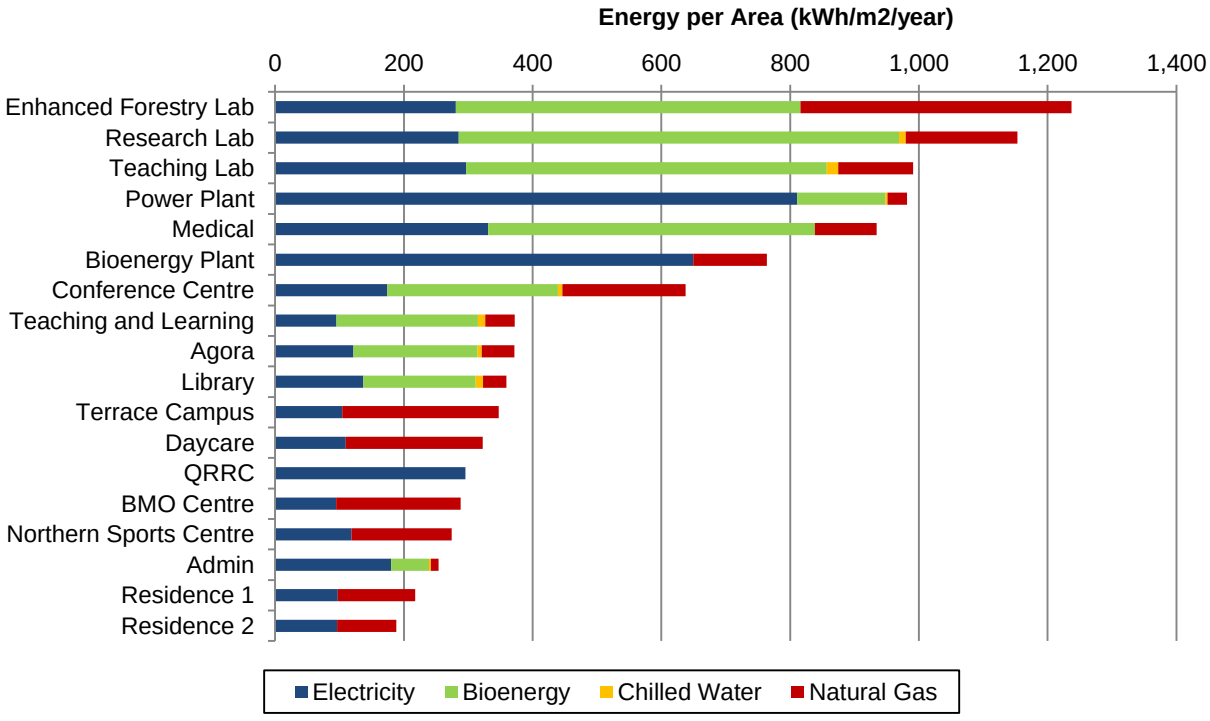

Figure 1 Energy Intensity by Building (Sep 2013- Aug 2014)

In terms of electricity intensity the Power Plant and Bioenergy Facility are using the most electricity per square meter. 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.

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

Similar to the electricity intensity, the four lab buildings are the largest consumers of heat, followed by the Conference Centre. The Conference Centre will be investigated as part of the 3rd Phase of Continuous Optimization which will be kicked off in May 2015.

Table 3 summarizes the annual energy consumption, energy intensity, cost intensity, and savings compared to last year for each building under the Energy Management program.

Table 3 Building Energy and Cost Intensity

	Building Area m^2	Annual Energy Use kWh/y	Annual Cost $/y	Energy Intensity kWh/m^2/y	Cost Intensity $/$m^2$/y	Savings from Last Year %
QRRC	812	175,051	16,594	216	10	28%
Research Lab	7,581	7,257,580	249,510	957	39	22%
Library	11,754	3,690,854	162,644	314	36	14%
Teaching and Learning	10,130	3,277,849	119,210	324	15	13%
Conference Centre	3,253	1,942,968	78,133	597	34	6%
Residence 2	7,425	1,355,993	76,455	183	14	5%
Power Plant	1,253	1,151,931	75,760	919	60	4%
Terrace Campus	1,314	449,508	36,601	342	14	3%
Northern Sports Centre	13,485	3,534,747	200,474	262	26	3%
Daycare	639	195,317	10,169	306	10	3%
Residence 1	7,425	1,566,812	84,840	211	14	2%
Teaching Lab	7,921	7,961,954	276,984	1005	15	1%
Maintenance Building	352	41,236	4,728	117	13	-1%
BMO Centre	1,320	358,859	24,503	272	16	-1%
Enhanced Forestry Lab	931	1,161,265	45,493	1247	23	-2%
Medical	4,468	4,316,311	155,383	966	13	-6%
BioEnergy Plant	1,046	837,138	63,951	800	28	-9%
Administration	9,161	2,671,392	139,943	292	57	-14%
Agora	8,556	3,784,099	133,037	442	36	-15%
Total	**98,826**	**45,730,863**	**1,954,413**	**463**	**20**	**5%**

The average BEPI for UNBC is 463 kWh/year/m^2: a 5% reduction from last year. Significant savings were observed for several buildings including the QRRC, Research Lab, Library, and Teaching and Learning Building. QRRC has been continually reducing electricity use after a visit from our energy team a year ago when several operating efficiencies were found and implemented. The Research Lab was the early focus of the C.Op implementation, and is a large reason why significant savings were seen over the past year. In terms of poor performing buildings, of special note is the Agora, where the cafeteria was renovated, and is now operating longer hours and 7 days a week. In addition to the increase in energy intensity seen in the Agora, the Administration building (which is connected to the Agora) also saw an increase in heating intensity after the cafeteria renovation.

Compared to other institutions, the UNBC BEPI of 463 kWh/year/m^2 was significantly below the outdated 719 kWh/year/m^2 reported by Natural Resources Canada for Canadian universities and colleges in 2003. Though there are more recent Canadian BEPIs being reported, there has been little updated data for universities and colleges. Since the energy consumption of a building is highly dependent on the function of a building, it is important to compare buildings with similar functions. When looking at individual buildings, the Building Owners and Managers Association of Canada: Building Environmental Standards program (BOMA BESt) reported BEPI averages in 2012 for certified multi-unit residential buildings and office buildings at 205 and 331 kWh/m^2, respectively. When comparing the BOMA BESt multi-unit residential buildings to the Residences, Residence 2 is slightly below, while Residence 1 is slightly above the average. Our Administration and BMO buildings are our only buildings with primarily offices, and are both outperforming the BOMA BESt average for office buildings.

3. ENERGY INITIATIVES

UNBC has a history of responsible energy use. The Energy Manager position was filled in June 2010; this has resulted in a renewed focus on the tracking of energy use, developing an energy policy and conservation procedures, and planning efficiency upgrade projects.

3.1 FY2015 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 aimed for a reduction of energy consumption by 10% over a 5-year period from 2010 to 2015. The 2-year Energy Manager contract with BC Hydro Power Smart required project implementations totalling 1,547,000 kWh of annual electricity savings by March 2015.

In FY2014-15 we completed a number of lighting retrofit projects, the C.Op implementation of three buildings, and our first natural gas reduction incented project. The completed FY2014-15 projects are summarized in Table 4. Annual utility savings are expected to exceed $200,000.

Table 4 FY2015 Energy Projects Summary

Energy Projects	Electricity Savings (kWh/y)	District Heat Savings (GJ/y)	Natural Gas Savings (GJ/y)	Utility Cost Savings ($/y)	Project Cost ($)	Incentive ($)
Exterior Lighting	66,000	0	0	$6,310	$101,950	$18,152
Teaching Lab Pot Lights/Exterior Lighting	59,000	0	0	$5,070	$21,320	$2,935
Medical Humidifier	492,000	-230	0	$59,700	$143,300	$74,941
C.Op Research Lab	351,874	1,285	0	$44,318	$84,130	$15,768
C.Op Teaching Lab	247,676	3,759	0	$48,667	$74,540	$16,175
C.Op Agora	218,660	1,249	0	$30,295	$85,790	$15,587
C.Op Medical (Investigation)	0	0	0	0	$12,920	$12,713
Teaching Lab Penthouse Lights	1,022	0	0	$90	$800	$110
Atrium Daylight Harvesting	57,600	0	0	$5,500	0	0
Administration Atrium Lighting	6,090	0	0	$590	0	0
Bentley Centre Pot Lights	17,000	0	0	$1,460	12,070	0
C.Op Administration (Investigation)	0	0	0	0	$18,420	$18,120
C.Op NSC (Investigation)	0	0	0	0	$20,670	$20,330
Reef Fish Tank Lights	2,300	0	0	$180	$1,600	0
Power Plant Air Handling Unit	40,000	0	450	$7,800	$60,000	$60,000
Chiller Shut-down	27,000	0	0	$9,970	0	0
Sweater Day Savings	0	350	0	$2,100	$200	$200
Total	**1,586,200**	**6,413**	**450**	**$222,051**	**$637,700**	**$255,000**

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

3.1.1 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 building 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 the 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. The recommended measures were implemented for the Agora, Teaching Lab, and Research Lab with expected annual electricity savings of 818,200 kWh, annual heat savings of 6,300 GJ at a project payback of 1.6 years. The Medical building implementation was pushed back to March 2016 so that savings from the humidifier project could be verified first.

The following two phases of C.Op have been initiated with the investigation phase of Phase 2 C.Op examining the Administration Building and Charles Jago Northern Sport Centre being completed in September 2014, with the Implementation Phase to be completed by March 2016. Phase 3 C.Op will focus on the Conference Centre, Teaching & Learning Building, and Library, and will begin in summer 2015.

3.1.2 Medical Humidifier Upgrade

In spring 2015 the electric steam humidifier that supplies humidity to the Northern Health Science Research Facility was replaced. The new humidifier system sprays water into preheated air, and will save roughly 500,000 kWh worth of electricity and $60,000 in utility costs per year. The $150,000 of funding for this project was provided by the Northern Medical Program, the BC Hydro Custom Incentive Program, and the UNBC Revolving Loan.

3.1.3 Power Plant Air Handling Unit Upgrade

In 2014, UNBC secured $49,000 in funding from the Advanced Education Carbon Neutral Capital Program (CNCP) to modify the controls and dampers on a natural gas air handling unit in our Power Plant. In addition to CNCP funding, the remaining funding was secured from the Fortis BC Custom Design Program. This project is expected to save approximately 450 GJ of natural gas and $7,800 in utility costs per year, as well as help UNBC work towards our natural gas reduction targets.

3.2 Energy Project Budget

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 avoided energy costs 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.

By the end of FY2015 the Loan Fund has provided funding to 18 energy projects, with a total investment of $487,000. Over the next 5 years, the Loan Fund will be able to contribute over $1,200,000 towards energy projects, and the Energy Manager budget.

3.3 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 has addressed many of the recommended action items from the EMA session.

3.4 Student and Employee Engagement

In FY2015, UNBC was accepted into the BC Hydro Workplace Conservation Awareness (WCA) Program. The goal of the program is to promote knowledge and awareness, inspiring conservation and leadership, and generating the support of staff, faculty, and students required to save energy. In January 2015, we started working with Prism Engineering to develop a WCA program that will help us improve our communication and awareness around energy conservation while working towards our EMA targets.

As part of WCA, we successfully promoted Sweater Day 2015, and Earth Hour, where measurable savings were observed. On Sweater Day, over 80 participants posted photos of themselves in their sweaters with the hashtag #UNBCSweaterSelfie. In addition, we lowered set points for heating on campus which resulted in heat savings of roughly 9%. For Earth Hour, we turned off the atrium lighting, non-essential lighting, and non-essential air handling equipment on the Prince George campus. We sent a team around campus to document areas that were over-lit and under-lit, and to turn off any lights that were missed. This resulted in a 13% reduction of electricity over 3 hours.

4. 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.

4.1 Electricity Savings

In FY2015, UNBC decreased electricity consumption by 528,000 kWh compared to last year. At the marginal rate of electricity these savings are worth $53,700, however, due to the 9% electricity rate increase, UNBC spent an additional $15,700 on electricity. When compared to our electricity baseline, we saved 2,582,000 kWh worth of electricity over the past year; $238,000 in avoided cost savings. Figure 2 and Figure 3 show the overall electricity consumption and costs compared to baseline consumption over the past five years.

Figure 2 demonstrates an overall reduction in electricity consumption over 5 years of 12%. Half way through FY2015, we successfully met our 10% electricity reduction target despite our significant 4% increase in consumption due to the commissioning of the Bioenergy Plant in 2011. Even though the 10% reduction target is corrected for square footage, industrial plants have much higher energy intensities than normal buildings due to their small building footprints, and the operation of process equipment that consume large amounts of electricity.

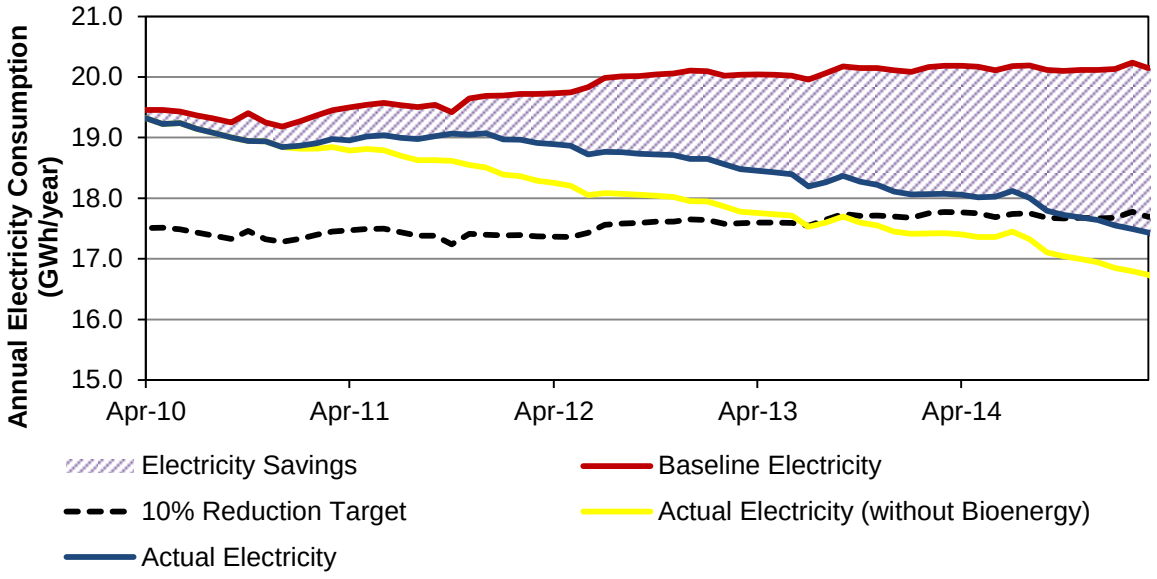

Figure 2 Annual Electrical Usage Compared to Baseline

Figure 3 shows that despite the overall reduction in electricity use, the cost of electricity is increasing. However, had we continued at our baseline consumption, in FY2015 we would have spent an additional $238,000 on electricity. Over the past 5 years, $680,000 in electricity costs have been avoided due to our reduction in electricity consumption.

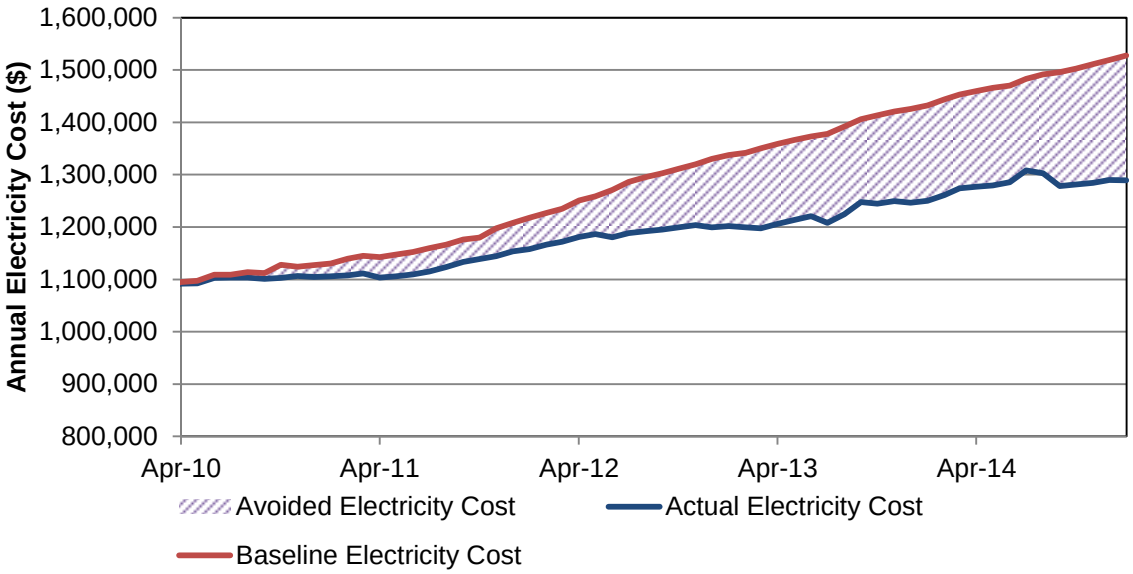

Figure 3 ***Annual Electricity Costs and Savings***

4.2 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.

Figure 4 and Figure 5 show our annual heating breakdown and costs. Compared to last year, we saw an 8% reduction in our heat consumption. Though we have not seen a decrease in heat used compared to our baseline, we saw cost savings of approximately $393,000 in the last year due to our use of bioenergy. Over the past 4 years, the Bioenergy Plant has helped UNBC avoid $2,630,000 worth of natural gas and carbon offset purchases, with net savings of $364,000 after the operating and maintenance costs of the Bioenergy Plant are factored in.

It is important to note that moving from purely natural gas to a mix of bioenergy and natural gas leads to discrepancies in comparing energy output. Notably, a natural gas boiler efficiency is assumed to estimate the Bioenergy heat output in units equivalent to gigajoules of natural gas, and added to the billed consumption from our natural gas utilities. Because we are assuming a natural gas boiler efficiency, there is difficulty comparing the current heat consumption to the consumption prior to the Bioenergy Plant. We recently installed BTU meters to measure the heat output of the Power Plant, and are in the process of gathering data for a more accurate comparison.

Going forward, with the implementation of our three C.Op phases, we will see substantial heat and natural gas savings.

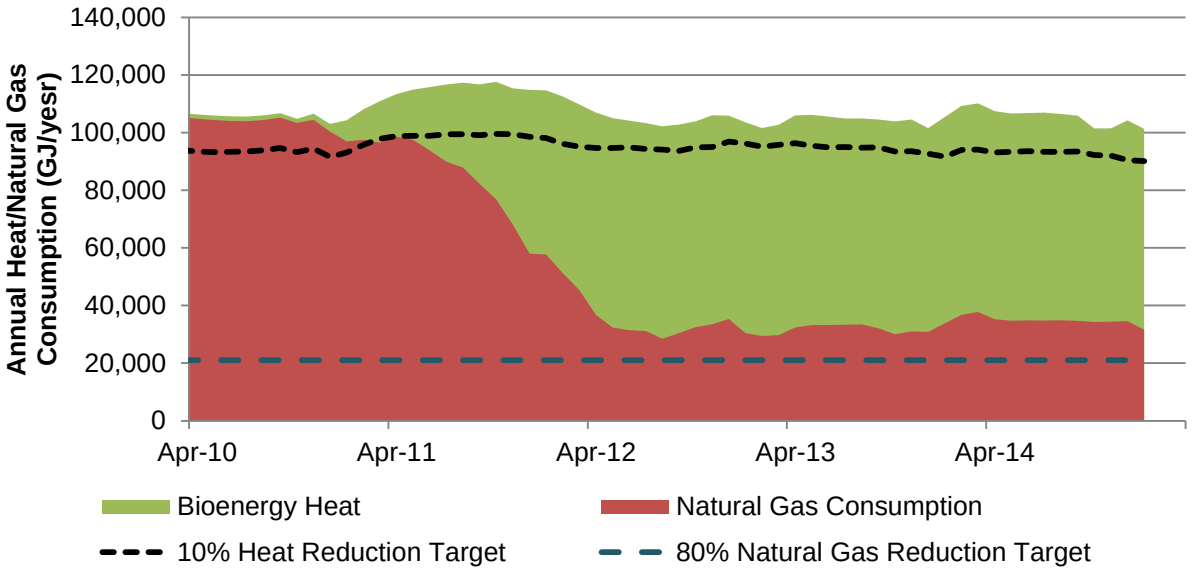

Figure 4 ***Annual Heating Demand Compared to Baseline***

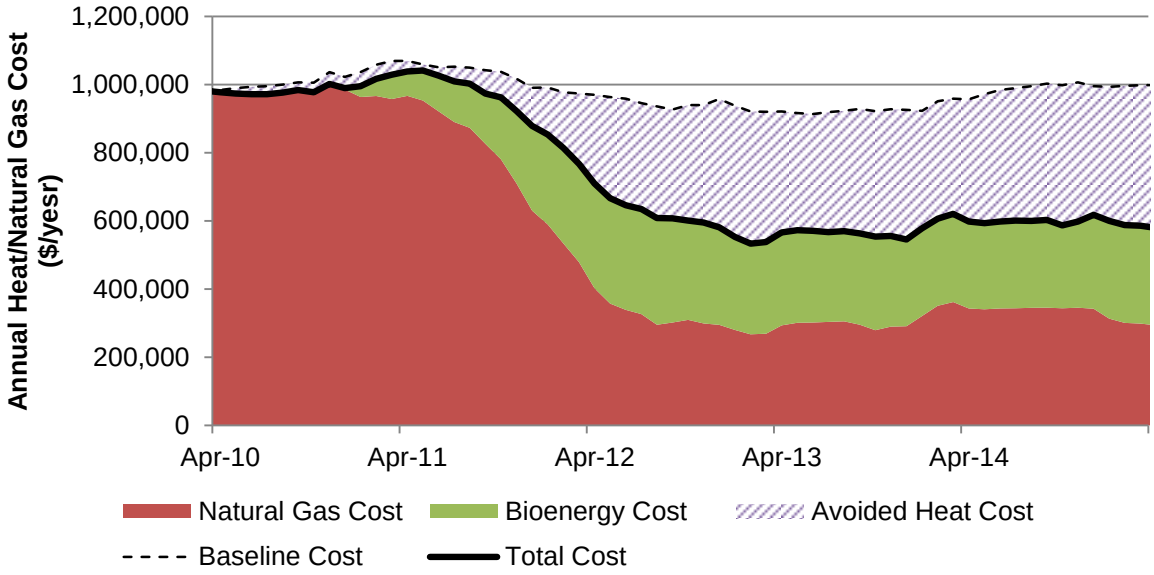

Figure 5 ***Annual Heat and Natural Gas Costs and Savings***

4.3 Greenhouse Gas Reductions

As part of the public sector within the province of British Columbia, UNBC is required to purchase carbon offsets for non-biogenic greenhouse gas emissions associated with building energy consumption, mobile fleet fuel, and paper consumption. The University measures and reports its greenhouse gas emissions using SmartTOOL, through an initiative of the provincial government. Table 5 summarizes the annual carbon emissions reported from SmartTOOL.

With the commissioning of the Bioenergy Plant in 2011, UNBC has seen a 64% decrease in carbon emissions for offset (non-biogenic). Comparing 2014 to 2013, an increase in total emissions was seen due to more bioenergy being used, however the emissions for offset

increased only slightly due to increases in mobile fuel and paper usage. It is important to note that emission factors are constantly being revised, leading to large discrepancies when comparing years. Most notably, a number of emission factors were changed in 2013: 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 resulted in a major increase in total emissions compared to 2012.

Table 5 Greenhouse Gas Emissions (t CO_2e)

Source	2014	2013	2012	2011	2010
Fuel Combustion	1,720	1,719	1,677	3,021	5,186
Biogenic Fuel Combustion	7,431	6,814	3,525	2,395	0
Electricity	254	260	461	470	473
Paper	67	60	63	80	40
Mobile	29	25	24	19	17
Mobile (Biogenic)	1	1	1	1	0
Total	**9,502**	**8,879**	**5,751**	**5,985**	**5,716**
Total (Biogenic)	**7,432**	**6,814**	**3,525**	**2,396**	**1**
Total for Offset	**2,070**	**2,065**	**2,226**	**3,589**	**5,715**

5. ENERGY MANAGER TOTAL SAVINGS

Since the beginning of the Energy Management Program at UNBC in 2010, 41 energy projects have been completed for annual electricity savings of 2,630,000 kWh. To-date the electricity projects have saved $292,000, and have received incentive funding totalling $376,000. Additional electricity savings of $388,000 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 6 shows that the Energy Management Program has saved UNBC over $1,400,000 in avoided electricity costs, incentive funding, and salary funding over the past five years.

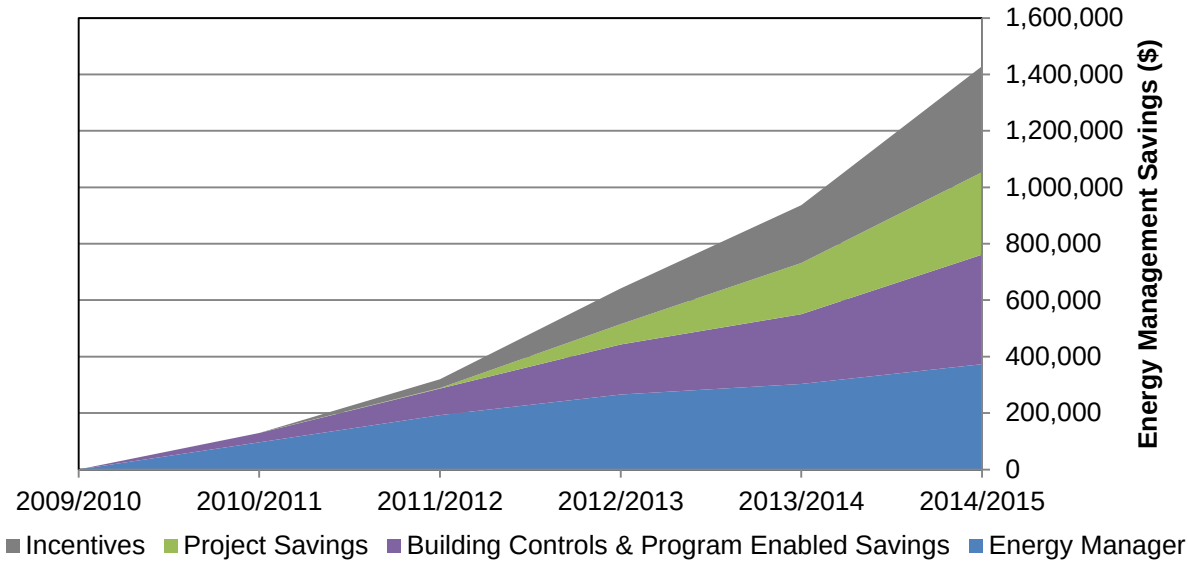

Figure 6 ***Energy Manager Results***

6. ENERGY MANAGEMENT GOING FORWARD

With a major focus on electricity reduction projects, UNBC has met the electricity reduction targets outlined in the Energy Policy, and in the BC Hydro Power Smart Energy Manager contract. Going forward, we will be focusing increasingly on employee and staff engagement, as well as reducing our carbon footprint through heat reduction projects. We will also be setting new Energy Policy targets for the next 5 years. The new targets will be finalized and outlined in next year's SEMP report.

APPENDIX A – COMPLETED PROJECT LIST

Past/Completed Projects	Description	Electrical Svgs (kWh)	Other Fuel Savings (GJ)	Utility Cost Savings ($)	Total Project Cost ($)	BC Hydro Incentive ($)	Simple Pay Back (years)	Date Started	% Complete	Projected Completion Date
Humidifier upgrade	Displace electric heating with hot water from Bioenergy	500,000	-300	59,700	143,300	75,000	1.1	Sep-12	25	Mar-15
Chiller Operating Schedule	Optimize operating schedule (night shutdowns, september shutdown)	27000		10000	0	0	0	Jun-14	100	Sep-14
Continuous Optimization - Phase 1 Implementation	Optimize building systems for Agora, Teaching Lab, Research Lab, and Medical Building	818,210	6,293	123,280	196930	0	1.6	Sep-12	50	Mar-15
Power Plant AHU	Hardwire AHU with boiler operation	40000	450	12900	68000	54700	1.0	Apr-14	95	Mar-15
Teaching Lab Penthouse	Replace T12 fluorescent lighting with T8	1022	0	90	800	110	7.7	Jan-15	100	Feb-15
Reef Fish Tank	Replace metal halides with LEDs	2300	0	180	700		3.9	Nov-14	100	Jan-15
PHW BTU meter install	Install BTU meters on North and South hot water loops leaving Power Plant	0	0	0	16000	0	0	Aug-13	100	Sep-13
Exterior Lighting - Agora/Medical Wallpacks	Replace 50W and 70W MH wallpacks with 13.5W LEDs	19852	0	2100	6,900	945	2.8	Nov-13	100	May-14
Teaching Lab Pot lights	Replace CFL/incandescent pot lights with LEDs	56678	0	8300	14,100	1,990	1.5	Sep-13	100	May-14
Bentley Pot Lights	Replace 2-pin CFL with screw-in LED and 4-pin LEDs	338	0	1800	12,383	0	6.9	Sep-13	100	May-14
Administration Atrium Lighting	Replace high bay lighting with LEDs	6090	0	600	0	0	0.0	Sep-12	100	Jun-14
Power Factor Correction	Connect CT to capacitor bank	0	0	10700	200	0	0.0	Nov-13	100	Dec-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	Sep-12	100	Sep-13
Exterior Lighting (Bollards)	Replace exterior bollard lighting with LED/motion sensing models	7000	0	669	53,123	1,925	76.5	Oct-12	100	Sep-13
Agora Daylight Harvesting	Connect Agora lighting to daylight sensor to turn off all non-essential lighting during daylight	24600	0	2500	0	0	0.0	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	0	3400	0	0	0.0	Oct-11	100	Jun-13
Exterior Lighting (Globes)	Replace exterior globe lights with LED retrofit kits	59,000	0	6000	53505	16,227	6.2	Oct-12	100	Oct-13
Low-flow showerheads	Replace showerheads in Residence with low-flow models	0	1400	22,000	975	0	0.0	Dec-12	100	May-13
QRRC lighting upgrade	Replace T12 fluorescent lighting with T8	7,752	0	730	5128.72	1257.86	5.3	Nov-12	100	Mar-13
EFL Lighting Retrofit	Replace T12 fluorescent lighting with T8	1,181	0	111	578	139	4.0	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	Aug-12	100	Dec-12
Warehouse lighting	Replace MH high bay fixtures in warehouse	43511	0	4099	7201	2875	1.1	Aug-12	100	Dec-12
NSC Soccer field	Replace MH fixtures with impact resistant LED	130,598	0	12,302	125,188	40,000	6.9	Jul-12	100	Sep-12
Building energy displays	Install monitors outside Green Centre to display energy related data	0	0	0	0	0	0	Aug-11	100	Sep-12
NSC Field house relamp	New lamps for T5HO over field house	51,300	0	4,832	10,000	1,160	1.8	Aug-12	100	Aug-12
Coil Cleaning	Nalco coil cleaning initiative	224,610	0	21,158	23,523	9,684	0.7	Aug-12	100	Aug-12
NUSC Event Space LED	Replace incandescent lighting with LED	11,344	0	1,159	6,090	2,634	3.0	Aug-11	100	Jul-12
Terrace lighting upgrade	Replace T12 fluorescent lighting with T8	16,593	0	1,488	14,805	3,994	7.3	Aug-11	100	Apr-12
Utility meter installation	Install submeters for gas, electric, heat, cooling, domestic water	0	0	0	0	0	0	Jul-10	100	Jun-12
Residence Lighting - Common Areas	Replace T12 fluorescent lighting in residences with T8	14,414	0	1,358	17,216	3,208	10.3	Aug-11	100	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	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	0	897	0	0	0		100	Mar-12
Theatre lighting	Replace incandescent lighting with LED	78,705	0	7,414	22,811	11,988	1.5	Dec-11	100	Apr-12
Medical AV Cooling	Install fans to take advantage of free cooling overnight	22,950	0	2,162	11,000	0	5.1	Nov-11	100	Apr-12
Admin Chiller	Replace water cooled centrifugal chiller with air cooled model	98,600	0	13,400	70,000	0	5	Sep-11	100	Mar-12
Ice Mountain	Store ice/snow for summer cooling	0	0	0	0	0	0	Sep-11	100	Nov-11
Canfor Theatre Lighting	Replace incandescent lighting in Canfor Theatre with LED	3,700	0	349	6,000	0	2	Aug-10	100	Aug-10
Terrace Boiler	Replace aging natural gas boiler for Terrace campus	0	300	5,400	45,000	0	8	Aug-10	100	Oct-10
Green Centre Lights	New Green University Center offices - LED lighting	1,240	0	117	640	0	5.5	Nov-10	100	Jan-11
Winter Garden Lights	Convert to Hi-Bay LED	2,630	0	248	640	0	2.6	Dec-10	100	Jan-11
District Energy Pump Study	Review system flow dynamics and pumping requirements for district energy water distribution loops	0	0	0	0	0	0	Jan-10	100	May-11
NUSC Event Space (Round 1)	Halogen to LED - testing 1 fixture	960	0	90	402	160	4.4		100	Mar-12
Rotunda Ramp	Halogen to LED	2,475	0	233	774	390	3.3		100	Aug-12
Rotunda Gallery	Halogen to LED	5,931	0	559	1,987	1,165	3.6		100	Aug-11
Agora North Entrance	Metal Halide to LED	999	0	94	476	244	5.1		100	Aug-11
Bookstore/Cafeteria Lighting	Replace halogen and incandescent lighting with LED	20,796	0	1,959	6,684	3,649	1.5		100	Aug-11
Thirsty Moose Lighting	Replace halogen and incandescent lighting with LED	6,034	0	568	2235	1582	1.1		100	Dec-10
Wind turbine	Preliminary investigation into installing wind generation on campus	0	0						100	Sep-11
Total		**2,657,101**	**8,143**	**373,789**	**1,112,930**	**337,698**	**2.1**		100	

Behavioural/ Education Programs (If applicable)	Description	Electrical Svgs (kWh)	Heat Savings (GJ)	Total Utility Savings ($)	BC Hydro Incentive ($)	Date Started	% Complete	Projected Completion Date
Earth Hour 2015	Announce email, shut down lighting and air handlers, lighting audit (savings over 3 hours)	480		52		Mar-15	100	Mar-15
Sweater Day 2015	Social Media campaign, set point adjustment (savings over month)	0	350	2100	200	Feb-15	100	Feb-15
Residence competition	Two residence buildings compete to lower electrical consumption	2400		150	0	Oct-10	100	Apr-11
Residence competition	Two residence buildings compete to lower electrical consumption	4300		405	0	Oct-11	100	Nov-11
Wintergreen 2011	Promote turning off computer and HVAC during winter holidays	41200		3,100	0	Dec-11	100	Jan-12
Wintergreen 2012	Promote turning off computer and HVAC during winter holidays	79000	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		**205,380**	**1220**	**28,807**	**0**			

APPENDIX B – POTENTIAL PROJECTS

Project Name	Description	Potential Electrical Savings (kWh)	Potential Fuel Savings (GJ)	Potential Utility Cost Savings ($)	Estimated Project Cost ($)	Potential BC Hydro Incentive ($)	Projected Simple Pay Back (years)	Next Steps
NSC Wallpacks	Convert 150W wallpacks to LEDs	18,000		1400	13000		9.3	
Utilidor Lighting Controls	Switch portion of lighting to non-essential, and add occupancy sensors	46,000		3700	21,000		5.7	Develop project design
2x4' 3xT8-mag LED retrofit	2x4' 3xT8(mag ballast) to linear LED	365,000		39800	320000		8.0	
Power Plant Lighting retrofit	Power Plant highbay lighting replaced with LEDs	33,000		2600	29000		11.2	
2x4' 3xT8-elec LED retrofit	2x4' 3xT8 (elect ballast) to linear LED	24,000		2600	33000		12.7	
Restroom Lighting Controls	Motion sensors in restrooms							Find suitable locations, and estimate savings
Stairway Lighting Controls	Motion sensors in stairwells							Estimate savings
Hallway Lighting Motion Sensors	Motion sensors in hallways							
Essential Lighting Review	Review current essential lighting and switch excess lighting to non-essential							Review lighting requirements for essential lighting
Server room HVAC	Replace 2 Liebert chillers in Admin server room	72,000		7,200	130,000		18.1	
Chiller Bypass	Install heat exchange to bypass chiller in shoulder seasons	100,000		24,900	120,000		4.8	Being studied by 5th year engineering design group
Cooling Tower Replacement	Replace Cooling tower and decommission							
Residence 1 Baseboards	Replace electric baseboards in Res 1 with hot water units	326,000	-1,534	25,000	250,000		10.0	
Residence 2 Baseboards	Replace electric baseboards in Res 2 with hot water units	310,000	-1,459	24,000	250,000		10.4	
Residence Behavior	Community-based social marketing aimed at forming positive behaviors relating to energy and water use							Determine best way to engage residence occupants
Natural Gas Reduction Projects								
Flue Gas Heat recovery Option 1 (Peak Heat)	Recover latent heat from Bioenergy flue gases into low temperature loop for peak building demand		800	8,800				Currently being studied by Environmental Engineering Master's student
Flue Gas Heat recovery Option 2 (Peak Heat + Res Baseboards)	Recover latent heat from Bioenergy flue gases into low temperature loop for peak building heat and residence baseboards		2,100	23,100				
T&L Heat Recovery	Heat Recovery in T&L building							
Power Plant Study	Determine efficiency of natural gas boilers, and opportunities to reduce improve efficiency (boiler startup and 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
Ventilation Review	Review ventilation standards, and modify ventilation rates as appropriate							Review standards and current ventilation rates
Conference Centre Investigation	Investigate why the Conference Centre is using so much heat							Data and operation analysis
Lab Heat recovery	Recover heat from Medical Building and Lab 8							Independent Study course starting Jan 2013
Totals		**1,294,000**	**-93**	**163,100**	**1,166,000**	**0**	**7.1**	
Approved Projects								
Continuous Optimization - Phase 3	Optimize building systems for Conference, Library, T&L	405,000	600	45,000	163,160	82,000	1.8	To sign agreement with BC Hydro in Jan 2015
Conference Centre Air Handler	Convert natural gas air handler to district heating system (NG to bioenergy)	0	840	3,260	15,000		4.6	CNCP Proposal
Street Lighting	Replace parking lot and street lights with LEDs	96200	0	9300	84100		9.0	CNCP Proposal, will submit BC Hydro incentive proposal
Totals		**855,600**	**2,640**	**103,534**	**262,260**	**82,000**	**6**	
Projects In Progress								
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 consultation and review
Workplace Conservation Awareness	Awareness campaigns supported by BC Hydro Program	354,400	1,200	45,974	5,200	5,200		Started Jan 2015
25th Anniversary Solar PV	Install 25 solar PV on NUSC (16 from SD57, 9 purchased by UNBC)	5000	0	500	38600	29300	18.6	
Botanical Gardens Pump Control	Add scheduler to pump, and tune VSD	8,000		800	500	0	0.6	Purchasing electrical equipment
Continuous Optimization - Phase 1 Implementation	Optimize building systems for Medical Building	98,000	800	15,100	16000	0	1.1	Investigation Phase complete, implementation pending verification from humidifier project
Continuous Optimization - Phase 2 Investigation	Optimize building systems for NSC and Administration				38,500	38,500	0.0	Investigation Phase complete, implementation started
COp - Phase 2 Admin	Admin Implementation	183,000	1,100	21,843	13,700	0	0.6	
COp - Phase 2 NSC	NSC Implementation	452,000	2,030	58,568	46,500	0	0.8	
Sustainable Communities Demonstration Project - Phase 1a	Connect EFL, Residences and Daycare to Bioenergy plant, using excess capacity from pellet boiler or flue gas heat recovery to provide hot water.	-100,000	6,580	80,000	2,200,000		25.0	Piping installed,
Totals		**646,000**	**10,510**	**176,811**	**2,359,000**	**73,000**	**11.8**	

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-13	Continuous Optimization Phase 2 Prism Engineering Aug-14	Continuous Optimization Phase 3 Jul-15	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
Kyrke Gaudreau	Sustainability Manager	kyrke.gaudrea@unbc.ca	250-960-6623	UNBC

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:	**1**	☐	☐
☐ a) What is your kWh reduction target?	1		
☐ b) What is the Key Performance Indicator for your organization?	1,2		
☐ c) Who do you need to engage to make your plan successful?	1		
2) A table that compares all your building in your portfolio	4	☐	☐
☐ a) BEPI- updated to the current year	3-5		
☐ b) Explanation of Top 10 worst performing buildings	3-5		
3) Explain what the opportunities are to become more efficient.	6-8	☐	☐
☐ a) Project List	6-8,15-16		
☐ b) Initiative List: Behavioural and Organizational	6-8,15		
☐ c) Studies: Outline which buildings have had studies completed.	17		
4) Outline the budget to implement projects	7	☐	☐
☐ a) If No Budget? Can't forecast your budget? You must explain why not and what you intend to do about getting a budget.	7		
5) Conclusion: How is your plan doing?		☐	☐
☐ a) Outlined kWh saved	9-11		
☐ b) Outlined GHG tons saved	12		
☐ c) Outlined total dollars saved to the organization	13		
☐ d) Outlined avoided cost	9-11		
☐ e) Outlined total dollars saved	9-13		
☐			
6) Senior Management Support		☐	☐
☐ a) Approval of the SEMP : Signature on the SEMP	Cover Page		

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						