UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

BC Hydro Power smart

FY2023 Strategic Energy Management Plan

October 12, 2022

Senior Management Support: _____

Rahim Somani, Vice-President, Finance and Administration

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1. OVERVIEW

As Canada's Green University™, the University of Northern British Columbia (UNBC) is committed to minimizing its environmental impact and operating costs by reducing energy consumption through energy efficiency projects, student and staff engagement, and energy awareness campaigns. Not only are we bound to this through social responsibility, but from a strategic priorities standpoint:

> ***Ensure financial accountability, sustainability, and operational effectiveness.***
>
> - UNBC Strategic Road Map, 2018

The cornerstone of UNBC's energy management program is renewable and efficient energy systems that are of particular interest to northern and remote communities. Through the expansion of an award-winning bioenergy system, and the ongoing efforts of the Energy Management (EM) team, UNBC has achieved a 44% reduction in electricity use, a 70% reduction in natural gas consumption (and associated greenhouse gas emissions), and a 43% reduction in utility costs compared to 2010 baseline levels. When compared to FY2021, natural gas consumption in FY2022 decreased by 50%. This is mainly due to increased operation of the Bioenergy Plant after significant maintenance shutdowns in FY2021 and FY2020.

The EM program at UNBC has been strongly supported by BC Hydro for the past 13 years. They currently provide 50% of the funding for a dedicated Energy Manager, as well as incentives to implement energy efficiency, energy conservation, and low carbon electrification projects. BC Hydro has contributed over $1.63 million to UNBC's EM program, which has facilitated numerous projects that have helped to save roughly $4.6 million in electricity costs. This year, UNBC intends to claim at least 500,000 kWh towards the BC Hydro Energy Manager target. Alongside the projects, we will continue to engage the UNBC community through the Energy Wise Network to maximize conservation and awareness efforts.

In addition to the BC Hydro targets, UNBC previously outlined long-term energy reduction targets: a 25% reduction in energy use and an 85% reduction in natural gas use by 2020 (compared to 2010 levels). These targets will be updated as part of a broader renewal of the University's Energy Policy and long term GHG emissions reduction planning. As of March 31, 2022, UNBC saw a 24% reduction in energy use and a 70% reduction in natural gas use compared to 2010. Natural gas consumption continued to decrease compared to the two previous years owing to the increasingly more stable operation of the Bioenergy Plant in FY2022 with fewer equipment breakdowns.

Through the EM program, and the switch from fossil fuels to bioenergy, UNBC has avoided the purchase of roughly $7.9 million worth of energy since 2010. Add to that the over $2.2 million brought in through incentives and salary reimbursements, and UNBC's commitment to sustainable operations can be valued at over $10.1 million.

2. ENERGY MANAGEMENT AT UNBC

The energy management portfolio includes all facilities where UNBC has direct operational control. This enables 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, the Wood Innovation Research Lab (WIRL) 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, while accommodating roughly 95% of the population.

2.1. ENERGY CONSUMPTION AND COST

UNBC uses a mix of different energy sources, primarily electricity, bioenergy, and natural gas. Diesel and propane represent less than 1% of the total UNBC energy consumption and cost. Fuel for vehicles and mobile equipment is not included within the scope of the energy management program. Table 1 lists the actual consumption and cost for each utility based on invoiced amounts.

Table 1 – FY2022 Utility Breakdown

	Annual Consumption		Annual Consumption		Annual Cost
Electricity	11,296,912	kWh	11,296,912	kWh eq	$1,007,716
Bioenergy (Hog Fuel)	3,138	bdt	16,429,692	kWh eq	$255,387
Natural Gas	32,148	GJ	8,930,073	kWh eq	$381,881
Bioenergy (Pellets)	162	bdt	1,221,826	kWh eq	$4,828
Propane	6,088	L	43,122	kWh eq	$7,668
Total			37,921,624	kWh eq	$1,657,480

Figure 1 shows the breakdown of energy consumption from Table 1 for FY2022. Electricity accounted for 30% of total energy consumption, and heat generated from hog fuel (sawmill wood waste), natural gas, and wood pellets accounted for the remaining 70%. Bioenergy (hog fuel and pellets) accounted for almost twice as much as natural gas. The Prince George campus operates two bioenergy systems: a 4.4 MW Bioenergy Plant that uses hog fuel to make hot water for the main campus district heating loop; and a 0.4 MW Pellet Plant that uses wood pellets to produce low-temperature water for on-campus student housing, the Daycare, and the Enhanced Forestry Lab (EFL). Natural gas is used to back up the bioenergy systems on the Prince George campus, and to heat buildings not served by the district heating loops.

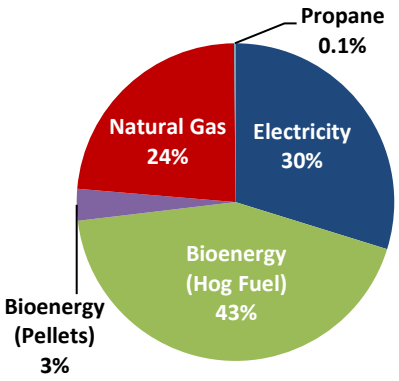

Figure 1 - Energy Use Breakdown

Although electricity accounted for only 30% of the energy consumption, it represented 61% of total energy costs, due to the relatively high marginal rate of electricity, see Table 2. At the Prince George Campus, electricity costs about 1.5 times the cost of natural gas per unit of energy, and almost 4 times the cost of hog fuel. This, however, is based on primary energy and does not take into account efficiency losses when converting natural gas or bioenergy into useable heat.

Table 2 – FY2022 Marginal Energy Rates

Energy Source	Account	Marginal Rate (¢/kWh)
Electricity	Prince George Campus	6.03
	Bioenergy Plant	7.95
	Northern Sport Centre	6.12
	QRRC	9.64
	WIRL	9.78
	Terrace	12.61
Natural Gas	Prince George Campus	3.84
	Northern Sport Centre	3.85
	EFL	4.44
	Bio Plant	4.44
	Agora	4.44
	WIRL	4.44
	Terrace	7.05
Bioenergy (Hog Fuel)	Prince George Campus	1.55
Bioenergy (Pellets)	Prince George Campus	0.40

A provincial carbon tax is included in the cost of natural gas. As of April 1, 2022, this is currently set at $50 per tCO2e, equal to the minimum carbon pricing set by the federal government. The federal government carbon pricing schedule is currently set to increase the carbon price to $170 per tCO2e by 2030, increasing by $15 per year starting in 2023 (the previous annual increase rate was $10 per year). Figure 2 shows the historical marginal rate for natural gas for the Prince George Campus and the projected marginal rate based only on the increasing carbon tax. The cost increase expected is significant, from 10.67 $/GJ in FY2022 to 17.64 $/GJ in FY2031 – an increase of 65%. Using the total cost of natural gas in FY2022, this would translate to roughly $248,000 in additional cost in FY2031 for the same amount of energy. This is just taking into account the increase in carbon pricing; gas commodity prices and other fees will likely also increase. Hence, not only is it crucial for reducing GHG emissions, there is also a clear economic justification for continuing to reduce natural gas consumption.

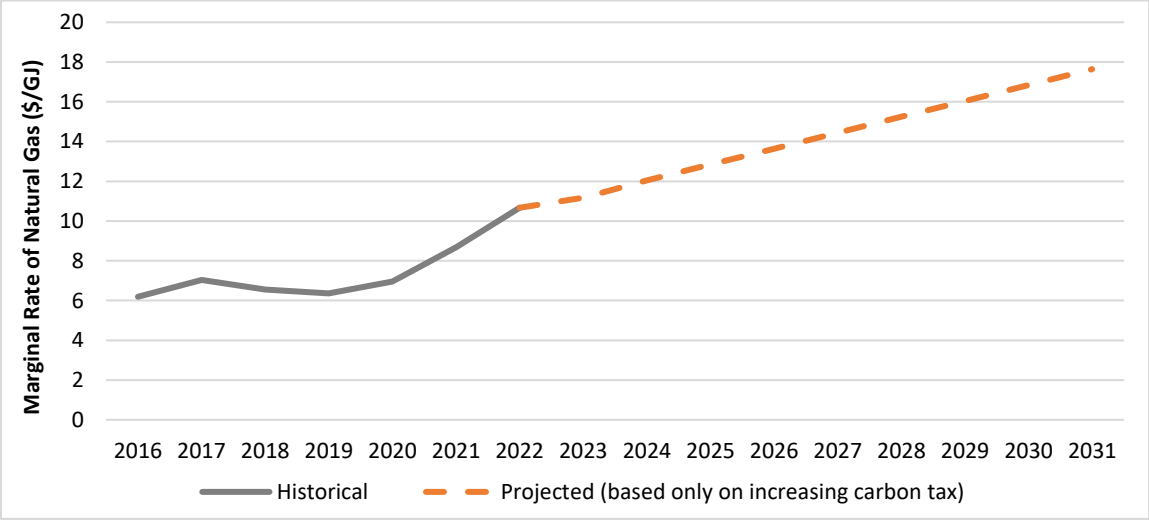

Figure 2 – Prince George Campus Natural Gas Marginal Rate by Financial Year

2.1.1. BIOENERGY AND DISTRICT HEATING

The Prince George Campus has two district heating systems:

1. The main district heating (Main DH) system, which serves 9 buildings, anchored by the Bioenergy Plant and backed up by the natural gas boilers in the Power Plant, and
2. The Low-temperature district heating (Low-temp DH) system, which serves 4 buildings, anchored by the Wood Pellet Plant and backed up by the Main DH.

The Low-temp DH system was commissioned in September 2016, and the Wood Pellet Plant was re-commissioned in November 2016. The Low-temp DH system delivers heat to both student residence buildings, the Daycare Centre, and the Enhanced Forestry Lab.

The two DH systems are integrated at the Bioenergy Plant allowing the new Low-temp DH system to use excess capacity from the Bioenergy Plant as back-up. If capacity from the Bioenergy Plant is not available, the extra heat is provided by the back-up natural gas boilers in the Power Plant.

A fuel breakdown for the Main DH and Low-temp DH systems for FY2022 is shown in Figure 3. In total, 4,400 GJ of wood pellets was used by the Wood Pellet Plant, 59,160 GJ of hog fuel was used by the Bioenergy Plant, and 23,130 GJ of natural gas was used by the natural gas boilers. When compared to FY2021, natural gas use decreased by 59%. This is a result of the increased operating time of the Bioenergy Plant and fewer equipment breakdowns. With continued preventative maintenance, the Bioenergy Plant's operating time is expected to continue to increase in the future and that should further reduce the use of natural gas.

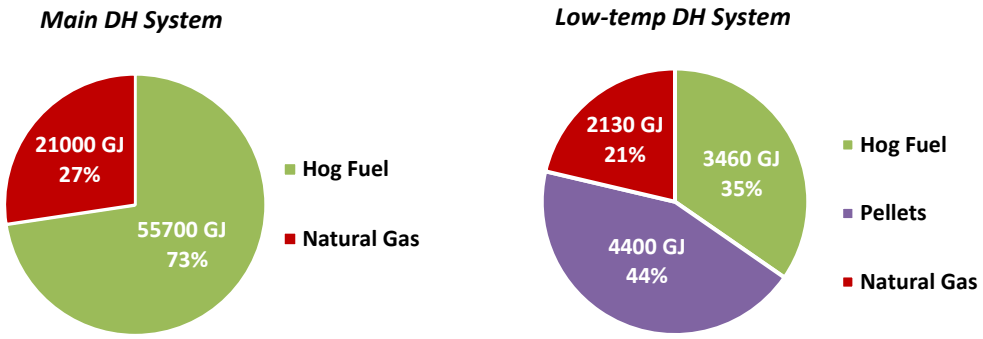

Figure 3 – FY2022 District Heating Fuel Breakdown

2.1.2. ENERGY CONSUMPTION AND INTENSITY BY BUILDING

In 2012, UNBC installed sub-meters throughout the Prince George Campus to measure electricity, hot water, chilled water, natural gas, and domestic water at the building level. The sub-metered data allows us to monitor energy consumption, identify areas of improvement, and verify savings from implemented projects.

Figure 4 shows the breakdown of energy consumption by building. The energy sources include electricity, the Main DH system, cooling from the central chillers, direct natural gas combustion, the Low-temp DH system, and propane.

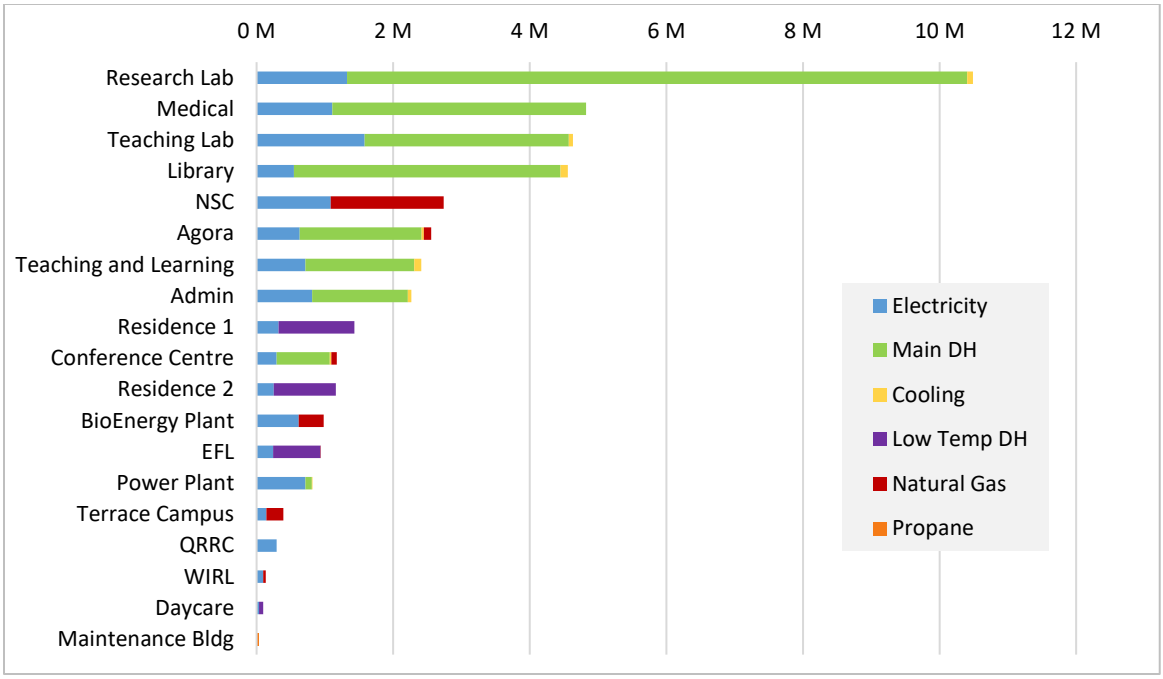

Figure 4 – FY2022 Annual Energy Breakdown (kWh_{eq}/year)

For information on how heat is generated for the two district heating systems, reference Section 2.1.1.

Though Figure 4 shows the magnitude of the energy used by each building, it does not account for the size of the buildings. In order to determine performance of the buildings relative to one another, we correct for floor area and group them according to function; see Table 3 below.

The term 'energy intensity' may also be referred to as Building Energy Performance Index (BEPI) or Energy Use Intensity (EUI) – both are measured in units of energy use per area such as ekWh/m^2 or GJ/m^2. In 2021, Energy Star Portfolio Manager, a Canadian utility usage and energy benchmarking software, reported the median BEPI at Canadian colleges/universities to be between 1.01-1.44 GJ/m^2, or 280-400 ekWh/m^2; the range represents whether transmission of energy is included or not. Though this benchmark is current, it does not distinguish between the different building functions (laboratories, administrative, etc.), whether an institution is research intensive or not, or account for variances in climate. All of these factors can make comparing any BEPI challenging. Statistics Canada is completing an extensive *Survey of Commercial and Institutional Energy Use* using 2019 data, but findings are yet to published. With this difficulty in cross-institutional comparison in mind, UNBC can instead be compared against its own track record.

By evaluating the information in Figure 4 and Table 3, one can see that laboratory buildings are the largest consumers of energy both in terms of total energy and BEPI. They account for 50% of UNBC's annual energy consumption, but only 21% of the total floor space. This high demand is a result of lab buildings operating 24 hours/day and conditioning 100% outdoor air – since recirculation of air is prohibited.

Despite its small footprint, the EFL traditionally has a very high BEPI as a result of significant heating requirements (year-round operating greenhouse) for the small space, and poor insulation due to the amount of single-pane glass. Energy efficiency measures continue to be implemented to improve this. Recent examples include the completion of a lighting upgrade in November 2019 and heating control valve installation in March 2022.

Table 3 – FY2022 Energy, Green House Gas (GHG), and Cost Intensity by Building

	Building Area	Annual Consumption	Annual Cost	Energy Intensity	GHG Intensity	Cost Intensity
	m^2	kWh/yr	$/yr	ekWh/ m^2/yr	kg $CO2_{eq}$/ m^2/yr	$/$m^2$/yr
Laboratories						
EFL	931	937,099	$92,168	1,007	31	$99
Medical	4,468	4,822,334	$137,422	1,079	43	$31
Research Lab	7,581	10,491,387	$223,486	1,384	61	$29
Teaching Lab	7,921	4,634,226	$175,017	585	21	$22
Subtotal	**20,901**	**20,885,047**	**$628,094**	**999**	**40**	**$30**
Industrial						
Bioenergy Plant	1,046	980,212	$79,957	937	68	$76
Power Plant	1,253	816,482	$63,259	652	9	$50
WIRL	921	132,671	$16,596	144	8	$18
Subtotal	**3,220**	**1,929,365**	**$159,813**	**599**	**28**	**$50**
Administrative						
Conference Centre	3,253	1,176,523	$39,019	362	17	$12
Agora	8,556	2,558,887	$82,915	299	13	$10
Teaching & Learning	10,130	2,410,925	$88,672	238	9	$9
Library	11,754	4,556,390	$100,218	388	17	$9
Terrace Campus	1,314	392,269	$36,208	299	35	$28
Childcare Centre	639	99,301	$9,532	155	4	$15
QRRC	812	293,858	$32,284	362	4	$40
Admin	9,161	2,266,229	$90,516	247	8	$10
Subtotal	**45,619**	**13,754,383**	**$479,365**	**302**	**13**	**$11**
Recreation/Accommodation/Other						
NSC	13,485	2,738,003	$173,772	203	23	$13
Residence 1	7,425	1,432,428	$141,271	193	6	$19
Residence 2	7,425	1,160,956	$114,634	156	5	$15
Maintenance Bldg	352	41,556	$7,684	118	26	$22
Subtotal	**28,687**	**5,372,943**	**$437,361**	**187**	**14**	$15
Total	**98,427**	**41,941,737**	**$1,704,632**	**426** [1]	**20** [2]	**$17** [3]

[1] This is an average Energy Intensity calculated via Total Annual Consumption divided by Total Building Area.

[2] This is an average GHG Intensity calculated via Total CO_2 Emissions divided by Total Building Area.

[3] This is an average Cost Intensity calculated via Total Annual Cost divided by Total Building Area.

In FY2022, the overall BEPI for UNBC decreased slightly to 426 kWh/m^2/yr from 430 kWh/m^2/yr in the previous year – a 0.9% decrease. This is despite the increased use of the Bioenergy Plant, which has a lower efficiency than the natural gas boilers. This is also despite the increased occupancy in buildings in FY2022 when compared to FY2021 (due to the COVID-19 pandemic). As a result of the increased use of the Bioenergy Plant, the GHG intensity decreased by 51% compared to FY2021. Additionally, despite increasing gas prices, the cost intensity decreased

compared to FY2021 by 6%. This is also indicative of a reduction in the use of natural gas which has a higher cost than bioenergy.

2.2. ENERGY MANAGEMENT BUDGET

Partial funding for the EM program at UNBC is provided by BC Hydro. Up to $60,000 of the Energy Manager salary is funded by BC Hydro's Energy Manager Program. In addition, UNBC regularly applies for incentive funding from BC Hydro to help implement electricity efficiency projects. UNBC also receives funding from the Ministry of Advanced Education and Skills Training Carbon Neutral Capital Program (AEST CNCP) to implement greenhouse gas reduction projects. The remainder of the project funding comes primarily from UNBC's Energy Conservation Revolving Loan Fund and Routine Capital funding.

2.2.1. ENERGY CONSERVATION REVOLVING LOAN FUND

The Energy Conservation Revolving Loan Fund (Loan Fund) was created in 2012 when $250,000 was made available to fund energy efficiency upgrade projects. After an energy reduction project is implemented, a portion of the energy cost 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 eventually the Energy Manager salary.

Most energy projects are financed through the UNBC Energy Conservation Revolving Loan Fund, with incentives and outside funding being added to the fund as they are received.

By the end of FY2022, the Loan Fund facilitated $2.94 million of spending towards energy efficiency projects. A summary of the Loan Fund cash flow can be seen in Figure 5. The implemented projects have saved roughly $3.24 million in utility costs, with net utility savings of approximately $1.56 million after loan repayments.

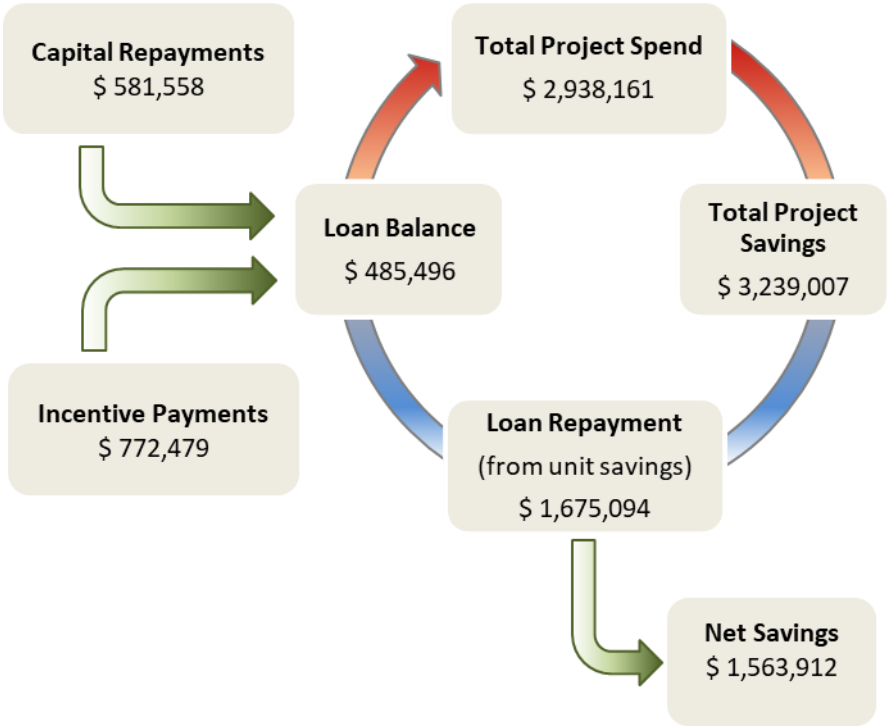

Figure 5 - Revolving Loan Summary

2.3. ENERGY COMMITMENTS AND TARGETS

UNBC's former Energy Policy set the following targets:

1. Reduce electrical and thermal energy consumption (combined) by 25% by 2020;
2. Reduce fossil fuel consumption for heating by 85% by 2020.

Reductions are based on a comparison with the 2009/2010 baselines, corrected for building floor space and variations in weather. To reach these targets UNBC had to implement a wide variety of energy efficiency projects over the last decade, as well as gain the attention, support, and participation of students, staff, faculty, and senior administration.

New targets are being developed as part of renewed long term planning for the energy management program, which includes establishing a long term Greenhouse Gas Emissions Reduction Plan. Compared to 2007 baseline levels, UNBC's GHG emissions have reduced by 50% as of 2021, primarily due to the Bioenergy Plant offsetting the consumption of natural gas. This meets the 2030 BC provincial target of 40% reduction as set in the Climate Change Accountability Act. The longer term provincial reduction targets are 60% by 2040 and 80% by 2050. To help meet these targets, the Province also established 2030 emission reduction targets for four sectors, including "buildings and communities" set at 59-64%. UNBC has already met this sectoral target in the past, in each of the six years between 2013-2018, before the Bioenergy Plant's major maintenance shutdown in 2019. At their lowest point in 2015, emissions were 70% lower than the 2007 baseline. To further reduce emissions, deep building retrofits, including envelope upgrades, are anticipated in the coming years, in addition to other initiatives like low carbon electrification and heat recovery.

UNBC commits to aggressive energy conservation through advanced technological and material improvement to all of our campuses. Furthermore, continued community engagement for our students, staff, and faculty will play a major role in knowledge sharing with the next generation and empowering everyone to 'do their part'. Through the energy management program, and with BC Hydro's ongoing support, UNBC will endeavor to remain a responsible and accountable community leader with respect to minimizing our use of precious environmental resources.

3. ENERGY INITIATIVES

The energy management program keeps a detailed list of past and future conservation projects to meet its energy reduction targets. The list is updated and prioritized regularly to address the operational issues and requirements of the campuses from which they arise. In addition, projects are planned and scheduled based on internal capacity and the availability of funding. A full list of completed and current projects and studies is included in the appendices.

The following sections of the report detail the multi-angled approach UNBC takes in energy management, as well as community engagement and training. There are many ways to affect change in an organization, so by tackling the issue of UNBC's resource consumption through various avenues, we give ourselves the greatest chance for success.

3.1. ENERGY WISE

UNBC is an active participant in the BC Hydro Energy Wise Network. As a network member we host an engagement campaign for our campus community each year, promoting energy use awareness and conservation. In FY2022, the campaign was geared towards specific tasks or actions for participants to complete through a bingo-styled game. The appeal of this type of campaign was that it could work for anyone, anywhere, in the era of COVID-19. This was the second time this campaign was undertaken due to its popularity in FY2021. UNBC is also taking

part in the Energy Wise Network in FY2023 and will be carrying out an engagement campaign focused on reducing energy usage for space heating.

3.2. ENERGY MANAGEMENT ASSESSMENT (EMA)

UNBC completed its most recent Energy Management Assessment (EMA) on November 22, 2021. The EMA is typically carried out every two years and is designed to help evaluate the current state of an energy management program, identify gaps and opportunities for improvement, and establish the activities needed to reach a desired future state. This was UNBC's sixth EMA and was facilitated by CLEAResult. It was attended by nine UNBC leadership stakeholders, including all of the vice-presidents at the time. Overall, a rating of 91% was determined based on assessing each of the applicable areas shown in Figure 6.

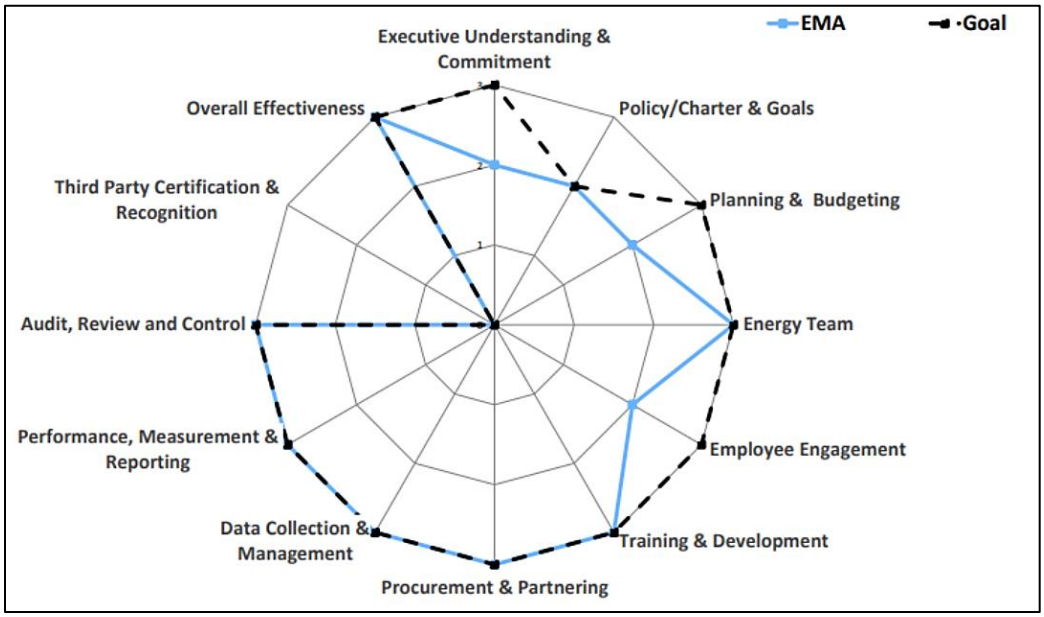

Figure 6 – 2021 Energy Management Assessment Analysis for UNBC

Overall, it was found that UNBC has a strong inclination towards energy management, supported by a strong team with well-planned actions for continuing energy efficiency. However, as seen in Figure 6, a few areas were identified as not fully meeting the desired goals, and corresponding recommended actions were outlined to improve these areas.

Under the area of executive understanding and commitment, it was recommended to formalize a recognition process through the Executive Sponsor for the energy team and employees who contribute to energy efficiency. This has not yet been initiated but will be investigated in the coming year. Additionally, it was recommended that the Energy Manager provide regular updates to the energy team and executive sponsor on energy efficiency upgrades and initiatives. This is currently being carried out through quarterly updates.

Under the area of planning and budgeting, it was recommended to continue using the Energy Conservation Revolving Loan Fund to invest in energy management at UNBC. As described in Section 2.2.1, the Fund continues to be maintained and used to invest in energy management projects. An additional recommendation was to formalize the budgeting process for energy management by identifying short and long-term projects for inclusion in university budget planning. The process has started for incorporating energy budgeting into the long-term capital planning of the institution. Short-term energy management budgeting is currently incorporated into the Facilities budgeting for each fiscal year, which then feeds into the overall university budget.

Under employee and student engagement, recommended actions included optimizing the delivery of online content via UNBC's social platforms and website to provide updates and highlight success stories related to energy management. Further work is required on updating the website and providing more regular updates. However, social media has been used to promote success stories such as the continued operation of the solar panels at the Conference Centre, to promote the Energy Wise campaign, and also to point to the website when public reports are published such as the Climate Change Accountability Report. Another recommendation was to run an engagement campaign on energy conservation. This continues to be done at least once annually through participation in the Energy Wise Network, as described in Section 3.1.

3.3. CONTINUOUS OPTIMIZATION

UNBC enrolled in the BC Hydro Continuous Optimization (C.Op) Program in 2012. At the outset of the program and with the help of Prism Engineering, 9 different buildings were identified on the Prince George campus as having significant energy and cost saving opportunities. A plan was developed to deliver upgrades and retrofits to key systems, equipment, and controls in each of the 9 buildings over 3 Phases, starting with the buildings that had the highest savings potential. We are referring to this as Round 1 of C.Op.

In FY2019, C.Op Phase 3/Round 1 fully wrapped up with the completion of the Q4 Coaching Reports for the Conference/NUSC, Library, and Teaching & Learning buildings. The total savings were calculated to be approximately $140,000/year, as a result of these efforts for the 9 buildings in Round 1 of C.Op.

In FY2020, Round 2 of C.Op was proposed by BC Hydro for customers who had gone through Round 1 and for whom it had been at least 5 years since the completion of the buildings in a given phase. As such, UNBC qualified to revisit the buildings that participated in Round 1, Phase 1. These buildings include Agora, Research Lab, and Teaching Lab. Investigations into the continued functionality of previously instituted measures, as well as any new possible measures, were completed in FY2021.

In FY2022, the second phase for Round 2 was successfully carried out. This included two buildings: the Northern Sport Centre and the Charles J. McCaffray Hall (Administration Building). The third and final phase of Round 2 is currently being implemented in FY2023. This includes three buildings: the Conference Centre, Library, and Teaching and Learning building. As in the case of Round 1, Round 2 consulting is being provided by Prism Engineering, with guidance and collaboration from the UNBC EM team, thus providing continuity to the process.

3.4. LED LIGHTING RETROFITS

The Prince George campus underwent extensive lighting upgrades most recently in FY2020 to replace magnetic-ballasted linear fluorescent fixtures from the original campus build. With the conclusion of these projects, partial or complete retrofits have been accomplished in all of the original buildings. While no dedicated LED lighting upgrades are being carried out in FY2023, there are still lighting upgrades being planned for the future, such as for the Northern Sport Centre basketball court. Additionally, lighting continues to be upgraded as part of space renovations where applicable, such as for the Library first floor renovation in FY2022, where the opportunity was taken to upgrade the existing lighting to networked LED lighting.

3.5. HEAT EXCHANGER UPGRADES

Another energy efficiency initiative that UNBC is undertaking is a multi-year series of heat exchanger upgrade projects. In FY2022, a comprehensive upgrade was completed for the heat exchanger systems in the Dr. Donald Rix Northern Health Sciences Centre (Medical Building),

following on from upgrades completed in previous years, including in the Power Plant, Charles J. McCaffray Hall (Administration Building), Teaching & Learning Centre, and the Conference and Northern University Student Centre. The main intent of these projects is to replace aging inefficient heat exchanger systems with newer more efficient systems. This entails replacing large inefficient plate-and-frame heat exchangers with smaller more efficient brazed plate heat exchangers. Additionally, this often involves replacing multiple large inefficient fixed speed pumps with fewer and smaller variable speed drive pumps. The redesigns can also include decoupling systems so that they can be run independently, such that equipment can be shut down when not needed. These optimizations, large and small, ultimately improve the efficiency of each system that is upgraded, thereby resulting in reduced energy consumption.

In FY2023, two heat exchanger systems have been upgraded in the Agora building. The building's remaining heat exchangers are planned to be upgraded in FY2024 with preliminary design work already underway. Further similar upgrades in other buildings, including the energy intensive Research Laboratory, are planned to be completed in the coming years. One of the positive byproducts of the upgrades is that the temperature of the main district heating loop is anticipated to decrease, which should allow for more heat recovery opportunities.

3.6. LOW CARBON ELECTRIFICATION

The purpose of low carbon electrification (LCE) at UNBC is to decrease the carbon emissions while still providing cost effective and efficient energy services to the campuses. Predominantly hydroelectrically generated electricity presents an opportunity to reduce the carbon intensity of heating demands if it is used as an enabler for low carbon heating. Merely converting heating loads from natural gas to electric resistive heating is neither cost effective nor sensible from an energy best use perspective.

UNBC has reduced its carbon emissions by up to 70% compared to 2007 baseline levels, through adoption of two biomass heating systems. Although not intended as electrification initiatives, these have increased the electrical demand of the University by about 900,000 kWh annually.

The remaining carbon intensive energy services include heating at the NSC and Terrace campus, diesel for backup electricity generation, and the vehicle fleet.

In FY2018, the University ordered a new electric vehicle for the Facilities department to service the new WIRL building in downtown Prince George. It is now the department's most used light-duty vehicle for travelling on the main campus and within Prince George. It is estimated to reduce carbon emissions by 2.1 tonnes CO2e/yr, while adding 2200 kWh to the annual electrical consumption. Further electrification of the university fleet is required in the years ahead to help meet the province's target of reducing public sector fleet emissions by 40% below 2010 levels by 2030.

Currently a number of small LCE projects are being worked on, primarily looking at using heat pumps for domestic hot water (DHW) heating. As an example, a hybrid heat pump hot water heater has been installed in the Agora to replace an existing ineffective heater that used glycol heated by the district heating system. Similar replacements are planned for other DHW heaters in the Agora. A more substantial DHW heat pump system is also being planned for the Northern Sport Centre, where gas-fired boilers are currently used. Additionally, a heat pump system will be looked at for the standalone Maintenance Building which currently relies on propane for its heating needs.

These comparatively small projects will help inform the planning and design of larger and more complex electrification projects in the future. One such example would be a full-scale implementation of an air source heat pump installation to reduce the natural gas consumption of the NSC by 90%. This would be coupled with aggressive heat recovery and conversion to hydronic heat distribution within the building to enable future incorporation of district heating, geo-exchange

or other renewable heating options. At present this project is cost-prohibitive; however, we anticipate additional work to revise the efficiency of the design and implementation. The goal of 90% reduction in natural gas consumption would equate to reducing gas consumption by 5200 GJ/year and avoiding 258 t CO2e/yr.

3.7. FY2022

In FY2022, UNBC completed the second phase of Continuous Optimization Round 2, which was supported by funding from BC Hydro. This entailed the investigation and implementation of measures to reduce energy use in two buildings: the Northern Sport Centre (NSC) and the Charles J. McCaffray Hall (Administration Building). A total of 21 existing measures were reconfirmed and 7 new measures implemented, resulting in total fuel savings of 3,034 GJ/year and total electrical savings of 541,854 kWh/year. Thus, the FY2022 electrical savings target of 500,000 kWh was successfully exceeded.

Table 4 – FY2022 Project List

Project	Electricity Savings	Project Cost	Cost Savings	Payback
	(kWh/y)	($)	($/yr)	(y)
C.Op Round 2 – NSC	409,825	3,100	63,398	0.1
C.Op Round 2 – Admin Building	132,029	6,300	16,811	0.4
Subtotal	541,854	9,400	80,209	0.1

3.8. FY2023

In FY2023, UNBC is currently implementing the third and final phase of Continuous Optimization Round 2, which is supported by funding from BC Hydro. This entails the investigation and implementation of measures to reduce energy use in three buildings: the Conference Centre, Library, and Teaching and Learning building. The Investigation Phase has been completed and the Implementation Phase is currently underway. Upon completion, it is expected that a total of 27 existing measures will have been reconfirmed and 9 new measures implemented, resulting in total fuel savings of 6,098 GJ/year and total electrical savings of 634,831 kWh/year. The FY2023 electrical savings target of 500,000 kWh will therefore be met and exceeded.

Table 5 – FY2023 Project List

Project	Electricity Savings	Project Cost	Cost Savings	Payback
	(kWh/y)	($)	($/yr)	(y)
C.Op Round 2 – Conference Centre	82,665	9,300	14,202	0.7
C.Op Round 2 – Library	393,639	4,200	36,618	0.1
C.Op Round 2 – T&L Building	158,527	4,900	19,214	0.3
Subtotal	634,831	18,400	70,034	0.3

3.9. FY2024

Table 6 shows various projects for potential implementation in FY2024, such as a lighting upgrade at the Northern Sport Centre. However, this list is not exhaustive and more detailed planning will be carried out in the next few months to finalize the list of projects to be carried out in FY2024.

As described in Section 3.5, further heat exchanger system upgrades will be implemented over the coming years. Design work is already underway for upgrades to the remaining Agora heat exchanger systems, with installation expected in summer FY2024. Also, as mentioned in Section

3.6, small heat pump conversion projects are expected to continue in the next year, in preparation for larger LCE projects such as a full scale retrofit of the Northern Sport Centre.

Other long-term projects being considered include flue-gas heat recovery for the Bioenergy Plant, cooling tower replacement or upgrade, campus heat balancing, building envelope upgrades, and further lighting upgrades. As part of long term GHG emissions reduction planning, additional related projects may be identified in the coming year.

Table 6 – Potential Project List for FY2024

Project	Electricity Savings (kWh/y)	Project Cost ($)	Cost Savings ($)	Payback (y)
Secondary Loops – SPR	40,000	5,000	3,600	1.4
Chilled Water Loop – SPR	23,000	4,000	2,090	1.9
Chilled Water Loop – Heat Movement	140,000	150,000	12,600	12
EFL Shade Curtains	1,000	130,000	6,490	20
NSC Lighting Upgrade	50,000	55,000	4,950	11

4. ENERGY PERFORMANCE

To assess energy performance, we compare monthly energy consumption for each utility account to a FY2010 baseline. Baselines were developed comparing the FY2010 utility data to the degrees of heating and/or degrees of cooling required based on the outdoor air temperature. Outdoor air temperature is the largest driver of energy consumption at UNBC. Occupancy is a driver for the two Residence buildings but has proven to be less significant for the other buildings.

Figure 7 shows the annual energy intensities compared to the FY2010 baseline intensity which corrects for variations in weather. Overall, UNBC has achieved a 24% reduction in energy use compared to FY2010. Figure 7 also shows how UNBC has reduced its natural gas consumption by 70% compared to FY2010. The natural gas reduction started in FY2011 when the 4.4 MW Bioenergy Plant was commissioned and started providing heat to the Prince George Campus. The Bioenergy Plant now meets, on average, 85% of the annual heating requirements of the buildings connected to the main district heating loop.

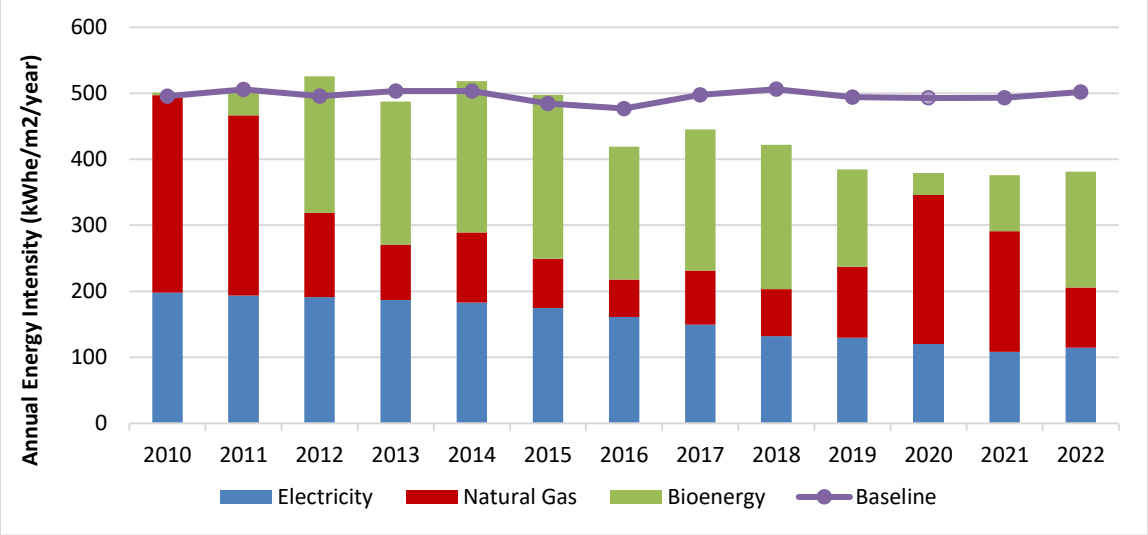

Figure 7 - Historical Energy Intensity by Financial Year

In FY2017, the Low-temp DH loop, anchored by the Wood Pellet Plant, was commissioned, displacing natural gas at the Neyoh Residence and the EFL greenhouse. In FY2018, the Keyoh Residence and Daycare centre were converted to hot water systems and connected to the Low-temp DH system. Now only 3 of UNBC's 22 buildings use natural gas or propane as their primary means of heating: the Maintenance Building, the Northern Sports Centre, and the Terrace campus.

By the end of FY2022, UNBC has seen an overall reduction of 24% in utility costs since FY2010, as shown in Figure 8. When compared to the baseline energy cost, the cost savings is 43%. In other words, we've grown the University while simultaneously reducing energy consumption.

One of the core reasons for utility cost reduction has been the Bioenergy Plant. Hog fuel used by the Bioenergy Plant is lower in cost than natural gas. In more recent years, the lower-than-baseline energy costs can also be traced to two factors: (i) UNBC started purchasing natural gas for its two largest accounts from Shell Canada in FY2015, lowering the marginal rate on both, and (ii) there has been an extensive effort to reduce natural gas consumption through recommissioning building automation systems and various other energy management projects. The significant ongoing increase in natural gas prices is reflected in the noticeable rise in the baseline trend shown in Figure 8.

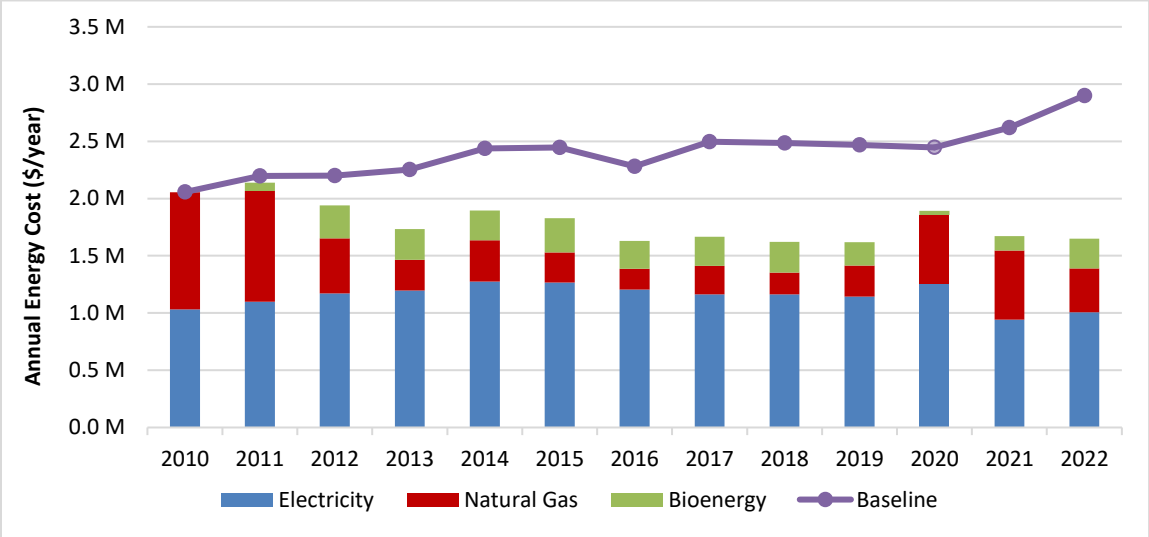

Figure 8 - Historical Energy Cost by Financial Year

4.1. ELECTRICITY SAVINGS

UNBC has reduced electricity consumption by 44% from 2010 baseline levels, as shown in Figure 9, equivalent to almost $700,000 in annual savings. Compared to FY2021, consumption in FY2022 increased by 6%. This is likely due to an increase in occupancy and use of spaces after the initial period of the COVID-19 pandemic that was concentrated in FY2021. When compared to the largely pre-pandemic FY2020, electrical consumption in FY2022 was 5% lower.

As shown in Figure 9, our collective efforts on energy efficiency and conservation have resulted in the avoided purchase of $4.6 million worth of electricity since 2010.

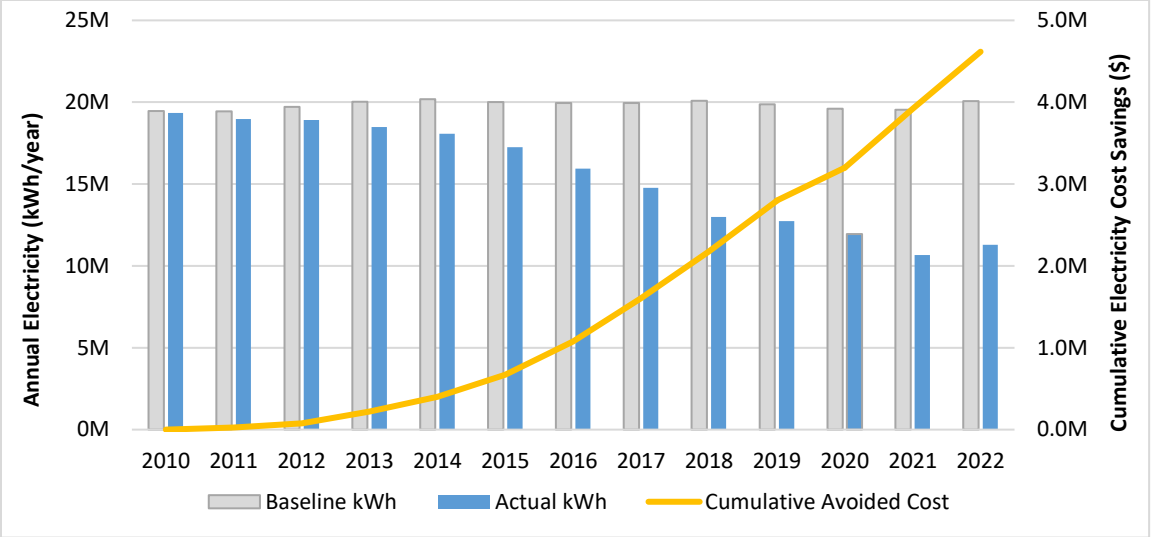

Figure 9 - Historical Electricity Consumption by Financial Year

4.2. HEAT SAVINGS

Since FY2010, UNBC has reduced natural gas consumption by 70% through the conversion to bioenergy on the Prince George Campus. However, with the start-up of the Bioenergy Plant the total purchased heat increased slightly as seen in Figure 10. The term *purchased heat* refers to the energy content of the purchased natural gas, hog fuel and wood pellets used to produce heat. Note an energy density of 18.8 GJ/bdt is used to calculate energy content of wood biofuel.

The reason for an increase in purchased heat is due to the difference in efficiencies between the Bioenergy Plant and the natural gas boilers. In FY2010, the natural gas boilers provided all of the heat to the Main DH loop, and ran relatively efficiently. As bioenergy has replaced the use of the natural gas boilers, when the boilers are needed as back-up, they operate at a lower firing rate resulting in a lower efficiency. In addition, the efficiency of the Bioenergy Plant is slightly lower than that of the natural gas boilers at full capacity, and can vary widely depending on the moisture content of the fuel, the time between boiler cleanings, and operator interventions.

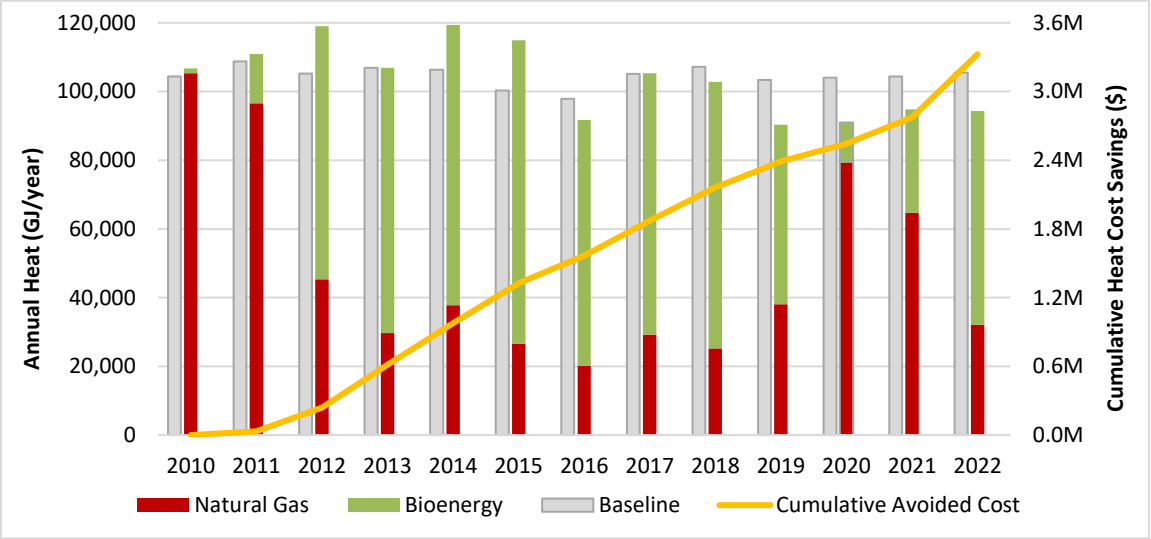

Figure 10 - Historical Heat Consumption by Financial Year

Comparing FY2022 to FY2012 when the Bioenergy Plant came fully online, we have seen a 21% decrease in purchased heat, equivalent to roughly 24,650 GJ. As a result of increased use of the Bioenergy Plant in FY2022, natural gas consumption reduced by 50% when compared to FY2021. This trend is expected to continue as the Bioenergy Plant returns to increasingly more stable operation.

In summary, despite recent operational challenges with the Bioenergy Plant, it has enabled UNBC to cut heating costs by over $3.3 million since it's commissioning 10 years ago. The hog fuel used by the Bioenergy Plant is roughly 40% of the cost of the equivalent amount of natural gas and therefore still more economically viable than natural gas. As can be seen in Figure 10, the recent significant increase in natural gas prices has in turn led to a sharp rise in cumulative savings as a result of being able to use bioenergy for most of our heating needs instead of natural gas.

As the EM program continues to identify and deliver savings and efficiency improvements to our natural gas and bioenergy heating systems, we will continue to see the cumulative savings grow.

5. SUMMARY

Over the past 13 years, the UNBC EM program has brought in $1,394,800 in incentives, $824,400 in salary reimbursements, and has implemented 6.8 million kWh/yr worth of electrical conservation projects and 10,600 GJ/yr worth of natural gas conservation projects. When these savings are added to those attributed to the Bioenergy and Wood Pellet Plants, UNBC has saved a total of $7,943,000 in utility costs.

Figure 11 shows the breakdown of the $10,162,000 value of UNBC's energy management program and funding partnerships with BC Hydro, Fortis BC, and the Carbon Neutral Capital Program.

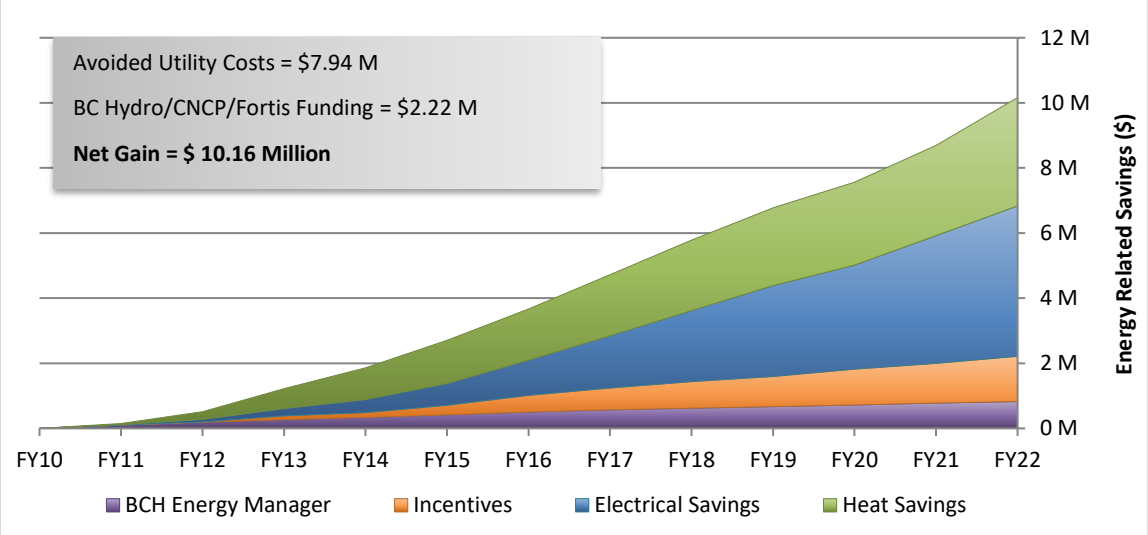

Figure 11 - Energy Management and Utility Savings

APPENDIX A – COMPLETED PROJECT LIST

	Project	Campus	BC Hydro Project Number	Electricity Savings (kWh/y)	Electricity Demand Savings (kW/month)	Natural Gas Savings (GJ/y)	District Heat Savings (GJ/y)	Cost ($)	BC Hydro Incentive ($)	Fortis Incentive ($)	CNCP Funding ($)	Revolving Loan Contribution ($)	Total Savings Last year ($)	Total Savings to-date ($)	Completion Date
1	Canfor Theatre Lighting (Round 1)	Main	-	3700	1	0	0	6000	0	0	0	0	401	3266	10-Aug
2	Terrace Boiler Replacement	Terrace	-	0	0	300	0	45000	0	0	0	0	5219	44666	10-Oct
3	Green Centre Lighting	Main	-	1240	0	0	0	640	0	0	0	0	135	1077	11-Jan
4	Wintergarden Lights	Main	-	2630	1	0	0	640	0	0	0	0	245	1989	11-Jan
5	Agora North Entrance Lighting	Main	PSPX110586	999	0	0	0	476	218	0	0	0	60	508	11-Apr
6	Rotunda Gallery Lighting	Main	PSPX110587	5931	1	0	0	1987	1165	0	0	0	553	4401	11-May
7	Rotunda Gallery Ramp Lighting	Main	PSPX111364	2475	1	0	0	774	390	0	0	0	231	1837	11-May
8	Admin Chiller for electrical vault	Main	-	98600	11	0	0	70000	0	0	0	0	7569	59348	12-Mar
9	T&L Daylight Harvesting	Main	-	9519	2	0	0	0	0	0	0	0	862	6580	12-Mar
10	Medical AV free cooling	Main	-	22950	3	0	0	11000	0	0	0	0	1762	13702	12-Apr
11	NUSC Event Space	Main	PSPX110510	11344	7	0	0	6090	2474	0	0	6090	1710	11940	12-Jun
12	NSC Soccer Field and Gym	NSC	SUCH12-1103	182000	56	0	0	135188	41160	0	0	0	19533	138353	12-Sep
13	Agora Daylight Harvesting	Main	-	24600	6	0	0	0		0	0	0	2295	15178	13-Jun
14	Admin Daylight Harvesting	Main	-	33000	8	0	0	0		0	0	0	3079	20139	13-Jul
15	Workplace Conservation Campaign	Main	BCH-02090	304636	0	0	0	5311	4935	0	0	0	33641	106571	16-Jan
16	Workplace Conservation Campaign	NSC	BCH-02090	32222	0	0	0	0	0	0	0	0	3612	11443	16-Jan
17	Workplace Conservation Campaign	QRRC	BCH-02090	4303	0	0	0	0	0	0	0	0	480	1520	16-Jan
18	Workplace Conservation Campaign	Terrace	BCH-02090	2821	0	0	0	0	0	0	0	0	325	1028	16-Jan
19	Workplace Conservation Campaign	Bio	BCH-02090	13240	0	0	0	0	0	0	0	0	1484	4702	16-Jan
20	NSC C.Op	NSC	BCH-03368	-	0	-	0	27028	0	0	0	22702	-	288266	16-Mar
21	Energy Wise FY2017	Main	BCH-03654	0	0	0	0	270	267	0	0	0	0	0	16-Apr
22	Terrace exterior lighting (PSPX)	Terrace	PSPX111693	504	0	0	0	162	77	0	0	162	53	159	16-Apr
23	BMO Boiler Replacement	BMO	-	0	0	0	0	0	0	4050	0	0	0	0	16-Oct
24	Daycare Heating System conversion	DC	-	0	0	400	-400	-	0	0	0	0	243	729	17-Aug
25	Power Plant Boiler Bypass/DHW Tank	Main	-	0	0	0		98184	0	0	0	0	2800	13294	17-Sep
26	Residence Lighting	Main	SUCH11-965	284000	0	0	0	61547	24090	0	0	61547	15947	167555	12-May
27	Residence Lighting	Main	PSPX112054	14414	0	0	0	17216	3208	0	0	17216	9048	95068	12-Jul
28	Thirsty Moose Lighting	Main	PSPX101130	6034	2	0	0	2311	1412	0	0	0	0	5478	11-Sep
29	Bookstore/Cafeteria Lighting	Main	PSPX100434	20796	7	0	0	6684	3258	0	0	6684	1959	20583	11-Dec
30	Terrace Campus lighting upgrade	Terrace	PSPX153073	16599	0	0	0	14805	3994	0	0	14396	1489	15273	12-Jun
31	NUSC Event Space (Round 1)	Main	PSPX111455	960	1	0	0	402	160	0	0	0	1069	10961	11-May
32	Lecture Theatre Lighting	Main	PSPX113112	78705	26	0	0	22811	11988	0	0	22811	7414	75745	12-Jun
33	EFL Cold Storage Lighting	Main	PSPX130081	1181	0	0	0	578	139	0	0	0	111	1076	13-Jan
34	QRRC Lighting Upgrade	QRRC	PSPX112392	7752	3	0	0	5129	1258	0	0	5129	741	7045	13-Mar
35	Coil Cleaning	Main	SUCH12-1077	195000	39	0	0	23523	9684	0	0	23523	0	92751	12-Aug
36	Canfor/Warehouse	Main	SUCH12-1112	99000	22	0	0	53046	21214	0	0	0	9302	90984	12-Dec

	Project	Campus	BC Hydro Project Number	Electricity Savings (kWh/y)	Electricity Demand Savings (kW/month)	Natural Gas Savings (GJ/y)	District Heat Savings (GJ/y)	Cost ($)	BC Hydro Incentive ($)	Fortis Incentive ($)	CNCP Funding ($)	Revolving Loan Contribution ($)	Total Savings Last year ($)	Total Savings to-date ($)	Completion Date
37	Exterior Lighting - globes	Main	BCH-00377	66000	0	0	0	106629	18152	0	0	42936	6310	57322	13-Nov
38	Teach Lab Pot lights/Agora exterior	Main	BCH-01166	59000	13	0	0	26433	2935	0	0	26433	7464	62574	15-Feb
39	Teaching Lab Penthouse Lighting	Main	PSPX142369	1022	0	0	0	781	105	0	0	781	79	608	15-Feb
40	Reef Tank Lighting	Main	-	2300	0	0	0	1664	0	0	0	700	191	1467	15-Feb
41	Teaching Lab C.Op	Main	BCH-02088	-	0	0	-	72290	0	0	0	72290	-	219048	15-May
42	Research Lab C.Op	Main	BCH-02086	-	0	0	-	58598	0	0	0	58598	-	126452	15-May
43	Agora C.Op	Main	BCH-02087	-	0	0	-	59694	0	0	0	59694	-	124701	15-May
44	Medical Humidifier	Main	BCH-01716	476000	66	0	-280	151240	74941	0	0	151240	47185	354084	15-Feb
45	Power Plant AHU controls	Main	-	40000	6	450	0	68430	0	25811	48661	19769	6708	50907	15-Mar
46	Conference Solar PV	Main	-	5000	5	0	0	30287	0	0	0	5986	400	2834	15-Sep
47	Main campus streetlights/wall packs	Main	BCH-02693	167000	0	0	0	164188	45160	0	44700	118107	13360	91324	16-Jan
48	NSC Exterior lighting	NSC	BCH-02694	86000	0	0	0	60027	20717	0	0	60027	6880	47029	16-Jan
49	Terrace Exterior Lighting	Terrace	-	4896	0	0	0	9073	0	0	0	1811	432	2809	16-Apr
50	Main campus wall packs	Main	BCH-03047	53000	0	0	0	20411	8073	0	0	10515	4240	26149	16-Aug
51	Neyoh Heating System Conversion	Main	Program Enabled	386700	69	3000	-4500	500000	0	0	0	100000	0	24938	16-Aug
52	Neyoh Heating System Conversion	Bio	Program Enabled	-37200	-4	0	0	0	0	0	0	0	-2870	-8610	16-Aug
53	Conf/NUSC Air Handler HW conversion	Main	-	0	0	846	-816	6368	0	0	6368	0	1774	11976	16-Jan
54	Residence Low-flow showerheads	Main	-	0	0	1400	0	696	0	0	0	696	0	45567	13-Jul
55	Corner Store Reno	Main	PSPX153444	1230	0	0	0	2047	333	0	0	0	98	607	16-Aug
56	Admin Lighting Upgrade	Main	Program Enabled	118000	17	0	0	103498	0	0	40952	0	8260	46143	17-Mar
57	Library Lighting -1st Floor	Main	BCH-04148	139000	46	0	0	70409	20013	0	35385	33242	9764	50450	17-Aug
58	Conf/NUSC Lighting	Main	BCH-04149	69000	12	0	0	52659	10768	0	29978	20354	5294	27354	17-Aug
59	D.C./Research Lab/PP Highbays	Main	BCH-04147	81000	14	0	0	36040	11394	0	0	12826	5670	27508	18-Jan
60	Soccer Field lighting controls	NSC	BCH-04240	55000	3	0	0	28288	8119	0	0	28288	3850	18923	17-Oct
61	Power Plant/Utilidor Lighting	Main	BCH-04146	94000	11	0	0	34718	9612	0	0	15699	6580	31241	18-Jan
62	Recycling Room Lighting	Main	PSPX170052	1030	0	0	0	878	0	0	0	504	72	342	18-Feb
63	Keyoh Heating System conversion	Res	BCH-04873	366000	67	2000	-3500	100000	0	0	0	0	17606	90972	18-Jun
64	Library - Wavelinks Lighting	Main	BCH-04866	122000	47	0	0	195000	21713	0	65385	173287	6935	29034	19-Jan
65	Library - Medical Lighting	Main	BCH-04867	64000	31	0	0	77000	11517	0	0	65483	13665	50731	18-Jul
66	Agora Lighting	Main	BCH-05420	135000	65	0	0	279000	23522	0	32692	222786	11452	34356	20-Feb
67	Research Lab Lighting	Main	BCH-05431	187000	82	0	0	395000	59734	0	32693	302573	17874	53621	20-Feb
68	Admin Lighting	Main	BCH-05405	71000	28	0	0	119500	12603	0	0	106897	4908	14724	20-Feb
69	EFL Lighting	Main	BCH-05406	77000	15	0	0	60000	13950	0	0	46050	4043	12129	20-Feb
70	Medical C.Op	Main	BCH-02089	48000	0	0	207	1284	0	0	0	0	8779	57820	16-Mar
71	Admin C.Op	Main	BCH-03370	-	0	0	-	-13627	0	0	0	5119	-	94924	16-Mar
72	Conf/NUSC C.Op	Main	BCH-04062	61000	0	0	1118	12542	0	0	0	4838	11147	62269	17-Sep
73	Library C.Op	Main	BCH-04061	384000	0	0	2366	31479	0	0	0	12303	41378	231148	17-Sep

	Project	Campus	BC Hydro Project Number	Electricity Savings (kWh/y)	Electricity Demand Savings (kW/month)	Natural Gas Savings (GJ/y)	District Heat Savings (GJ/y)	Cost ($)	BC Hydro Incentive ($)	Fortis Incentive ($)	CNCP Funding ($)	Revolving Loan Contribution ($)	Total Savings Last year ($)	Total Savings to-date ($)	Completion Date
74	T&L C.Op	Main	BCH-04063	159000	0	0	1799	34700	0	0	0	20128	22107	123495	17-Sep
75	Server Room HVAC - free cooling	Main	BCH-04865	111000	8	0	0	70672	20654	0	35385	49346	10340	20680	20-Sep
76	Primary Heating Loop - SPR	Main	-	35000	tbd	0	0	2000	0	0	0	2000	3150	6300	20-Jul
77	Bioenergy Plant Lighting	Main	-	9700	tbd	0	0	3000	0	0	0	3000	620	1240	21-Mar
78	C.Op Round 2 - Agora	Main	BCH-06549	251744	0	0	1438	1200	11050	0	10000	1200	32468	64938	21-Mar
79	C.Op Round 2 – Research Lab	Main	BCH-06378	319661	0	0	1196	23900	12050	0	10000	23900	44341	88682	21-Mar
80	C.Op Round 2 – Teaching Lab	Main	BCH-06550	512332	0	0	3423	117500	12300	0	10000	117500	82414	164828	21-Mar
81	Air Handling Unit – coil cleaning	Main	-	-	-	0	0	25000	0	0	0	25000	-	-	20-Oct
82	C.Op Round 2 - NSC	Main	BCH-07265	409825	11	2217	0	3100	21700	-	0	3100	63398	63398	22-Mar
83	C.Op Round 2 - Admin Building	Main	BCH-07266	132029	2	0	817	6300	14700	-	0	6300	16811	16811	22-Mar
	Total			**6,804,424**	**812**	**10,613**	**2,868**	**$3,826,698**	**$596,906**	**$29,861**	**$ 402,199**	**$ 2,211,566**	**$ 678,550**	**$ 4,059,061**	

APPENDIX B – PROJECTS IN PROGRESS

	Project	Campus	BC Hydro Project Number	Estimated Electricity Savings (kWh/y)	Estimated Electricity Demand Savings (kW/month)	Estimated Natural Gas Savings (GJ/y)	Estimated District Heat Savings (GJ/y)	Budget Cost ($)	BC Hydro Incentive ($)	Fortis Incentive ($)	CNCP Funding ($)	Revolving Loan Contribution ($)	Anticipated Cost Savings ($/yr)	Payback (y)	Expected Completion Date
84	C.Op Round 2 - Conference Centre	Main	BCH-08046	82665	0	0	1793	9300	5200	-	0	9300	14202	0.7	23-Mar
85	C.Op Round 2 - Library	Main	BCH-08047	393639	18	0	2446	4200	17000	-	0	4200	36618	0.1	23-Mar
86	C.Op Round 2 - T&L Building	Main	BCH-08048	158527	14	0	1859	4900	14700	-	0	4900	19214	0.3	23-Mar
	Total			**634,831**	**32**	**0**	**6,098**	**$ 18,400**	**$ 36,900**	**$ -**	**$ -**	**$ 18,400**	**$ 70,034**		

APPENDIX C – POTENTIAL PROJECTS IN FY2024

	Project	Campus	BC Hydro Project Number	Estimated Electricity Savings (kWh/y)	Estimated Electricity Demand Savings (kW/month)	Estimated Natural Gas Savings (GJ/y)	Estimated District Heat Savings (GJ/y)	Budget Cost ($)	Expected BC Hydro Incentive ($)	Fortis Incentive ($)	CNCP Funding ($)	Revolving Loan Contribution ($)	Expected Annual Utility Savings ($/y)	Payback (y)	Expected Completion Date
87	Secondary Loops - SPR	Main		40000	tbd	0	0	5000	tbd	0	0	5000	3628	1.4	24-Mar
88	Chilled Water Loop - SPR	Main		23000	tbd	0	0	4000	tbd	0	0	4000	2086	1.9	24-Mar
89	Chilled Water Loop - Heat Movement	Main		140000	tbd	0	0	150000	tbd	0	20000	130000	12698	11.8	24-Mar
90	EFL Shade Curtains	Main		1000	tbd	800	0	130000	tbd	0	0	130000	6490	20	24-Mar
91	NSC Lighting Upgrade	Main		50000	tbd	0	0	100000	10000	0	35000	55000	4950	11	24-Mar
	Total			**254,000**	**0**	**800**	**0**	**$389,000**	**$10,000**	**$0**	**$55,000**	**$324,000**	**$29,852**		

APPENDIX D – COMPLETED STUDIES

	Study	Campus	BC Hydro Project Number	Cost ($)	BC Hydro Incentive ($)	Revolving Loan Contribution ($)	CNCP Funding ($)	Completion Date
1	Renewable energy study	Main	-	5,000	0	0	0	11-Sep
2	Ice Mountain study	Main	-	0	0	0	0	11-Nov
3	Anaerobic Digester study (ENVS417)	Main	-	0	0	0	0	12-Dec
4	Medical Humidifier study (PHYS402)	Main	-	0	0	0	0	12-Dec
5	Lab Heat Recovery study (ENSC499)	Main	-	0	0	0	0	13-Apr
6	C.Op Investigation - Research Lab	Main	COP10-416	16,028	15,768	16,028	0	13-Oct
7	C.Op Investigation - Agora	Main	COP10-419	15,891	15,587	15,891	0	13-Oct
8	C.Op Investigation - Teaching Lab	Main	COP10-420	16,442	16,175	16,442	0	13-Oct
9	C.Op Investigation - Medical	Main	COP10-421	12,922	12,713	12,922	0	13-Oct
10	C.Op Investigation - Admin	Main	COP10-415	18,418	18,119	18,418	0	14-Aug
11	C.Op Investigation - NSC	NSC	COP10-414	20,665	20,330	20,665	0	14-Aug
12	C.Op Handoff - Research Lab	Main	COP10-416	2,643	2,600	2,643	0	15-Jul
13	C.Op Handoff - Agora	Main	COP10-419	2,562	2,520	2,562	0	15-Jul
14	C.Op Handoff - Teaching Lab	Main	COP10-420	2,562	2,520	2,562	0	15-Jul
15	Bioenergy Heat Recovery study (ENVS417)	Main	-	0	0	0	0	15-Dec
16	C.Op Investigation - Library	Main	COP10-417	19,740	19,420	19,740	0	16-May
17	C.Op Investigation - Conference/NUSC	Main	COP10-418	11,482	11,295	11,482	0	16-May
18	C.Op Investigation - T&L	Main	COP10-422	14,861	14,620	14,861	0	16-May
19	C.Op Handoff - Medical	Main	COP10-421	4,361	4,290	4,361	0	16-Jul
20	C.Op Handoff - Admin	Main	COP10-415	2,767	2,723	2,767	0	16-Jul
21	C.Op Handoff - NSC	NSC	COP10-414	2,863	2,817	2,863	0	16-Jul
22	C.Op Coaching - Research Lab	Main	COP10-416	3,384	3,329	3,384	0	16-Nov
23	C.Op Coaching - Agora	Main	COP10-419	8,484	4,312	8,484	0	16-Nov
24	C.Op Coaching - Teaching Lab	Main	COP10-420	6,616	4,308	6,616	0	16-Nov
25	Boiler Power/Plant Controls Study	Main	-	24,433	0	0	24,433	17-Mar
26	C.Op Handoff - Library	Main	COP10-417	4,792	4,714	4,792	0	17-Aug
27	C.Op Handoff - Conference/NUSC	Main	COP10-418	2,858	2,811	2,858	0	17-Aug
28	C.Op Handoff - T&L	Main	COP10-422	3,615	3,556	3,615	0	17-Aug
29	C.Op Coaching - NSC	NSC	COP10-414	5,578	5,488	5,578	0	17-Dec
30	C.Op Coaching - Admin	Main	COP10-415	4,023	3,958	4,023	0	17-Dec
31	C.Op Coaching - Medical	Main	COP10-421	1,799	1,770	1,799	0	17-Dec
32	C.Op Coaching - Library	Main	COP10-417	4,396	4,325	4,396	0	18-Aug
33	C.Op Coaching - Conference/NUSC	Main	COP10-418	3,507	3,450	3,507	0	18-Aug
34	C.Op Coaching - T&L	Main	COP10-422	3,507	3,450	3,507	0	18-Aug
35	Cooling Tower Review	Main	BCH-04450	11,690	1928	0	11,690	18-Mar
36	EFL Optimization	Main	BCH-04450	11,385	1928	11,385	0	18-Mar
37	NSC Heat Pump	Main	BCH-05207	10900	5451	5449	0	19-Jul
	Total			**$ 280,174**	**$ 216,275**	**$ 233,600**	**$ 36,123**	

APPENDIX E – COMMERCIAL ENERGY MANAGER LCE PROJECT FORECAST

Sector	Public or Private	Customer Name	Region	Description of Measure	Standard LCE Measure Name	New or Retrofit	Electrical Consumption (kWh/y)		Average Monthly Demand (kW)			Nat Gas Consumption (GJ/yr)		GHG Reduction	Annual Cost Saving $						Total Capital Cost	Incremental relative to Baseline	Non Energy Benefits	Measured Life/Persistence	Payback
							Current	Incremental (+/-)	Current	Incremental (+/-)	Months	Current	Incremental (+/-)	Tonnes CO2e/yr	Electric	Demand	Gas	Maintenance or others savings (annual)	GHG Offsetting Costs	TOTAL	$	$	(eg thermal comfort, noise reduction, air quality etc.)	In years	In years
Education - Adv	Public	UNBC	North	Pilot project - heat pump on Northern Sports Centre	HVAC Air-to-Air Heat Pump (ductless or minisplit)	Retrofit	1,182,600	140,000	228	16	6	6,032	-1500	-73	$ 7,784	$ 1,076	-$ 11,145	$ -	-$ 1,833	-$ 4,118	$ 72,000	$ 72,000		18	17.5
Education - Adv	Public	UNBC	North	Northern Sports Centre Low Carbon Heating Conversion	HVAC Air-to-Air Heat Pump (ductless or minisplit)	Retrofit	1,182,600	130,000	228	40	6	6,032	-5200	-258	$ 7,228	$ 2,690	-$ 38,636	$ -	-$ 6,448	-$ 35,166	$ 1,472,000	$ 1,472,000		18	41.9
Education - Adv	Public	UNBC	North	Northern Sports Centre - DHW Heat Pump System	DHW Air-to-Water Heat Pump Water Heater	Retrofit	1,182,600	30,300	228	11	12	6,032	-350	-17	$ 1,685	$ 1,480	-$ 2,601	$ -	-$ 428	$ 136	$ 60,000	$ 60,000		15	-442.4