UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

BC Hydro Power smart

FY2021 Strategic Energy Management Plan

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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 40% reduction in electricity use, a 24% reduction in natural gas consumption (and greenhouse gas emissions), and an 26% reduction in utility costs compared to 2010 baseline levels. Note, at the end of FY19 and FY20, natural gas reductions were at 76% and 63% respectively. This also resulted in 35% reduction in utility costs from baseline levels in those years. The reason for a backward slide in progress on this front is due to significant maintenance interventions with the Bioenergy Plant, as detailed in this report.

The EM program at UNBC has been strongly supported by BC Hydro for the past 10 years. They currently provide 50% of the funding for a dedicated Energy Manager, as well as incentives to implement energy efficiency and conservation projects. To-date, BC Hydro has contributed over $1.5 million to UNBC's EM program, which has facilitated 57 projects that have saved UNBC roughly $3.2 million in electricity costs. This year, UNBC intends to claim between 800,000 – 1,000,000 kWh towards their 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). As of March 31st 2020, UNBC saw a 27% reduction in energy use and an 24% reduction in natural gas use. In summary, we have not yet met our natural gas reduction targets due to a challenging last two fiscal years with maintenance on the Bioenergy Plant, but we have exceeded our overall energy reduction target by 2%; this is a significant accomplishment worth noting. The Bioenergy Plant is on track to be back in regular operation within FY2021. This, combined with continued natural gas reduction efforts, will enable UNBC to approach its 85% reduction goal.

Through the EM program, and the switch from fossil fuels to bioenergy, UNBC has avoided the purchase of roughly $5.8 million worth of energy over the past 10 years. Add to that the nearly $1.9 million brought in through incentives and salary reimbursements, and UNBC's commitment to sustainable operations can be valued at over $7.7 million.

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, 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, and house 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 – FY2020 Utility Breakdown

	Annual Consumption		Annual Consumption		Annual Cost
Electricity	11,793,245	kWh	11,793,245	kWh eq	$1,284,307
Bioenergy (Hog Fuel)	0	bdt	0	kWh eq	$0
Natural Gas	79,528	GJ	22,091,228	kWh eq	$594,020
Bioenergy (Pellets)	279	bdt	1,527,246	kWh eq	$8,132
Propane	6,503	L	46,061	kWh eq	$6,766
Total			35,457,780	kWh eq	$1,638,135

Figure 1 shows the breakdown of energy consumption from Table 1 for FY2020. Electricity accounted for 33% of total energy consumption, and heat generated from hog fuel (sawmill wood waste), natural gas, and wood pellets accounted for the remaining 66%. Of the heat, 62% was generated from natural gas, and only 4% from bioenergy. 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 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.

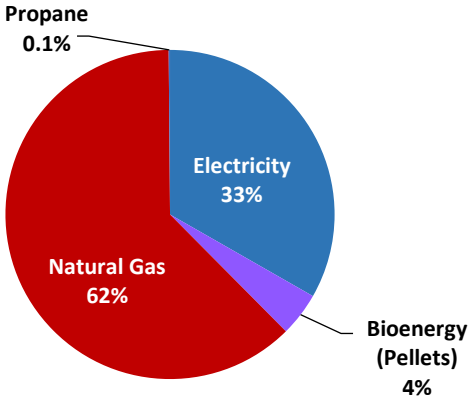

Figure 1 - Energy Use Breakdown

Although electricity accounted for only 33% of the energy consumption, it represented 68% of total energy costs, due to the relatively high marginal rate of electricity, see Table 2. Electricity costs 2 to 3 times the cost of natural gas per unit of energy, and over 10 times the cost of pellets. 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 – FY2020 Marginal Energy Rates

Energy Source	Account(s)	Marginal Rate (¢/kWh)
Electricity	Prince George Campus	6.22
	Bioenergy Plant	6.39
	Northern Sports Centre	6.39
	QRRC	10.12
	WIRL	10.43
	Terrace	10.45
Natural Gas	Prince George Campus	2.94
	Northern Sports Centre	3.04
	EFL	3.40
	Bio Plant/Daycare	3.46
	Agora	3.48
	WIRL	3.98
	Terrace	6.67
Bioenergy (Hog Fuel)	Prince George Campus	1.62[1]
Bioenergy (Pellets)	Prince George Campus	0.58

[1] This rate is from FY2019 for comparison. There was no hog fuel purchased in FY2020.

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 FY2020 is shown in **Figure 2**. In total, 5500 GJ (291 bdt) of wood pellets were used by the Wood Pellet Plant and 70,790 GJ of natural gas were used by the natural gas boilers. The Bioenergy Plant was shut down from March 2019 – March 2020 for major mechanical repairs, and again periodically throughout the summer and fall of 2020. This resulted in a 250% increase in natural gas consumption for FY2020 over FY2019. It is our goal to get the Bioenergy Plant back to regular, full-capacity operation as soon as possible and to return to lower GHG-emitting fuel.

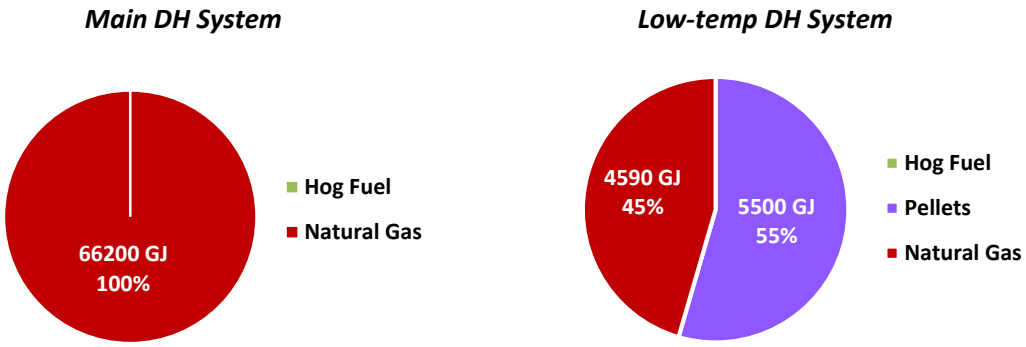

Figure 2 - District Heating Fuel Breakdown

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 3 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.

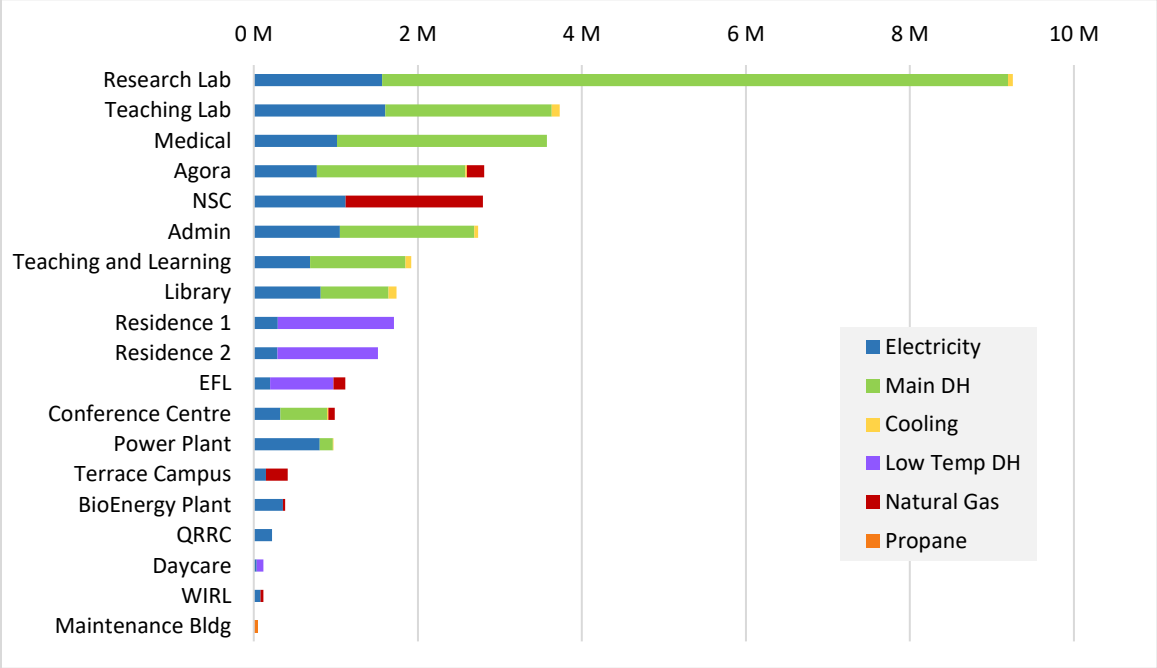

Figure 3 – FY2020 Annual Energy Breakdown (kWh_{eq}/year)

As previously detailed, no energy came from hog fuel in either the Main or Low-temp DH systems in FY2020 due to a significant maintenance shutdown. For a reminder on how heat is generated for the two district heating systems, reference Section 0.

Though Figure 3 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 2019, Energy Star Portfolio Manager, a Canadian utility usage and energy benchmarking software, reported the median BEPI at Canadian colleges/universities to be between 1.44-1.01 GJ/m^2, or 400-280 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 in the midst of conducting a *Survey of Commercial and Institutional Energy Use*, with data scheduled to be available in the fall of 2022. So, 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 3 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 nearly half (49%) of UNBC's annual energy consumption, but only one fifth (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.

The EFL traditionally has the highest BEPIs on campus 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. With the completion of a lighting upgrade in November 2019 to high-efficiency horticultural LEDs in the growth chambers, reductions in electrical consumption are becoming visible in the data. Their cumulative effect on the BEPI and GHG intensity will continue to improve over time; a 3% BEPI improvement for the EFL is noted between FY2020 and FY2019.

Table 3 – FY2020 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	1,115,305	$38,678	1,198	97	$42
Medical	4,468	3,572,685	$179,615	800	105	$40
Research Lab	7,581	9,255,775	$381,399	1,221	182	$50
Teaching Lab	7,921	3,731,143	$244,458	471	48	$31
Subtotal	**20,901**	**17,674,909**	**$844,150**	**846**	**433**	**$40**
Industrial						
Bioenergy Plant	1,046	384,204	$28,717	367	8	$27
Power Plant	1,253	970,519	$95,623	775	30	$76
WIRL	921	117,927	$13,567	128	8	$15
Subtotal	**3,220**	**1,472,650**	**$137,907**	**457**	**45**	**$43**
Administrative						
Conference Centre	3,253	986,756	$56,406	303	37	$17
Agora	8,556	2,809,516	$144,941	328	43	$17

Teaching and Learning	10,130	1,920,901	$115,390	190	21	$11
Library	11,754	1,740,116	$123,167	148	13	$10
Terrace Campus	1,314	413,236	$32,955	314	37	$25
Childcare Centre	639	118,229	$5,338	185	11	$8
QRRC	812	221,040	$25,581	272	3	$32
Admin	9,161	2,733,948	$165,766	298	33	$18
Subtotal	**45,619**	**10,943,742**	**$669,543**	**240**	**199**	**$15**
Recreation/Accommodation/Other						
NSC	13,485	2,792,497	$150,372	207	23	$11
Residence 1	7,425	1,707,201	$54,575	230	16	$7
Residence 2	7,425	1,513,787	$51,342	204	14	$7
Maintenance Bldg	352	46,061	$6,766	131	29	$19
Subtotal	**28,687**	**6,059,546**	**$263,055**	**211**	**81**	**$9**
Total	**98,427**	**36,150,846**	**$1,914,655**	**367 [1]**	**758 [2]**	**$19**

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

[2] This is a sum total of the GHG Intensity in each building.

Through heating campus with primarily natural gas instead of biofuel in FY2020, the overall BEPI for UNBC dropped to 367 kWh/m^2/yr from 385 kWh/m^2/yr in the previous year – a 4.7% decrease. This is primarily indicative of the higher efficiencies of the natural gas boilers over the Bioenergy Plant, and to a lesser extent it may related to the various LED lighting upgrades. This notion is supported by the largest drops in BEPI being for buildings which did not receive LED lighting upgrades. In contrast to the positive change in overall BEPI, the GHG intensity increased from 437 kg $CO2_{eq}$/m^2/yr to 758 kg $CO2_{eq}$/m^2/yr – a 73% increase. Again, this is related to the switch from primarily renewable fuel over to fossil fuel for FY2020.

2.2. ENERGY MANAGEMENT BUDGET

Partial funding for the EM program at UNBC is provided by BC Hydro. Up to $50,000 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 Carbon Neutral Capital Program (AVED 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 FY2020, the Loan Fund facilitated nearly $3 million of spending towards energy efficiency projects. A summary of the Loan Fund cash flow can be seen in Figure 4. The implemented projects have saved roughly $2.06 million in utility costs, with net utility savings of $860,000 after loan repayments.

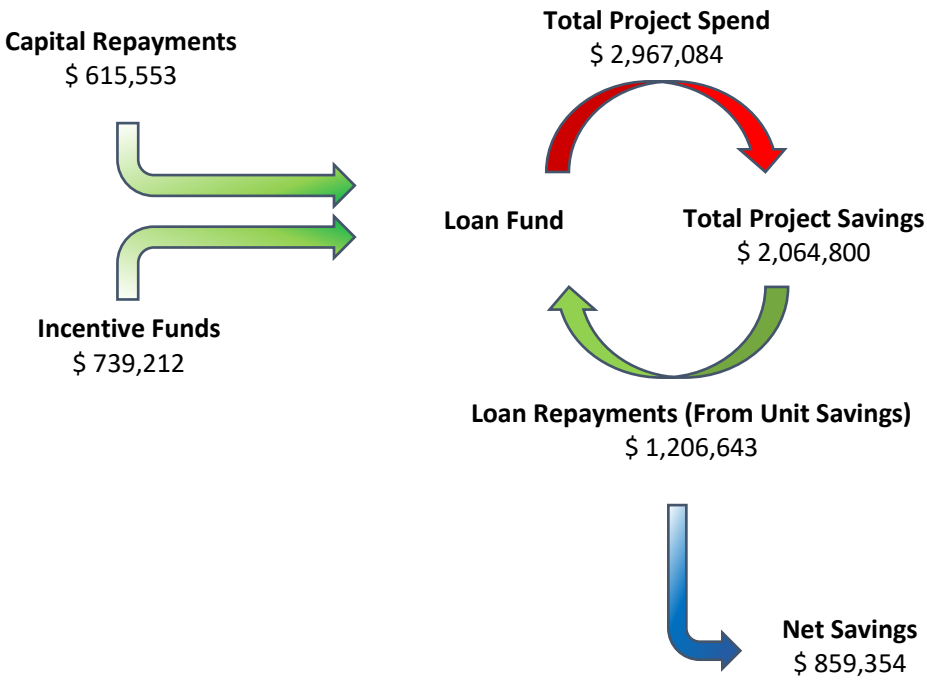

Figure 4 - Revolving Loan Summary

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.

Reduction 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.

In FY2020 – the final year of the existing Energy Policy – approximately 710,000 kWh/yr worth of energy efficiency projects were completed. In early September 2020, another energy project worth approximately 111,000 kWh/yr in savings was implemented. Section 4 Energy Performance details if this was enough to push UNBC across the finish line.

As we look forward to the next 10 years of energy management at UNBC we must reach higher and go further, starting with the development of new targets. The targets are being developed through FY2021 as 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 Appendix.

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 FY2020 the campaign focused on a series of simple conservation pledges that community members could make. In FY2021 the campaign is geared more towards specific tasks or actions for participants to complete over a two-week period through a bingo-styled game. The appeal of this type of campaign is that it can work for anyone, anywhere, in the era of COVID-19. It is our hope that this campaign both brings a sense of togetherness and purposeful action for our students, staff, and faculty, no matter where they may be in 2020/2021.

3.2. ENERGY MANAGEMENT ASSESSMENT (EMA)

UNBC completed an EMA in December 2017 to identify new priorities and opportunities to improve the Energy Management program (identified below). It was the intention to complete an updated EMA in January of 2020, however it was initially delayed due to the reorganization of the institution following a strike in November of 2019, and then again delayed with the shifting of our entire operational focus towards COVID-19 response. As the situation is still fluid, it's uncertain when the next EMA will be scheduled, but it is UNBC's intention to reschedule this as soon as reasonably possible.

> *Vision & Strategy*
>
> Align energy management program with Integrated University Action Plan. Understand key business drivers, and define new (broader) objectives.
>
> *Target-setting*
>
> Set reduction targets (and stretch targets) that account for capital projects, and non-capital activities for key operating areas. Ensure understanding and buy-in from key operating areas.
>
> *Operational Integration*
>
> Leverage building champions to increase participation in energy conservation. Create check-lists or leverage existing check-lists for maintenance, janitorial, H&S.
>
> *Asset Management*
>
> Predictive maintenance for key-consuming assets. Review operating and maintenance procedures for key energy consuming systems.
>
> *Messaging & Communication*
>
> Improve understanding of energy saving opportunities with different key stakeholder groups. Phased approach focusing on conservation goals, campaigns, and projects underway.

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. Over $140,000/year will be saved 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, will be undertaken in FY2021. This work will be conducted by Prism Engineering, with guidance and collaboration from the UNBC EM team, providing continuity to the process.

3.4. LED LIGHTING RETROFITS

The Prince George campus underwent extensive lighting upgrades 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.

In FY2021, LED lighting upgrades will be pursued for select fixtures in the process area of the Bioenergy Plant at a cost of approximately $3000. Estimated electrical savings for this project are around 9,700 kWh/yr. This is not enough to qualify for BC Hydro incentives as a stand-alone project. Nonetheless, it will improve safety, operations, and electrical consumption of the space, with a simple payback of less than 5 years.

3.5. LOW CARBON ELECTRIFICATION

The purpose of low carbon electrification (LCE) at UNBC is to decrease the carbon emissions while still providing cost effective and energy aware 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 80% 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 fiscal year 2018 the university ordered a new electric vehicle for the Facilities department to service the new WIRL building in downtown Prince George. This is expected to reduce carbon emissions by 2.1 tonnes CO2e/yr, while adding 2200 kWh to the annual electrical consumption.

As discussed in Section 3.8, a pilot project is proposed to gather data on the effectiveness of heat pumps in a cold climate. Key data related to cold weather coefficients of performance and the

overall electrical consumption is required to inform the design of a large air source heat pump system that has the potential to offset the majority of natural gas consumption at the NSC.

After the successful conclusion of the pilot heat pump project, UNBC proposes 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.

3.6. FY2020

UNBC completed five energy projects in FY2020, which are estimated to save 710,000 kWh annually and represent a 5.6% decrease in electricity consumption from the previous fiscal year. Of those savings, 470,000 kWh will count towards the BC Hydro Energy Manager target as summarized in Table 4.

Table 4 – FY2020 BC Hydro Incentive Project Summary

Project	BC Hydro Number	Electricity Savings	Cost Savings	Project Cost	Incentives ($)		Payback
		(kWh/yr)	($/yr)	($)	BC Hydro	CNCP	(yr)
NSC Low Carbon Electrification Study	BCH-05207	-	-	11,080	5,723	-	-
Research Lab	BCH-05431	187,000	16,961	390,831	59,734	-	19.5
Agora	BCH-05420	135,000	12,245	272,425	23,522	65,385	15.0
C.J.M. Hall	BCH-05405	71,000	6,440	121,184	8,980	-	17.4
EFL	BCH-05406	77,000	6,984	59,548	13,950	-	6.5
	Subtotal	470,000	42,630	855,068	111,909	65,385	14.6 avg

3.7. FY2021

In the current fiscal year UNBC has set out to complete a new round of C.Op investigations. After the investigations are complete, identified savings opportunities with a payback of less than 2 years (that do not exceed our maximum investment responsibility) will be implemented. Maintenance will be performed on 46 heating and cooling coils in three different buildings, which will have a significant effect on electrical savings as heat transfer across those coils improves. The Bioenergy Plant will receive a targeted lighting upgrade in the process area of the plant. The primary heating loop recently saw an upgrade completed to its controls structure, whereby the sequence of feedback dictating flow demand has been refined; the methodology applied to this is similar to what has been done in the past for the controls sequence for air flow through air handling units across the campus. And lastly, in early September a project was completed to improve electricity consumption for cooling of the main campus server room. This is achieved by using outdoor air for the majority of the year to cool the space, rather than the traditional electric air conditioning units. A secondary benefit of this project was the ability to redirect the ‘removed heat’ to a space in need – the nearby shipping /receiving area in the basement of the Administration building.

All of the aforementioned projects are outlined in Table 5. Combined, they are estimated to reduce electricity consumption by 800,000 – 1,000,000 kWh/yr; a 6.8 – 8.5% drop from FY2020.

CNCP funding and BC Hydro incentive funding is expected for FY2021, which will lower the payback periods for most projects. The remaining costs will be covered by the Revolving Loan Fund.

Table 5 – FY2021 Project List

Project	Electricity Savings	Project Cost	Cost Savings	Payback
	(kWh/y)	($)	($/yr)	(y)
Server Room HVAC	111,000	70,672	10,340	6.8
Primary Heating Loop - Static Pressure Reset (SPR)	35,000	2,000	3,150	1
Bioenergy Plant Lighting	9,700	3,000	620	4.8
C.Op Round 2 - Agora	218,495	22,050 max.	13,590	1.6
C.Op Round 2 – Research Lab	214,178	21,125 max.	13,322	1.6
C.Op Round 2 – Teaching Lab	264,035	21,325 max.	16,423	1.3
Air Handling Unit – coil cleaning	tbd [1]	25,000	tbd	tbd
Subtotal [2]	852,408	165,172	56,825	3.42 avg

[1] When this work was completed for 27 coils in 2012, savings were ~240,000 kWh/yr. In FY2021, UNBC will be cleaning 46 coils. Using the marginal rate of electricity from Table 2, potential cost savings are on the order of $25,000/yr, giving a simple payback of 1 year.

[2] These subtotals do not include the Air Handling Unit coil cleaning project, with the exception of Project Cost.

3.8. FY2022 & FY2023

In FY2022, the EM team will reassess the viability of a Low Carbon Electrification project for the Northern Sports Center (NSC), based on the results of a feasibility study conducted by Prism Engineering and reviewed by BC Hydro. The project would see a portion of the soccer fields heat supply coming from a heat pump that is tied into one of the current air handlers (AHU-2) on the roof of the NSC. This pilot would allow us to gather data on the effectiveness of heat pumps in a cold climate, and ideally help inform the design of larger scale heat pumps for use on this building or other UNBC assets. The project could offset approximately 1630 GJ of natural gas consumption per year and save roughly $1600 in utility costs.

FY2023 year will see the opportunity for funding of larger projects, such as flue-gas heat recovery for the Bioenergy Plant, since the Loan Fund will be well established after being in operation for 10 years. A refined list of projects will be formed over the upcoming year, and will be included in next year's report.

Table 6 – Potential Project List

Project	Electricity Savings (kWh/y)	Project Cost ($)	Cost Savings ($)	Payback (y)
FY2022				
EFL Shade Curtains	1,000	130,000	6,490	20
Secondary loops - SPR	40,000	5,000	3,600	1
Chilled Loop - SPR	23,000	4,000	2,070	2
C.Op Round 2 – Phase 2	644,353	tbd	40,078	tbd
FY2023				
Chilled water loop - heat movement	140,000	150,000	12,600	12
C.Op Round 2 – Phase 3	604,273	tbd	37,586	tbd

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 insignificant for the other buildings.

Figure 5 shows the annual energy intensities compared to the FY2010 baseline intensity which corrects for variations in weather. Overall, UNBC has achieved a 27% reduction in energy use compared to FY2010. Figure 5 also shows how UNBC has reduced its natural gas consumption by 24%. 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.

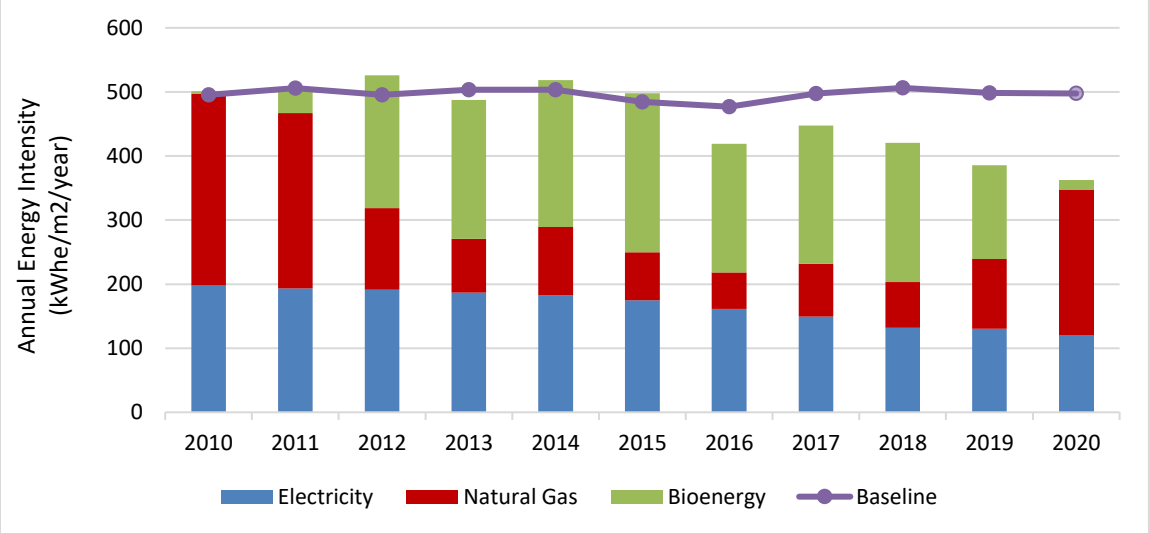

Figure 5 - Historical Energy Intensity

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 as their primary means of heating; the Maintenance Building, the Northern Sports Centre, and the Terrace campus.

By the end of FY2020, UNBC has seen an overall reduction of 8% in utility costs since FY2010, as shown in Figure 6. When compared to the baseline energy cost, the cost savings is 26%. In other words, we've grown the university while simultaneously reducing energy consumption.

One of the core reasons for utility cost reduction in the past was our Bioenergy Plant. Hog fuel used by the Bioenergy Plant was roughly half the cost of the equivalent amount of natural gas when the plant was commissioned, and throughout approximately the first 5 years of operations. However, in recent years, the cost of hog fuel has gone up significantly, while the price of natural gas remains low. Also, as previously mentioned, the Bioenergy Plant has experienced a prolonged shutdown due to significant maintenance interventions. So in more recent years, the lower-than-baseline energy costs can be traced to two things: (i) UNBC started purchasing natural gas for its two largest accounts from Shell Canada in FY2015, lowering the marginal rate by 1 cent/kWh 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.

UNBC has achieved a 40% reduction in electricity use from baseline levels in FY2020, equivalent to $424,902 annually, and $3.2 million cumulatively over the last 10 years. During the same time period, increasing rates for electricity mean we paid 25% more in absolute costs for electricity compared to FY2010.

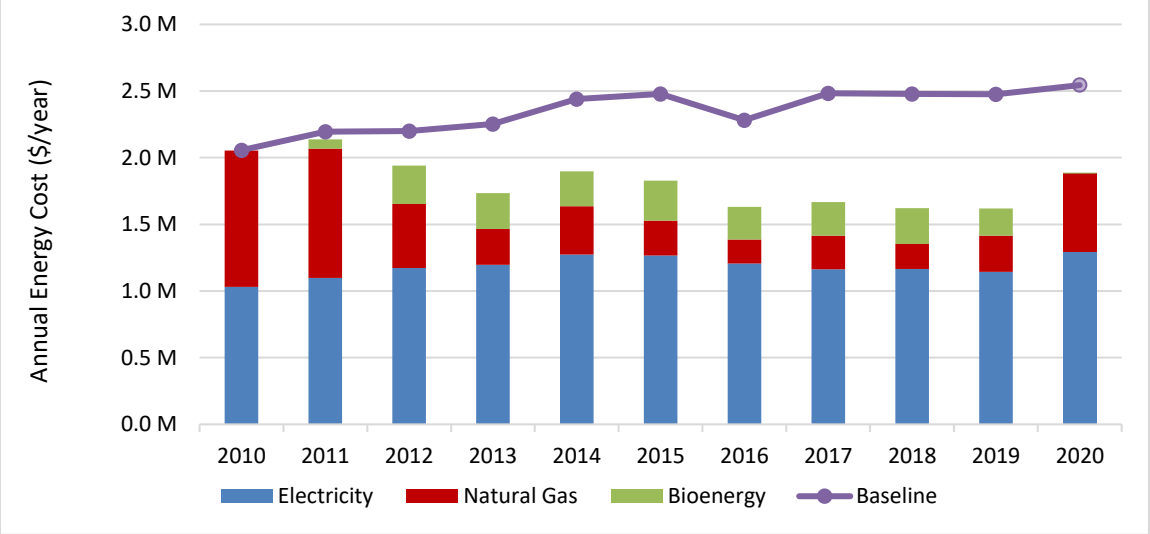

Figure 6 - Historical Energy Cost

4.1. ELECTRICITY SAVINGS

As previously mentioned, UNBC has reduced electricity consumption by 40% from 2010 baseline levels – shown in Figure 7. Compared to last year, consumption dropped by 917,866 kWh or 7.2%. This substantial decrease in consumption is due primarily to the strong focus on electricity reduction projects, specifically the 4 projects listed in Table 4 with anticipated savings of 710,000 kWh/yr. Unfortunately, due to persistent increases in electricity rates, absolute spending increased by approximately $149,000 from the year prior. Had we not implemented any of the electrical conservation efforts of the last decade, this number would be about $425,000.

The cumulative sum of our efforts have resulted in the avoided purchase of $3.2 million worth of electricity.

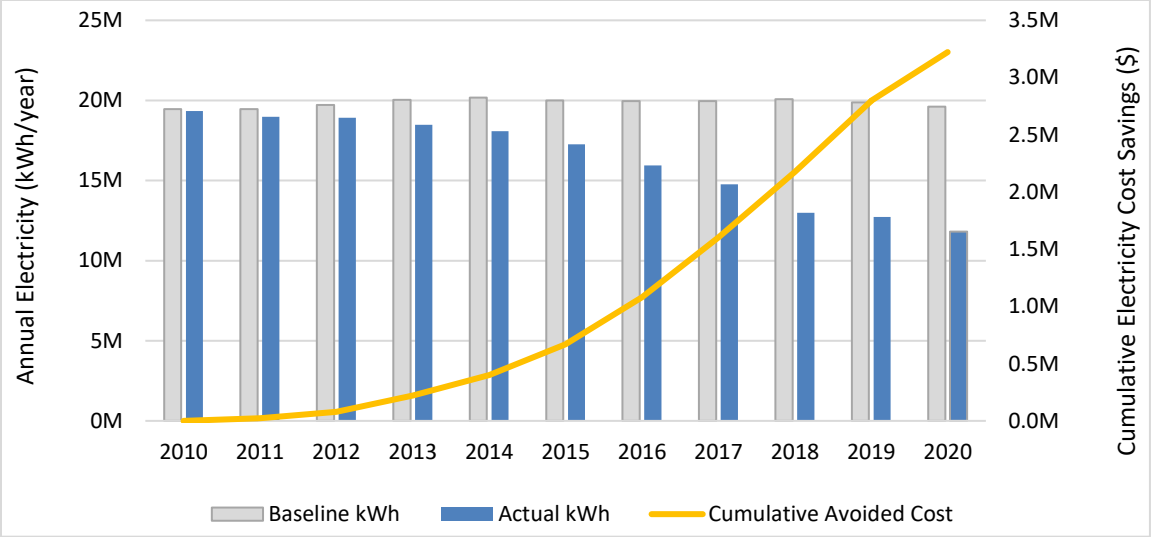

Figure 7 - Historical Electricity Consumption

4.2. HEAT SAVINGS

Since FY2010, UNBC has reduced natural gas consumption by 24% 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 8. 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.

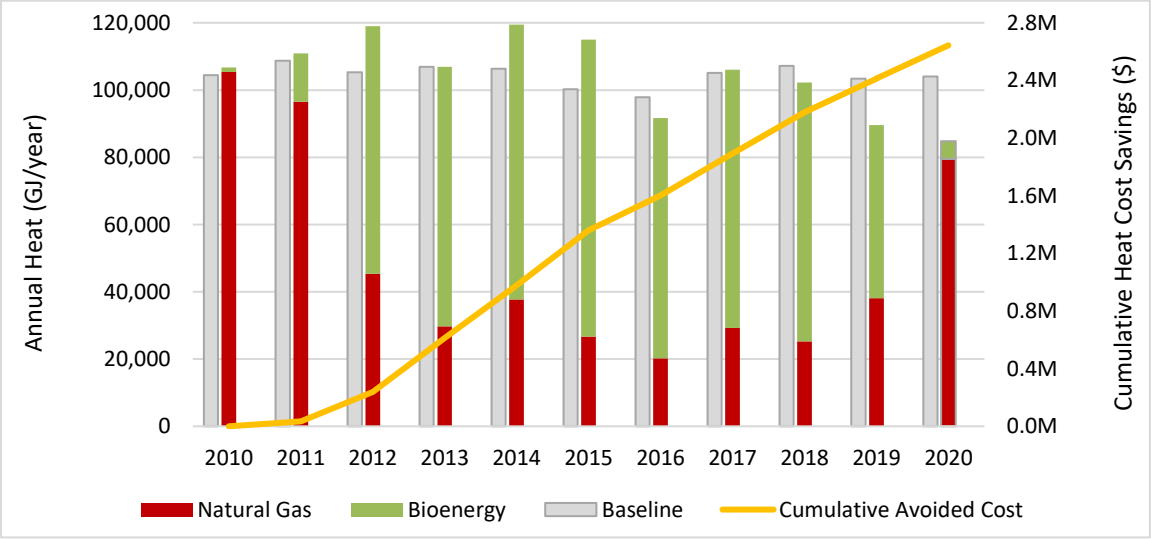

Figure 8 - Historical Heat Consumption

Comparing FY2020 to FY2012 when the Bioenergy Plant came fully online, we have seen a 29% decrease in purchased heat, equivalent to roughly 34,000 GJ. There was also a decrease of about 4800 GJ between FY2019 and FY2020. Unfortunately for our GHG emissions, we've seen a return to more fossil-fuel-intensive heating in the last year, and these numbers will carry through the data in FY2021. We anticipate to return to primarily biofuel heating before the end of October 2020.

In summary, despite recent operational challenges with the Bioenergy Plant, it has enabled UNBC to cut heating costs by over $2.6 million since it's commissioning 8 years ago. The hog fuel used by the Bioenergy Plant is roughly half the cost of the equivalent amount of natural gas and therefore still more economically viable than 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 11 years, the UNBC EM program has brought in $1,173,000 in incentives, $724,000 in salary reimbursements, and has implemented 6.4 million kWh/yr worth of electrical conservation projects and 10,300 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 $5,863,000 in utility costs.

Figure 9 shows the breakdown of the $7,763,500 value of UNBC's energy management program and funding partnerships with BC Hydro, Fortis BC, and the Carbon Neutral Capital Program.

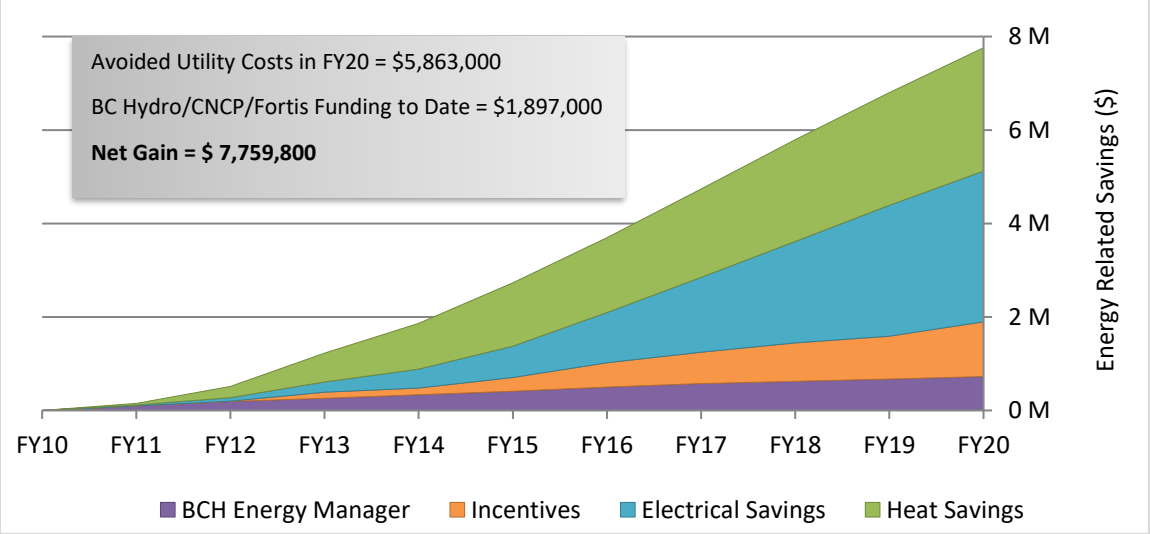

Figure 9 - Energy Management and Utility Savings

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	2464	10-Aug
2	Terrace Boiler Replacement	Terrace	-	0	0	300	0	45000	0	0	0	0	5219	34228	10-Oct
3	Green Centre Lighting	Main	-	1240	0	0	0	640	0	0	0	0	135	807	11-Jan
4	Wintergarden Lights	Main	-	2630	1	0	0	640	0	0	0	0	245	1499	11-Jan
5	Agora North Entrance Lighting	Main	PSPX110586	999	0	0	0	476	218	0	0	0	60	388	11-Apr
6	Rotunda Gallery Lighting	Main	PSPX110587	5931	1	0	0	1987	1165	0	0	0	553	3295	11-May
7	Rotunda Gallery Ramp Lighting	Main	PSPX111364	2475	1	0	0	774	390	0	0	0	231	1375	11-May
8	Admin Chiller for electrical vault	Main	-	98600	11	0	0	70000	0	0	0	0	7569	44210	12-Mar
9	T&L Daylight Harvesting	Main	-	9519	2	0	0	0	0	0	0	0	862	4856	12-Mar
10	Medical AV free cooling	Main	-	22950	3	0	0	11000	0	0	0	0	1762	10178	12-Apr
11	NUSC Event Space	Main	PSPX110510	11344	7	0	0	6090	2474	0	0	6090	1710	8520	12-Jun
12	NSC Soccer Field and Gym	NSC	SUCH12-1103	182000	56	0	0	135188	41160	0	0	0	19533	99287	12-Sep
13	Agora Daylight Harvesting	Main	-	24600	6	0	0	0		0	0	0	2295	10588	13-Jun
14	Admin Daylight Harvesting	Main	-	33000	8	0	0	0		0	0	0	3079	13981	13-Jul
15	Workplace Conservation Campaign	Main	BCH-02090	304636	0	0	0	5311	4935	0	0	0	33641	39289	16-Jan
16	Workplace Conservation Campaign	NSC	BCH-02090	32222	0	0	0	0	0	0	0	0	3612	4219	16-Jan
17	Workplace Conservation Campaign	QRRC	BCH-02090	4303	0	0	0	0	0	0	0	0	480	560	16-Jan
18	Workplace Conservation Campaign	Terrace	BCH-02090	2821	0	0	0	0	0	0	0	0	325	378	16-Jan
19	Workplace Conservation Campaign	Bio	BCH-02090	13240	0	0	0	0	0	0	0	0	1484	1734	16-Jan
20	NSC C.Op	NSC	BCH-03368	453000	0	1922	0	27028	0	0	0	22702	51602	236664	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	53	16-Apr
23	BMO Boiler Replacement	BMO	-	0	0	0	0	0	0	4050	0	0	0	0	16-Oct
24	Daycare Heat System conversion	DC	-	0	0	400	-400	-	0	0	0	0	243	243	17-Aug
25	PP Boiler Bypass/DHW Tank	Main	-	0	0	0		98184	0	0	0	0	2800	7694	17-Sep
26	Residence Lighting	Main	SUCH11-965	284000	0	0	0	61547	24090	0	0	61547	15947	135660	12-May
27	Residence Lighting	Main	PSPX112054	14414	0	0	0	17216	3208	0	0	17216	9048	76972	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	16665	11-Dec
30	Terrace Campus Lighting upgrade	Terrace	PSPX153073	16599	0	0	0	14805	3994	0	0	14396	1489	12295	12-Jun
31	NUSC Event Space (Round 1)	Main	PSPX111455	960	1	0	0	402	160	0	0	0	1069	8824	11-May
32	Lecture Theatre Lighting	Main	PSPX113112	78705	26	0	0	22811	11988	0	0	22811	7414	60917	12-Jun
33	EFL Cold Storage Lighting	Main	PSPX130081	1181	0	0	0	578	139	0	0	0	111	853	13-Jan
34	QRRC Lighting Upgrade	QRRC	PSPX112392	7752	3	0	0	5129	1258	0	0	5129	741	5563	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	72379	12-Dec
37	Exterior Lighting - globes	Main	BCH-00377	66000	0	0	0	106629	18152	0	0	42936	6310	44703	13-Nov
38	Teach Lab Pot lights/Agora exterior	Main	BCH-01166	59000	13	0	0	26433	2935	0	0	26433	7464	47646	15-Feb

	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
39	Teaching Lab Penthouse Lighting	Main	PSPX142369	1022	0	0	0	781	105	0	0	781	79	449	15-Feb
40	Reef Tank Lighting	Main	-	2300	0	0	0	1664	0	0	0	700	191	1084	15-Feb
41	Teaching Lab C.Op	Main	BCH-02088	264000	0	0	3228	72290	0	0	0	72290	43067	219048	15-May
42	Research Lab C.Op	Main	BCH-02086	214000	0	0	1146	58598	0	0	0	58598	24855	126452	15-May
43	Agora C.Op	Main	BCH-02087	218000	0	0	1031	59694	0	0	0	59694	24510	124701	15-May
44	Medical Humidifier	Main	BCH-01716	476000	66	0	-280	151240	74941	0	0	151240	47185	259714	15-Feb
45	Power Plant AHU controls	Main	-	40000	6	450	0	68430	0	25811	48661	19769	6708	37491	15-Mar
46	Conference Solar PV	Main	-	5000	5	0	0	30287	0	0	0	5986	400	2034	15-Sep
47	Main Campus streetlights/wallpacks	Main	BCH-02693	167000	0	0	0	164188	45160	0	44700	118107	13360	64604	16-Jan
48	NSC Exterior lighting	NSC	BCH-02694	86000	0	0	0	60027	20717	0	0	60027	6880	33269	16-Jan
49	Terrace Exterior Lighting	Terrace	-	4896	0	0	0	9073	0	0	0	1811	432	1945	16-Apr
50	Main campus wall packs	Main	BCH-03047	53000	0	0	0	20411	8073	0	0	10515	4240	17669	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	-2870	16-Aug
53	Conf Air Handler HW conversion	Main	-	0	0	846	-816	6368	0	0	6368	0	1774	8428	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	410	16-Aug
56	Admin Lighting Upgrade	Main	Program Enabled	118000	17	0	0	103498	0	0	40952	0	8260	29623	17-Mar
57	Library Lighting -1st Floor	Main	BCH-04148	139000	46	0	0	70409	20013	0	35385	33242	9764	30923	17-Aug
58	Conf/NUSC Lighting	Main	BCH-04149	69000	12	0	0	52659	10768	0	29978	20354	5294	16766	17-Aug
59	D.C./Research Lab/PP High bays	Main	BCH-04147	81000	14	0	0	36040	11394	0	0	12826	5670	16168	18-Jan
60	Soccer Field lighting controls	NSC	BCH-04240	55000	3	0	0	28288	8119	0	0	28288	3850	11223	17-Oct
61	Power Plant/Utilidor Lighting	Main	BCH-04146	94000	11	0	0	34718	9612	0	0	15699	6580	18081	18-Jan
62	Recycling Room Lighting	Main	PSPX170052	1030	0	0	0	878	0	0	0	504	72	198	18-Feb
63	Keyoh Heating System conversion	Res	BCH-04873	366000	67	2000	-3500	100000	0	0	0	0	17606	55760	18-Jun
64	Library - Wavelinx Lighting	Main	BCH-04866	122000	47	0	0	195000	21713	0	65385	173287	6935	15163	19-Jan
65	Library - Medical Lighting	Main	BCH-04867	64000	31	0	0	77000	11517	0	0	65483	13665	23400	18-Jul
66	Agora Lighting	Main	BCH-05420	135000	65	0	0	279000	23522	0	32692	222786	11452	11452	20-Feb
67	Research Lab Lighting	Main	BCH-05431	187000	82	0	0	395000	59734	0	32693	302573	17874	17874	20-Feb
68	Admin Lighting	Main	BCH-05405	71000	28	0	0	119500	12603	0	0	106897	4908	4908	20-Feb
69	EFL Lighting	Main	BCH-05406	77000	15	0	0	60000	13950	0	0	46050	4043	4043	20-Feb
70	Medical C.Op	Main	BCH-02089	48000	0	0	207	1284	0	0	0	0	8779	40262	16-Mar
71	Admin C.Op	Main	BCH-03370	144000	0	0	741	-13627	0	0	0	5119	16992	77931	16-Mar
72	Conf/NUSC C.Op	Main	BCH-04062	61000	0	0	1118	12542	0	0	0	4838	11147	39975	17-Sep
73	Library C.Op	Main	BCH-04061	384000	0	0	2366	31479	0	0	0	12303	41378	148393	17-Sep
74	T&L C.Op	Main	BCH-04063	159000	0	0	1799	34700	0	0	0	20128	22107	79282	17-Sep
	Total			**6,316,133**	**791**	**10,318**	**2,140**	**$ 3,574,026**	**$ 504,452**	**$ 29,861**	**$ 336,814**	**$ 1,980,220**	**$ 586,034**	**$ 2,713,574**	

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
75	Server Room HVAC - free cooling	Main	BCH-04865	111000	8	0	0	70672	20654	0	35385	49346	10340	6.8	20-Sep
76	Primary Heating Loop - SPR	Main	-	35000	tbd	0	0	2000	0	0	0	2000	3150	1.0	20-Jul
77	Bioenergy Plant Lighting	Main		9700	tbd	0	0	3000	0	0	0	3000	620	4.8	21-Mar
78	C.Op Round 2 - Agora	Main		218495		0	0	22050	11050	0	10000	22050	13590	1.6	21-Mar
79	C.Op Round 2 – Research Lab	Main		214178		0	0	21125	12050	0	10000	21125	13322	1.6	21-Mar
80	C.Op Round 2 – Teaching Lab	Main		264035		0	0	21325	12300	0	10000	21325	16423	1.3	21-Mar
81	Air Handling Unit – coil cleaning	Main	-			0	0	25000	0	0	0	25000	tbd	tbd	20-Oct
	Total			**852,408**	**8**	**0**	**0**	**$ 165,172**	**$ 56,054**	**$ -**	**$ 65,385**	**$ 143,846**	**$ 57,445**	**17**	

APPENDIX C – POTENTIAL PROJECTS IN FY2022/2023

	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
82	EFL Shade Curtains	Main		1000	tbd	800	0	130000	200	0	0	0	91	0	21-Feb
83	Secondary loops - SPR	Main		40000	tbd	0	0	5000	tbd	0	0	5000	3628	tbd	21-Feb
84	Chilled Loop - SPR	Main		23000	tbd	0	0	4000	tbd	0	12	4000	2086	tbd	21-Feb
85	C.Op Round 2 – Phase 2	Main		644353	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
86	Chilled water heat movement	Main		140000	tbd	0	0	150000	tbd	0	20000	130000	12698	12	21-Feb
87	C.Op Round 3 – Phase 3	Main		604273	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd	tbd
88	NSC Lighting	Main		50000	tbd	0	0	100000	10000	0	35000	55000	4950	11	21-Feb
89	NSC Heat Pump	Main		-89000	tbd	1630	0	150000	tbd	0	0	150000	-8811	tbd	21-Feb
	Total			**1,413,626**	**-**	**2,430**	**-**	**$539,000**	**$10,200**	**$0**	**$55,012**	**$344,000**	**$14,642**	**23**	

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 (Use drop down)	New or Retrofit	Electrical Consumption (kWh/y)		Average Monthly Demand (kW)		
							Current	Incremental (+/-)	Current	Incremental (+/-)	Months
Education - Adv	Public	UNBC	North	Pilot project - heat pump on Northern Sports Center	HVAC Air-to-Air Heat Pump (ductless or minisplit)	Retrofit	1,182,600	140,000	228	16	6
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

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 (+/-)	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
6,032	-1500	-73	$ 7,784	$ 1,076	-$ 11,145	$ -	-$ 1,833	-$ 4,118	$ 72,000	$ 72,000		18	17.5
6,032	-5200	-258	$ 7,228	$ 2,690	-$ 38,636		-$ 6,448	-$ 35,166	$ 1,472,000	$ 1,472,000		18	41.9