CITY OF NANAIMO
THE HARBOUR CITY

Strategic Energy Management Plan 2021

In partnership with:

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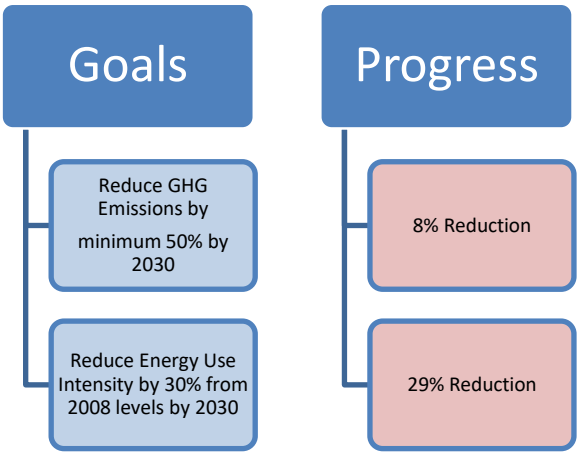
Executive Summary

City Council's 2019 – 2022 Strategic Plan includes a commitment to:

> ***"… take a leadership role and focus on our environmental impact and climate change contributions in our decision making and regional participation."***

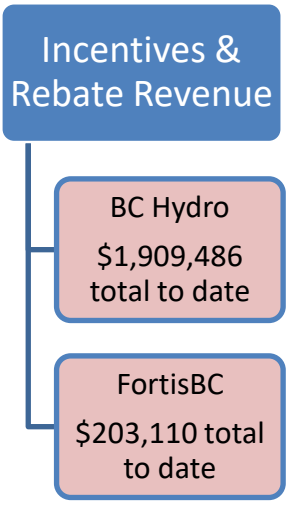
In April 2019 Council's declaration of a Climate Emergency set community-wide emissions reduction targets between **50% and 58% below 2010 levels by 2030**, and between **94% and 107% below 2010 levels by 2050**. By comparison the current BC Government legislated GHG emission target is to reduce emissions by 40% below 2007 levels by 2030. The City's community targets are the more rigorous and have been used throughout the Strategic Energy Management Plan (SEMP) as our organizational targets. These targets will require considerable financial and staffing resources to achieve, as well as strong community support and investment.



In addition to reducing emissions, the City maintains a goal to reduce our corporate portfolio Energy Use Intensity by 30% from 2008 levels. While meaningful progress towards lowering the Energy Use Intensity of many buildings has been made. **Progress towards the 2030 GHG reduction target currently falls well short of where it needs to be** and more aggressive action is needed to hit corporate targets. Undertaking Deep Energy Retrofits by implementing high performance building enclosure assemblies and ventilation processes would be ideal; however, these are costly undertakings and currently are not budgeted for. When undertaking new building construction, the City has been implementing design strategies that reduce energy demand and emissions; however, beyond 2022, we have limited new or remedial corporate building construction projects approved.

Support of our goals is provided by BC Hydro through numerous incentive funding agreements. These agreements are traditionally project-based energy reduction targets, however increasingly emission-reduction agreements have been presented. This funding has been instrumental in achieving a 29% reduction of 2008 energy consumption levels to date, especially considering the continued increase in service levels, capital funding constraints for infrastructure renewal and retrofit projects, and utility rate escalation. These pressures all challenge the Energy Team's ability to reach our goals.

Since inception of the City's Energy Manager Contract with BC Hydro in 2008, the City has implemented projects resulting in 48,162,783 kWh of avoided electrical consumption, and 157,353 GJ of avoided natural gas consumption. At today's rates, that's worth approximately $5.4 million in avoided costs. The City typically spends more than $4.4 million on electricity and natural gas annually; without the program that total would be closer to $4.8million.



The partnership with BC Hydro BC continues to be foundational to the Energy program success. The breadth and value of incentive programs have increased recently, providing even more financial support on numerous projects, programs, and initiatives. Since 2008, the City has received more than $2.11 million in funding support for energy related initiatives, with $368,058 pending.

Continuing to identify, develop and obtain funding for implementation and operation of electrification initiatives, is key. Considering progress to date towards our emissions reduction target for 2030, an **average annual reduction of 210 tCO_2e/year** is required to meet this goal**.**

Multi-Year Action Plan Key Metrics Summary					
Goal	Annual Target	2022	2023	2024	3-Year Average
GHG Emission Reductions (tCO2e)	210	2.1	187	1,056	415
Energy Use Index (EUI) Reduction (kWh/m^2)	9.4	0.8	6.7	38	15
Electrical Savings (kWh/year)	300,000	165,918	132,575	51,986	131,222
Fossil Fuel Savings (GJ/year)	4,315	0	2,145	15,200	5,782
Investment Required (Incremental Capital Cost)		$250,000	$1,800,000		
Incremental Capital Cost ($/$tCO_2e$)[1]		$2,380	$1,965		

The Multi-Year Action Plan Key Metrics Summary above outlines the City's budgeted[2] projects impacting EUI, planned electrical savings, and GHG reductions for the next three years. The City is prioritizing emission reduction projects in the coming years based on the prolonged impact of carbon emissions in our atmosphere. We recognize this leaves our Electrical Savings goal short in the budgeted capital plan.

[1] Incremental Capital Cost = Estimated Project Cost Divided by tonnes of GHG Emissions saved by the project.
[2] The Energy Team has identified an emission reduction project that would satisfy the GHG Emissions reduction goal over the next three years and are currently sourcing additional funding to supplement the amount currently allocated in the capital budgeted.

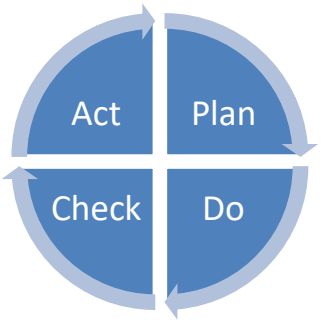
1. Purpose

This Strategic Energy Management Plan (SEMP) is the City of Nanaimo's (City) forward-looking business plan for reducing energy consumption, utility costs, and greenhouse gas (GHG) emissions from our buildings, fleet, and outdoor spaces. The SEMP details a plan to achieve progress toward the 2030 emissions targets, and beyond. **Meeting the targets set will require significant investments in electrification renewal measures for both facilities and fleet, and the continuation of making improvements in energy efficiency and systems optimization.**

Although the existing and targeted emissions reported herein, include those from both Facilities and Fleet Operations, a detailed Green Fleet Strategy and Asset Renewal Plan are being maintained separately.

This plan:

- Sets corporate objectives and targets (Plan)
- Provides a realistic plan for achieving them (Do)
- Sets benchmarks and tracks progress to measure success (Check)
- Identifies opportunities and areas for improvements (Act)
- Continually improves the process of all the actions listed above



The SEMP is reviewed semi-annually, adjusted and updated. The Energy Manager works with staff and stakeholders when determining what changes are needed to the plan.

The SEMP includes both a Multi-Year Action Plan Detailed Project List (Table 10), and a Master Project List (Appendix B) with potential new projects and activities not yet in the 10-Year Capital Plan.

2. Organizational Summary

- About 200 owned sites consuming varying amounts of energy
- About 631 Staff[3]
- About 140,000 m^2 of floor space
- $ 4,350,552 spent on energy in 2020
- Emitted 4,559 tonnes of carbon dioxide equivalent (tCO_2e) in 2020

2.1 Organizational Alignment

The City's Council set a 2019 – 2022 Strategic Plan that provides a road map for the organization and includes the following commitment:

"We will take a leadership role and focus on our environmental impact and climate change contributions in our decision making and regional participation."

In April 2019, recognizing the global concern raised by the International Panel on Climate Change (IPCC) to limit global warming to 1.5 Celsius, Nanaimo City Council declared a Climate Emergency and set new community-wide emissions reduction targets of between **50% and 58% below 2010 levels by 2030**, and between **94% and 107% below 2010 levels by 2050**. These targets are even more rigorous than the current BC Government legislated GHG emission targets for 2030, 2040 and 2050 of 40%, 60% and 80% below 2007 levels, respectively.

Later in this document, Figure 1 - Greenhouse Gas Emissions, shows where we are today and where we plan to be by 2030, assuming measures can be implemented according to current plans.

The City's Facility Asset Planning and Fleet Operations staff (herein referred to as the *Energy Team*) will meet annually to review energy and emissions management goals and establish suitable reductions in alignment with this framework.

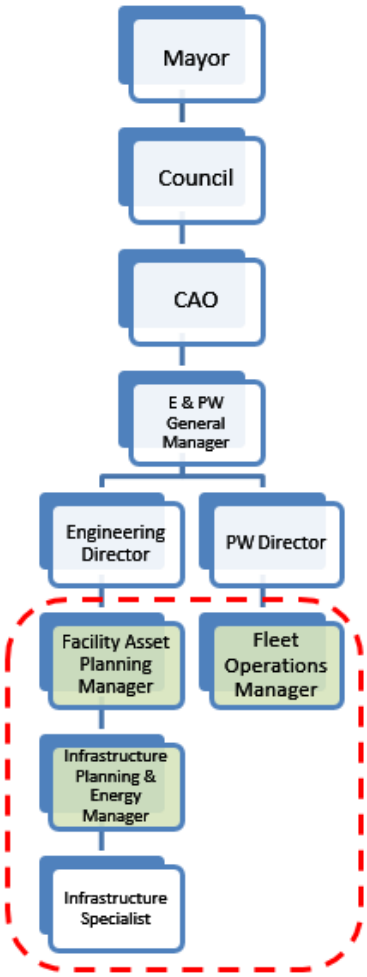
2.2 Organizational Profile

The primary management staff responsible for ensuring an efficiency and emission reduction lens is applied to renewal of facility and fleet assets and system improvements, are shown with green shading in the graphic below.

3 Staff includes permanent full-time and part time employees only. Does not include RCMP staff, Council (9 members), permanent auxiliary, temporary, or casual employees.

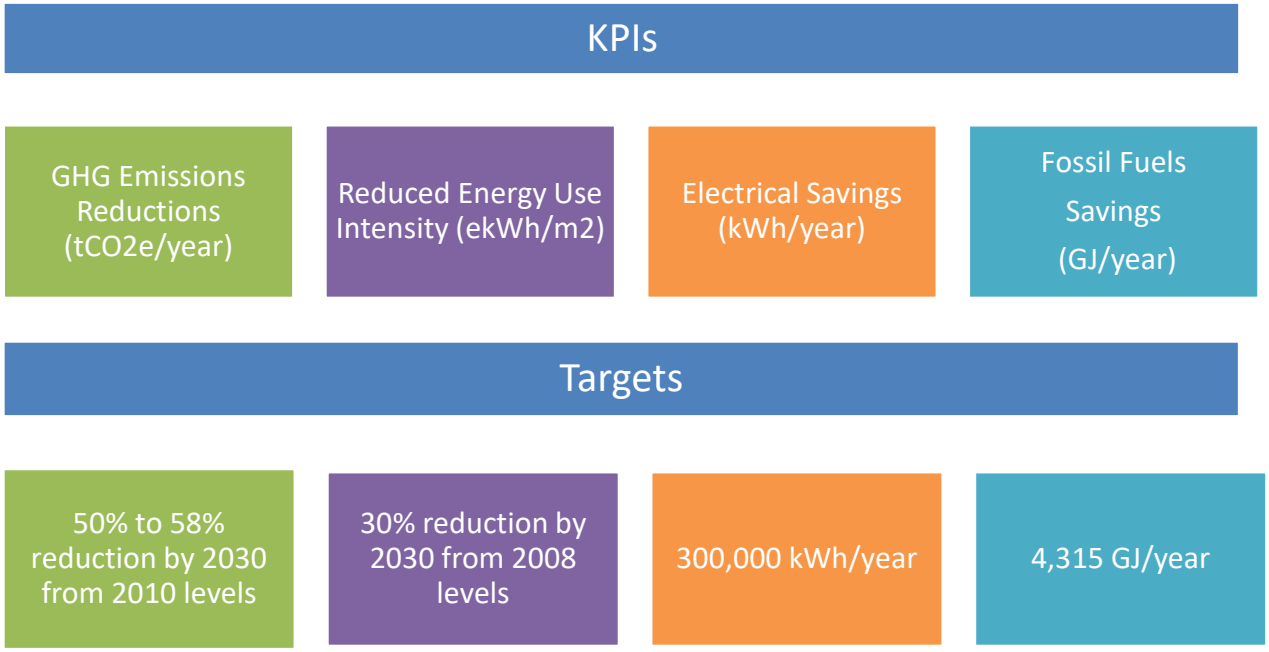
While the Energy Team is generally comprised of members from Facility Asset Planning and Fleet Operations, connecting with other management and staff on energy and efficiency measures is key to ensuring outcomes meet the needs of the organization.

The Energy Team reports through the director and general manager levels, and ultimately through the Chief Administrative Officer to Council and the Mayor. The area marked as red dashed line indicates the Energy Team.



3. Key Performance Indicators & Targets

Progress towards reducing corporate emissions, improving building energy performance (Energy Use Intensity), and reducing electricity and fossil fuels use, is being monitored and tracked using *key performance indicators* (KPI). These KPIs provide an indication as to how much progress is being made over time. There are four main KPIs tracked to assess our progress and the general success of this Strategic Energy Management Plan:



During the early years of this program, much of the emphasis was on electricity conservation. While electricity conservation efforts still play a very important role when renewing assets and making changes to systems and how they are operate, the global recognition of the effects of climate change and critical need to transition away from burning carbon-based fossil fuels, has become widely accepted. Fortunately, BC has a unique advantage compared to many parts of the world, in that the province's natural landscape allows generation of clean, renewable hydro power for its' citizens. Steps to replace fossil-fuel consumption with electrification options, can significantly reduce harmful greenhouse gas emissions, and help the City of Nanaimo move towards meeting its climate action goals.

3.1 Emissions Reporting

Nanaimo uses the baseline year of 2010. While the province uses 2007 as the baseline for it's targets, the City's Climate Emergency declaration in 2019 referenced 2010 baseline information. When calculating total reduction, the City's consideration of a 2010 baseline produces a more stringent reduction goal, and so 2010 baseline has been used.

Up to the end of 2020, as part of a municipality's signing onto the BC Climate Action Charter, the Provincial Government required an annual Climate Action Revenue Incentive Program (CARIP) report which included detailed actions taken to:

- Work towards achieving corporate carbon neutrality
- Measuring and reporting on both corporate and community-wide GHG emissions, and
- Create complete, compact, and energy efficient communities

The reporting of emissions followed specific guidelines to ensure equity and consistency among reporting communities. The emission reporting was limited to include "Traditional Services" only – defined as services that are most commonly provided by the majority of local governments. "Non-Traditional Services" constitute an additional 15.5% to the reported emissions in 2020 which were not included. The following shows the delineation between Traditional and Non-Traditional Services as considered in the CARIP reporting:

Traditional Services	Non-Traditional Services
•Adminstration & Governance •Drinking, Storm and Waste Water •Solid Waste Collection, Transportation & Diversion •Roads and Traffic Operations •Arts, Recreation and Cultural Services •Fire Protection •Contracted services	•RCMP •Processing of waste, recycleables or organics •New construction •Landfills, buildings and equipment at the landfill for the purposes of operating the landfill or processing waste •Airports or court houses •Leased facilities (PT, BH, PS, CSB, HAC) •Business travel •Employee commuting

For a complete list of Site Acronyms used in this document, see Appendix A, and for a Glossary of Terms, see Appendix D.

In May of 2020, the Government of BC announced the end of the CARIP reporting requirements, with the final submission only requiring a *Carbon Tax Calculation Form for fuels purchased between January 1 and December 31, 2020*.

Prior to CARIP ending, 100% of the carbon taxes paid would be returned municipalities for energy and emissions reduction projects. With the ending of CARIP, the City is awaiting the announcement of a

replacement program or other funding source for future carbon-reduction initiatives like the CleanBC Incentive Programs.

To ensure consistency with previous reporting, the established "Traditional Services" model will continue to be followed, however emissions related to "Non-traditional services", as well as emission reductions from these services will now be included, although tracked separately. See Appendix E for Corporate Emissions Data.

3.2 Energy Use Intensity

Energy Use Intensity (EUI) is a metric used to measure and compare a building's energy efficiency. A building's EUI is used to track improvements within the building and can be used to compare efficiencies between buildings, especially when used to compare similar buildings. The City uses a benchmark year of 2008 for EUI targets. This coincides with the creation of the Energy Manager role within the City, and marks the commencement of a specific effort to be more energy conscious. By continually making improvements to the operational efficiency of its building assets, the EUI is reduced, representing long term continual improvement.

Although electricity and natural gas consumption in a building are typically measured using different units, kilo-Watt-hours (kWh) and Gigajoules (GJ) respectively, the EUI calculations are converted to "equivalent" terms – *ekWh*. These equivalents allow comparison of overall energy usage when different sources exist. The EUI values in this plan are expressed as $ekWh/m^2$(equivalent kilo-Watt-hours per square meter of building area), and have not been adjusted to varying year-to-year weather conditions.

3.3 Electrical Savings

With the existing BC Hydro – City of Nanaimo Energy Manager Agreement, the targeted annual energy reduction is currently set at 300,000 kilo-Watt-hours (kWh) per year.

3.4 Fossil Fuel Savings

An average annual fossil fuel savings equal to 4,315 GJ is required to meet the **50% below 2010 levels by 2030** emissions reduction target established by City Council.

4. How Are We Doing?

This section discusses progress in relation to KPIs and targets discussed in Section 2.

4.1 KPI Progress

Energy and emissions reduction performance can be measured by trending the KPIs over time. An individual project's performance is evaluated based on avoided energy consumption by using the new, actual performance data, compared with previous baselined or estimated previous energy consumption. While performance can be normalized to account for fluctuations in weather, this has not been undertaken for this report. In addition, capturing changes in building use and service/occupancy levels is not readily feasible.

The table below presents a score card of KPI and the progress towards targets for energy and emissions. Values shown in green reflect those that are performing well, red are performing poorly, and yellow indicates that the performance is close to the target.

Table 1: KPI Score Card

Key Performance Indicator	Baseline[4]	Current Value[5] (2020)	Current Target (2020)	2030 Target
Corporate GHG Emission **(tCO_2e)**	4,955	4,559	3,716	2,478
Energy Use Intensity (EUI) **(kWh/m^2)**	366	214	301	256
Electrical Savings **(kWh/year)**		208,863	300,000	
Fossil Fuel Savings **(GJ/year)**		0	4,315	

4.2 Greenhouse Gas Emissions

Since 2008, the majority of the City's corporate GHG emissions reduction have been achieved from investments in energy conservation measures implemented through asset renewal, such as lighting, equipment, and vehicles, and when making improvements to how systems operate. Heating plant systems within facilities provide warm air for occupant comfort and produce hot water for sanitation, bathing, food and beverages, and for swimming in aquatic facilities. Heating plants are the largest consumers of fossil fuels within facilities, and buildings are responsible for about 40% of the City's

[4] Baseline year for Corporate GHG Emissions is 2010. Baseline for Energy Use Intensity is 2008.
[5] Corporate GHG Emission values and Energy Use Intensity are actual current values. Electrical Savings and Fossil Fuel savings are calculated based on initiatives undertaken.

overall corporate emissions. The City's fleet is currently responsible for about 60% of corporate emissions.

Of the total GHG emissions, 60% are associated with fleet and 40% with building

Figure 1, shows a relatively consistent portfolio-wide emissions profile from 2007 to 2020 of between 4,700 and 6,150 tCO_2e, with an overall decrease of 396 tCO_2e decrease since our baseline year of 2010 (-8%).

Figure 1: Greenhouse Gas Emissions (tonnes of CO_2e)

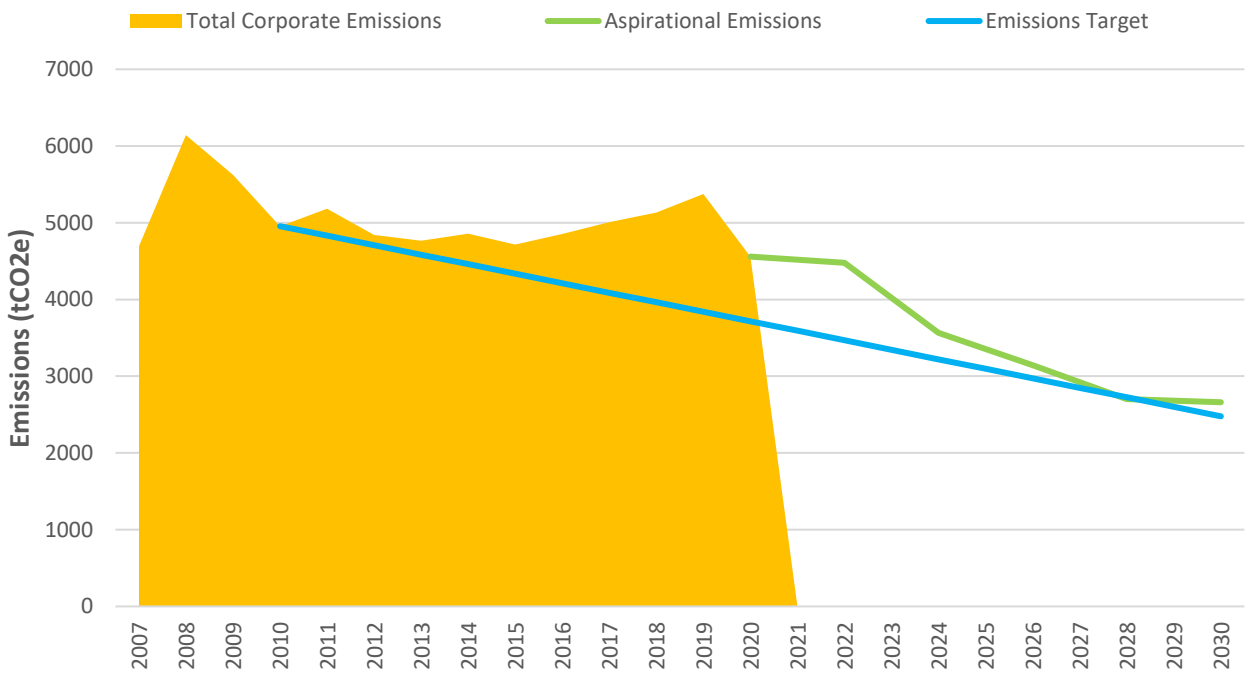


Figure 1: Although the current value for emissions appears favourable when compared to the previous years, it is skewed significantly due to the effects of COVID-19 shutting down the Beban Pool facility, and reducing operations at several other facilities.

Emissions have however remained fairly steady despite a continued increase in floor area of the portfolio and fleet inventory. However, the City's reduction targets is on an absolute basis, not on floor area (or *intensity*) basis. In order to reach the 50% to 58% reduction of 2010 levels by 2030, more aggressive action needs to be taken. Assuming a linear reduction pattern, in the 2020 reporting year, the City should have achieved a 25-29% reduction from the 2010 baseline to meet our reduction goal of 50% - 58% by 2030, or maximum emissions of 3,716 tCO_2e. Currently, emissions stand at 4,559 tCO_2e. The City is still far from its goal, which emphasizes how critical it is that investments are made in low or, preferably zero carbon technologies, and to become more aggressive with carbon reduction initiatives.

Recently completed low-carbon electrification studies of building heating, ventilation, and air conditioning systems have identified significant fuel switching (from natural gas to electric) opportunities that can be implemented to reduce GHG emissions (shown as aspirational emission reductions in Figure 1). Preliminary details of the projects are listed in the Multi-Year Action Plan (Table 9) and Master Projects List (Appendix B). If implemented, these projects would enable the City to nearly reach its 2030 target. Reductions in fleet emissions should facilitate the last reductions required to meet the City's 2030 target.

In 2008, the City experienced a significant increase in its building inventory (OWCC, VICC, FS4, Labieux Pump Station, and Rotary Park Fieldhouse) resulting in a 34% increase in floor area and commensurate increase in energy demands. Also, since 2007, the City has experienced a 9.4% increase in the number of full-time equivalent (FTE) employees. The addition of operational space and staff increases overall energy requirements and associated GHG emissions, requiring even more efficiency and carbon reduction measures to meet targets. The good news is that new corporate facilities continue to be designed with aggressive carbon-reducing efforts from the planning stages. Additionally, staff are encouraged to be conscientious with energy use through a number of behavioural education programs, and automation of systems to encourage energy savings.

For the period of January 1 to December 31, 2020, the City paid $149,791 in carbon tax. BC's current carbon tax price is set at $45 per tonne, however, senior government has announced a carbon price of $170 per tonne in 2030, with annual increases of $15 beginning in 2023. This original announcement has changed due to the ongoing COVID-19 pandemic recovery, however focus needs to be maintained on emission reduction where possible. As the carbon tax increases on fossil fuel consumption, the benefit of decreasing carbon emissions early will yield greater benefits.

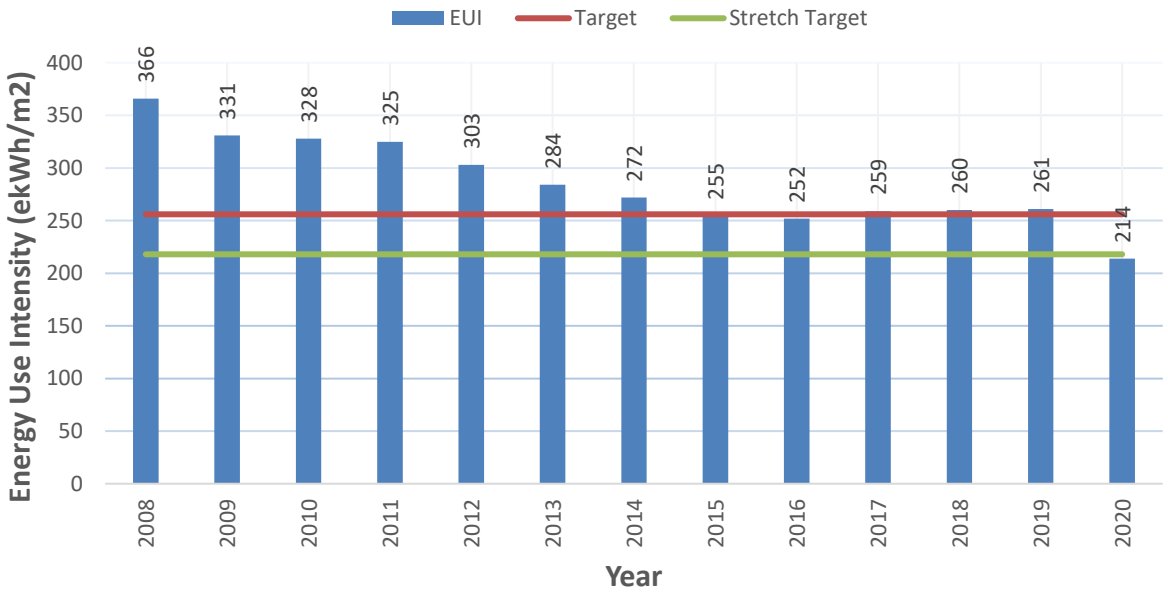
Also due to the pandemic, several facilities were not operating as usual in 2020 and 2021. This resulted in reduced energy consumption and emission levels which, while in our favour for now, still need addressing, as emissions and energy consumption will return to usual levels once normal operations have resumed.

This document does not specifically address in detail GHG emission reductions associated with our Green Fleet Strategy. In general however, the City is working to lower emissions from fleet through electrification and some intermediary steps of fuel switching to cleaner burning fuels (i.e. from diesel to CNG (compressed natural gas) with large refuse vehicles). As well, the passenger vehicles and other light duty vehicles that have reached the end of their useful economical service life will be replaced with new fully electric models as they become available.

4.3 Energy Use Intensity

One of the City's key objectives is improving each building's energy efficiency, whenever possible. The City has set a target to **reduce the averaged Energy Use Intensity (EUI)** of the 25 largest energy consuming buildings by **30% below 2008 levels**, equivalent to 256 ekWh/m^2. An even greater **'Stretch' operating target of 218 ekWh/m2** has been set to encourage going beyond normal abilities and create novel approaches and solutions. Progress towards each of these targets is illustrated in Figure 2. On average, the City has almost achieved its 30% reduction target, even before the pandemic modified organization operations. By continually implementing improvements to the operational efficiency of building assets, EUI is driven down, illustrating the success of the efforts being made.

Figure 2: Energy Use Intensity (EUI) – Average of 25 Largest Energy Consuming Sites Combined

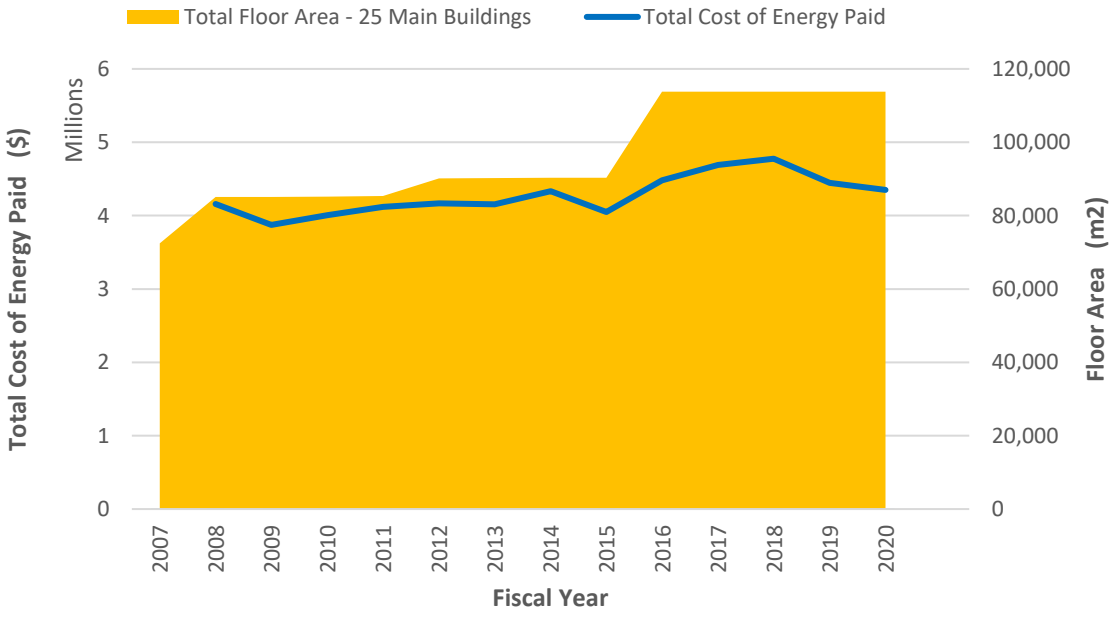


In 2020, the City reached a new low of 214 ekWh/m^2 for the combined average EUI of its 25 largest energy consuming buildings. As with GHG emissions, this is skewed due to several facilities not running at normal capacity due to COVID-19 restrictions. The historical trend indicates positive results towards the set target.

It is also important to recognize that as the City expands service-delivery with more programming and facility use, greater energy will be consumed and the EUI will increase. Continued improvements and behaviour-education is necessary to maintain our goals.

Figure 3 illustrates the City's increasing floor area over the last 13 years. These additional spaces need to be conditioned, requiring significant energy inputs. These energy inputs are not only electricity, but natural gas as well. As noted previously, the City's GHG reduction targets are absolute and not based on EUI. The 26% increase in floor area has thus far been accommodated within the EUI, but still must be accommodated within the absolute GHG reduction target. Future design of new facilities as close as possible to net-zero GHG emissions will be a critical component of the City achieving the carbon reduction targets.

Figure 3: Floor Area and Total Cost of Energy



The cost of electricity has increased 25.5% from 2014 to 2020. These rate increases would have translated into significant utility costs for the City had energy reduction measures not been implemented. Independent to market influences on the price of energy, **the City has worked to reduce the overall energy intensity of its 25 largest energy consuming facilities from 366 kWh/m2 in 2008 to about 260 kWh/m2 prior to COVID-19, resulting in a 29% reduction.**

Energy Use Intensity of buildings is 29% lower than the 2008 baseline

It should be noted that the EUI metric is a preferred performance indicator in contrast to paid energy costs, as the Energy Team and the City are unable to control utility rates.

4.4 Energy Savings

From 2008 to 2021, the energy efficiency projects utilizing BC Hydro and FortisBC funded programs, have cumulatively avoided spending approximately $5.4 million or $400,000 per year on electricity and natural gas resources. The energy savings associated with these efficiency programs is outlined in Figure 4, forthcoming. Progress towards these targets is tracked through individual incentive agreements that outline expected energy conservation improvements for the implemented solutions, as well as annual reporting on all measures implemented.

> From 2008 to 2021, the City has avoided spending $5.4 million in energy costs as a result of past energy efficiency projects completed

Annually, BC Hydro sets electricity reduction targets for the Energy Team in the BC Hydro - City of Nanaimo Energy Management Contract (Agreement). In addition, the Agreement requires the City to report on our progress towards the provincial GHG emission reduction targets. Together, these two metrics make up our Energy Savings. The two targets have to be carefully balanced as reducing GHG emissions typically results in increased electricity consumption. Recognising the importance of reducing carbon in the atmosphere, the Energy Team is shifting focus from electricity conservation to GHG emission reductions. We recognize this will impact our KPIs to reduce EUI and increase energy savings, however it specifically targets the more crucial emissions reductions and fossil fuel savings.

4.5 Electricity Savings

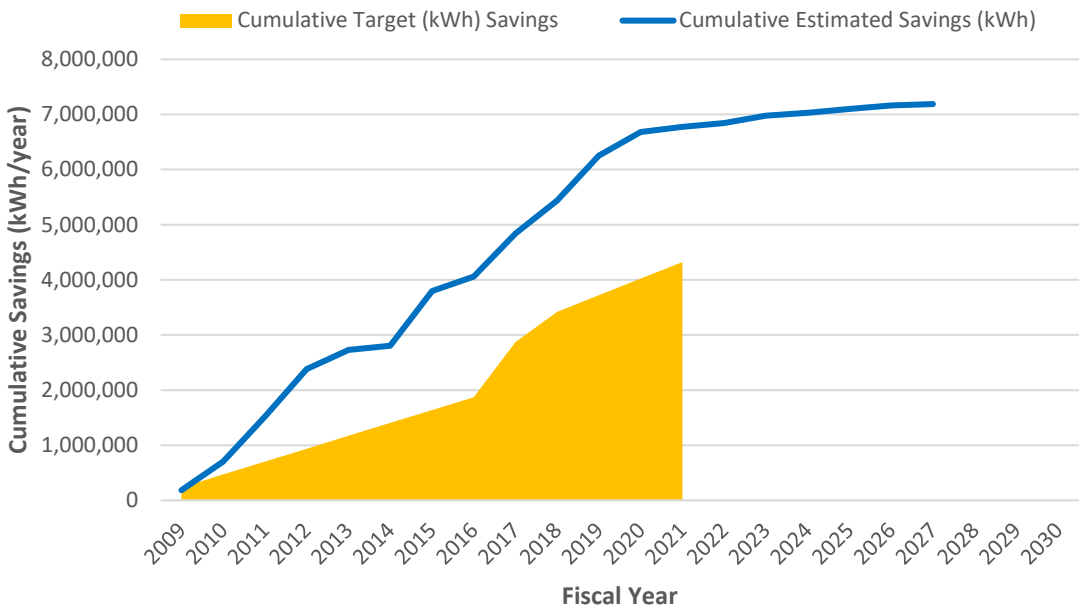
While finding ways to conserve electricity is very important, it is also important to recognize it as the cleanest source of energy available in British Columbia. As noted above, strategically increasing electricity use can displace the use of fossil fuels; switching to and thereby increasing electricity use will ultimately benefit the environment and planet.

When considering asset renewal, newer, more efficient, longer-lasting, and improved performance products are always sought. For example, since 2014 many of the electricity savings have been realized by renewing old lighting technology with newer light-emitting-diode (LED) products. These savings continue year-to-year into the future. This accumulation of energy savings is a good indicator of the energy management program's performance.

For 2021, the estimated electricity savings from completed asset renewals equates to 107,732 kWh. We recognize that this falls short of the 300,000 kWh target proposed by BC Hydro and need to review our strategy moving forward.

A graphical representation of the City's ***accumulated electricity savings***, compared to the annual BC Hydro target is shown in Figure 4. The graph demonstrates that over the long term, the City has exceed BC Hydro's accumulated savings targets, recognizing the variation in performance from year to year. The predicted savings from 2022 to 2027 in Figure 4 takes into account projects currently in the 10-Year

Figure 4: City Electricity Savings vs BC Hydro Target



Capital Plan. As most City facilities have, or will soon have LED lighting technology implemented, future savings in these types of projects are becoming fewer as shown by the flattening of the blue line in Figure 4.

Future planned projects which will affect electrical savings, and those that may *increase* electricity use and facility operating costs, when switching from fossil fuels to electricity, are detailed in Table 10: Multi-Year Action Plan Detailed Project List.

For reference, in 2020 the City consumed more than 18,700,000 kWh of electricity, producing 200 tCO2e, with an approximate total City cost of $2.6 million in the delivery of "Traditional Services". These numbers were lower than the usual of 22,500,000 kWh and $3.2M per year, due to some facilities operating at lesser capacity due to the COVID-19 pandemic.

The City has avoided $ 3.7 million in electricity costs as a result of conservation projects

Based on electricity rates at the time energy projects and activities were completed, it is estimated we have avoided spending approximately $3.7 million in electricity costs since 2009.

4.6 Fossil Fuel Savings

Significantly reducing the use of fossil fuels is critical when considering the GHG emission reduction targets set by Nanaimo City Council in 2019. To achieve a **reduction 50% to 58% below 2010 levels by 2030, and a reduction of 94% to 107% below 2010 levels by 2050** significant investments in higher-cost electrification, or other clean energy sources is required when renewing assets that are at the end of their useful economical service life. The Energy Team examines asset renewal opportunities and applies a ***climate sensitive lens***, recognizing that emission-reducing opportunities are governed by each asset's expected life-cycle. A total life-cycle cost analysis considering capital cost, ongoing operations, maintenance, and energy and carbon tax costs for proposed new assets is important in the decision making process. With 2050 fast approaching, assets with longer service lives must be considered against the 94%-107% reduction in GHG emissions goal of 2050 and not the 50%-58% reduction target of 2030.

Table 2 provides the City's 2020 fossil fuel consumption for buildings and fleet, including both the Traditional and Non-traditional Services (discussed earlier) and resulting emissions. As with energy consumption, consumption of fossil fuels was lower than usual in 2020 due to operational impacts of the pandemic.

Table 2: 2020 Fossil Fuels - Consumption & Emissions

Traditional Services				
Buildings	Consumption		Emissions	
Natural Gas	36,443	GJ	1,817	tCO2e
Home Heating Fuel	25,663	L	66	tCO2e
		Sub-total	*1,883*	*tCO2e*
Fleet	Consumption		Emissions	
Natural Gas	10,001	GJ	499	tCO2e
Diesel	349,818	L	893	tCO2e
Gasoline	175,801	L	401	tCO2e
Propane	56,798	L	88	tCO2e
Contracted and Employee	Not Applicable		595	tCO2e
		Sub-total	*2,476*	*tCO2e*
		Total	*4,359*	*tCO2e*
Non-Traditional Services				
Buildings	Consumption		Emissions	
Natural Gas	4415	GJ	210	tCO2e
Fleet (RCMP)				
Gasoline	267,753	L	611	tCO2e
		Total	*861*	*tCO2e*

In 2008 when the Energy Management Program was initiated, the City set a 1% annual reduction target for natural gas and other fossil fuels (based on the 2008 total consumption). This was equivalent to a targeted reduction of approximately 573 GJ/year (approximately 32 tCO_2/year).

Recognizing the urgent need to address climate change, a more aggressive GHG emission reduction target was set in 2019 at 50-58% reduction from the 2010 baseline levels. By 2030, this would yield a 34,500 GJ or 2,082 tCO_2e reduction from the 2020 actual emission levels.

Future planned project opportunities identified thus far, which can affect fossil fuel savings and significantly reduce emissions, are detailed in Tables 9 and 10: Multi-Year Action Plan and in the Master Project List in Appendix B. The Master Project list is maintained to allow the Energy Team to keep track of the status of all active and potential projects. This enables the team to identify whether there are sufficient projects underway and on the horizon to meet the objectives and targets of this SEMP. The Master Project List is also used to capture any new projects for evaluation. This ensures we do not lose sight of existing opportunities and that we have a healthy source of new projects to draw from as funding is made available.

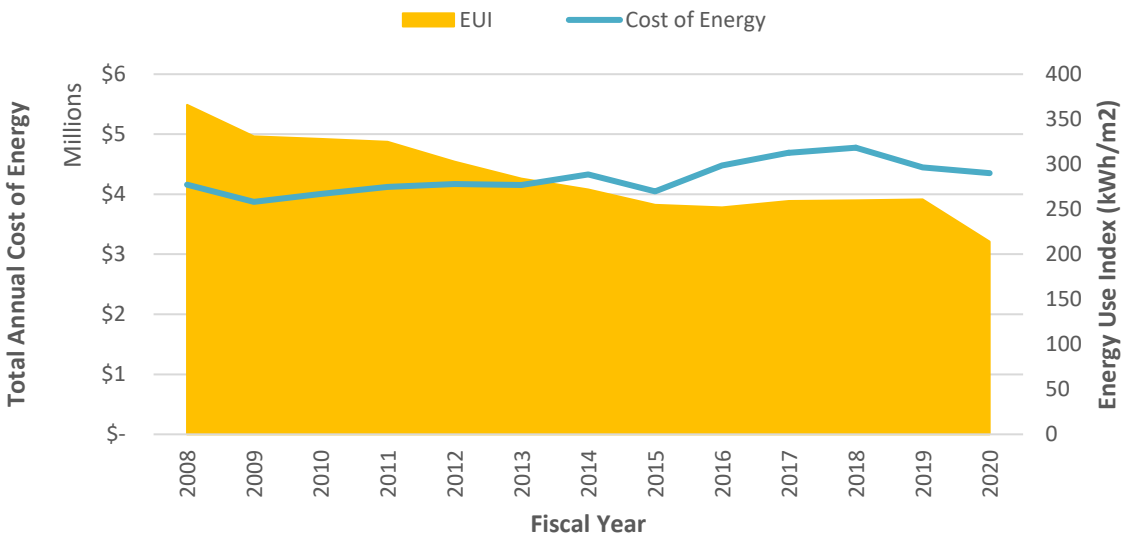
Since 2008, the City has completed a number of natural gas conservation projects. Based on the billing rate of natural gas at the time these projects and activities were completed, the cumulative saving are estimated to be $1,691,430.

4.7 Energy Spent and Energy Use Intensity

Strategic energy conservation efforts while renewing assets at many City facilities has improved our facility EUI (efficiency) over time, keeping operating costs associated with increasing electricity and natural gas consumption from sharp increases. Even with BC Hydro rates increasing 65.8% since 2007, the City's total spend on corporate energy consumption has only increased about 15% between 2008 and 2019 (prior to COVID-19).

Figure 5 illustrates the trend of the total cost of energy compared to non-weather adjusted EUI at the City's top 25, largest energy consuming buildings.

Figure 5: EUI and Cost of Energy



As electrification projects are implemented in buildings, increased energy costs are expected since electricity has a greater unit cost than the equivalent unit of natural gas. Current carbon tax pricing of $45/tonne (t) of CO_2e are expected to increase $15/t annually, reaching $170/t by 2030. This will offset the lower price per unit of natural gas, making the premium associated with electricity less. **Not only will the City will pay less tax the sooner transitions are made to clean electricity, but the faster carbon emissions are reduced, and the impacts on our climate slowed.**

5. Facility Benchmarks

To evaluate the effectiveness of efficiency measures implemented and to identify new opportunities for improvement, it is necessary to monitor and compare individual building energy performance over time. Facility Benchmarking compares how each facility is currently performing against a *benchmark year* (a reference point), and its performance relative to other similar facility types within the organization.

As the Energy Management Program began in 2008, this is the year selected as the baseline year for buildings built before this time. However for buildings built after 2008, the year the building came into operation is the benchmark year chosen. The following comparison graphs for each facility group, show the baseline year as the first bar, followed by the last 5 years of energy performance data, and then the last bar for each facility represents the 30% reduction target from the baseline.

In this section, the 25 largest energy consuming City facilities are compared with bar graphs to illustrate a benchmark year (2008), Energy Use Intensity (EUI) for the past 5 years for each facility, and the 30% energy use intensity reduction target for each. The table below each graphing of facilities, provides data on 2020 electricity and fossil fuel consumption, and resulting EUI, cost/m^2 of floor space, and annual emissions.

In general, there are several factors that come into play when comparing facilities, including such things as building design, location, climate, building age, type of construction, operating equipment type and condition, building controls, hours of use, and occupancy levels.

The total energy use represents electricity and fossil fuel consumed to meet building needs for heating, cooling, lighting, ventilation, domestic hot water, computers, building automation systems, and process loads. Process loads generally include all mechanical equipment like pump motors, actuation devices, electric vehicle charging equipment, refrigeration systems in ice arenas, elevators, and kitchen equipment.

5.1 Recreation Facilities

Recreation facilities, especially aquatics and arenas, have the highest energy needs and produce the larges amount of emissions of all City buildings. Overall, recreation facilities consume about 46% of the City's corporate electricity use and 76% of the natural gas used in 2020. These buildings have been the primary source of energy reduction opportunities, and will yield the most significant source of corporate GHG emission reductions.

Figure 6: Recreation Facilities – 2008, 2016 to 2020 EUI Performance

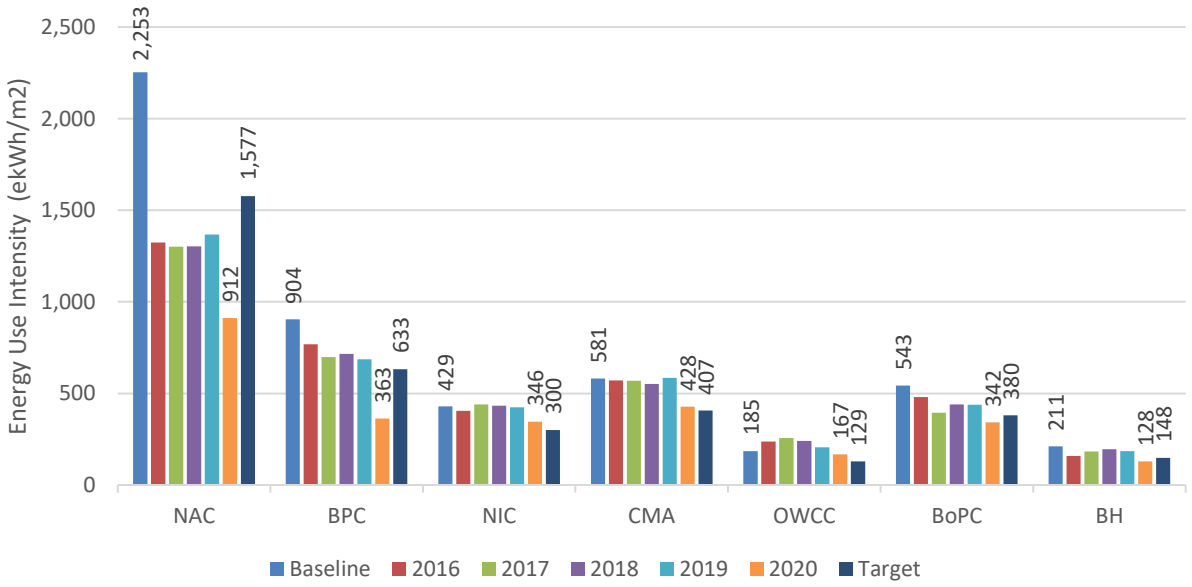


Table 3: Recreation Facilities for 2020

Facility	Floor Area (m2)	Electricity (kWh)	Fossil Fuel (ekWh)	Total EUI (ekWh/m2)	Total Cost ($/m2)	Emissions (tCO2e)	Emissions (tCO2e/m2)
NAC	6,235	1,401,807	4,283,004	912	$41.3	784.0	0.130
BPC	15,330	1,327,510	2,323,833	363	$19.3	431.0	0.043
NIC	6,714	1,199,226	1,049,028	346	$23.3	201.0	0.031
CMA	2,512	619,258	456,673	428	$29.3	88.6	0.035
OWCC	3,392	334,941	232,133	167	$12.2	45.2	0.013
BoPC	2,490	156,988	239,601	342	$10.8	44.7	0.017
BH	2,323	223,692	165,437	128	$10.0	32.1	0.011

5.2 Emergency Services

Fire Rescue and Police Services provide 24-hour service to the public, and as a result require intense use of energy to operate these facilities. These facilities accounted for about 7% of the corporate electricity use, and 4% of the natural gas use in 2020. The new Fire Station No.1 will open in summer of 2022, eliminating the last City facility using diesel oil for heating purposes, and significantly reducing GHG emissions. All remaining fire stations will be upgraded to LED lighting in the next few years as well, reducing Energy Use Intensity for each site. The Police Annex has increased its' EUI due to a reconfiguration of the internal spaces and significantly more staff occupying the building.

Figure 7: Emergency Services – 2008, 2016 to 2020 EUI Performance

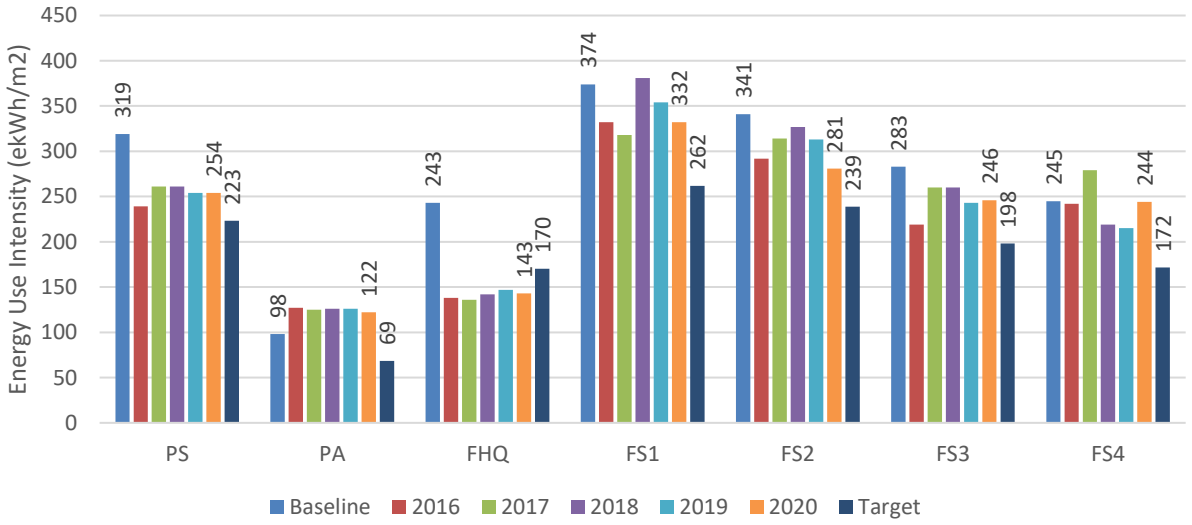


Table 4: Emergency Services for 2020

Facility	Floor Area (m2)	Electricity (kWh)	Fossil Fuel (ekWh)	Total EUI (ekWh/m2)	Total Cost ($/m2)	Emissions (tCO2e)	2020 tCO2e/m2
PS	3,976	870,480	138,611	254	$19.8	44.6	0.011
PA	2,292	139,560	140,833	122	$9.2	6.2	0.003
FHQ	651	151,753	16,944	143	$17.0	3.7	0.006
FS1	1,382	181,800	303,495 **	332	$29.8	85.5	0.062
FS2	727	75,720	128,611	281	$19.6	25.3	0.035
FS3	658	61,393	101,389	246	$17.9	20.0	0.030
FS4	820	104,820	95,000	244	$20.2	19.8	0.024

5.3 Civic Buildings

Civic buildings are generally operated from Monday to Friday, 8 am to 4:30 pm providing service to the public. These facilities accounted for about 5% of the corporate electricity use, and 5% of the natural gas use in 2020.

Over the last few years, the Service and Resource Centre (SARC) building has seen an increase in use with more staffing being added to the building; hence the EUI has increased. A lighting upgrade is planned for City Hall (CH) in 2024, which will decrease the building's EUI. The Community Services Building (CSB) has been sold to BC Housing, and will be removed from the City's inventory in next year's report.

Figure 8: Civic Office Buildings – 2008, 2016 to 2020 EUI Performance

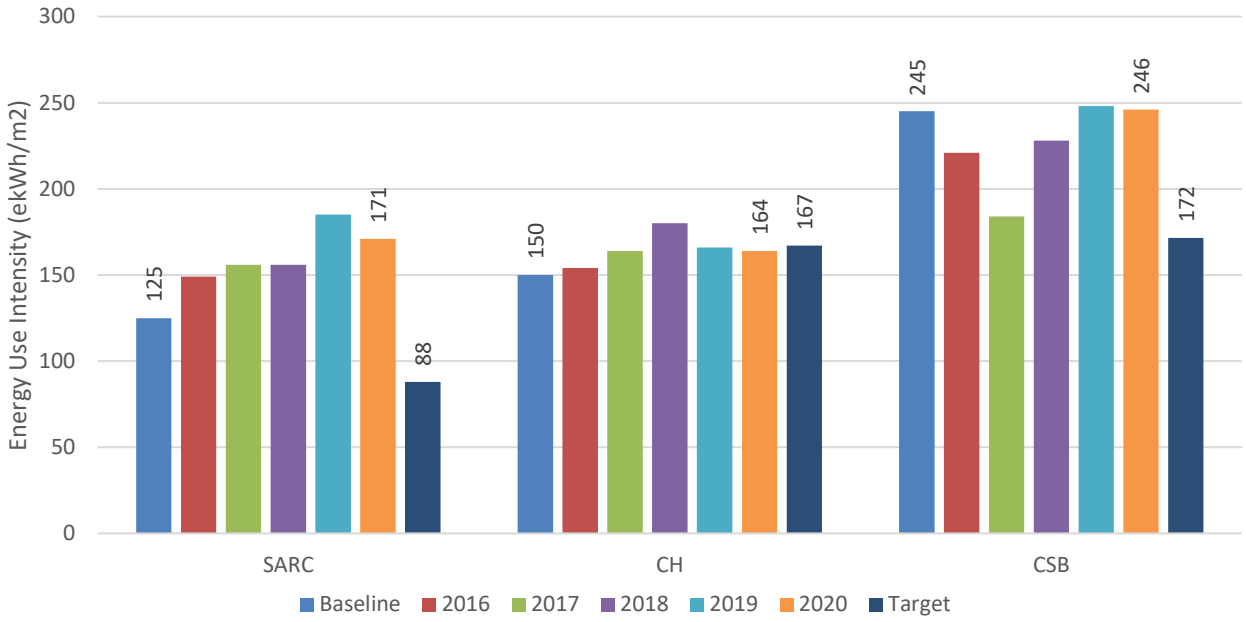


Table 5: Civic Office Buildings for 2020

Facility	Floor Area (m2)	Electricity (kWh)	Fossil Fuel (ekWh)	Total EUI (ekWh/m2)	Total Cost ($/m2)	Emissions (tCO2e)	Emissions (tCO2e/m2)
SARC	4,862	688,305	116,374	171	$13.6	28.2	0.006
CH	1,678	130,486	150,053	164	$12.3	28.3	0.017
CSB	1,309	75,720	246,667	246	$14.6	7.1	0.005

5.4 Parkades

These structures provide 24-hour parking year round. Overhead lighting remains on and the semi-enclosed parkades run exhaust fans to maintain acceptable air quality standards. These facilities accounted for about 5% of the corporate electricity use, and consumed no natural gas in 2020.

Figure 9: Parkades – 2008, 2016 to 2020 EUI Performance

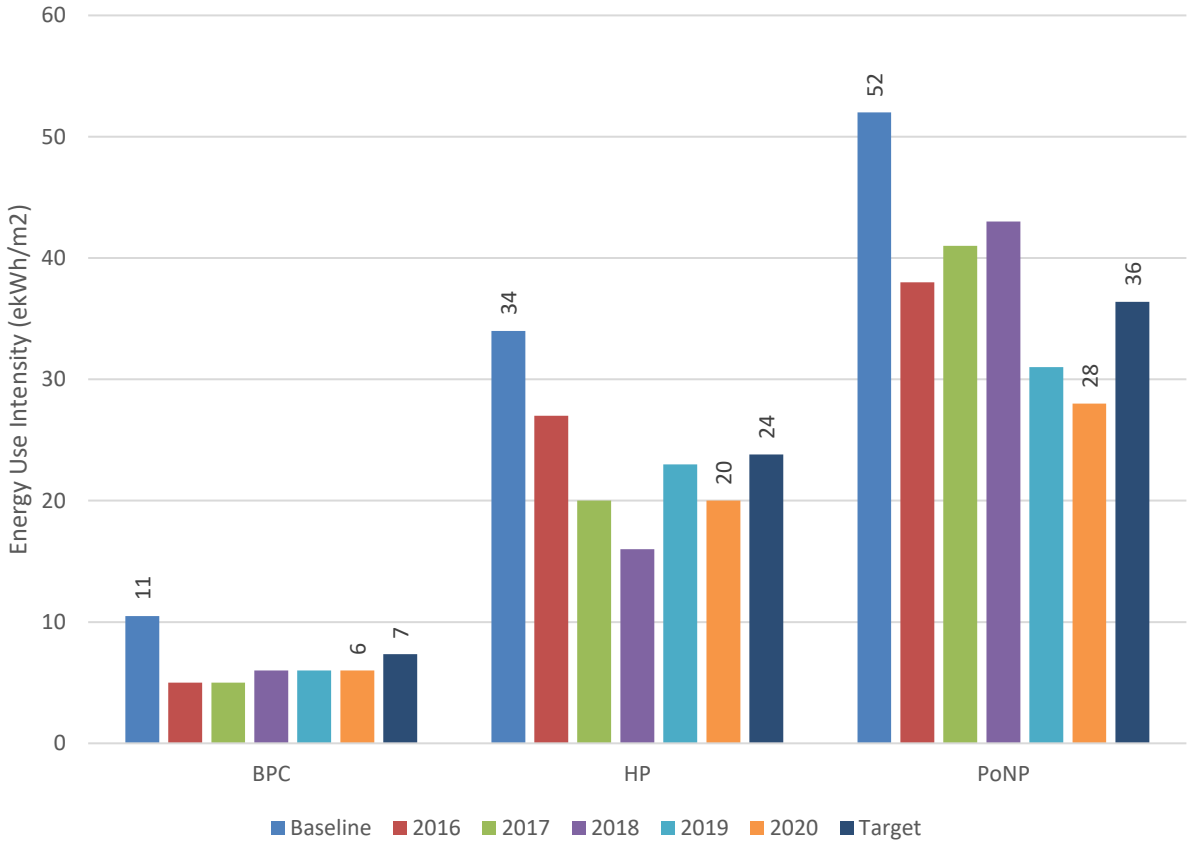


Table 6: Parkades for 2020

Facility	Floor Area (m2)	Electricity (kWh)	Fossil Fuel (ekWh)	Total EUI (ekWh/m2)	Total Cost ($/m2)	Emissions (tCO2e)	Emissions (tCO2e/m2)
BP	9,711	55,221	0	6	$0.8	1.2	0.0001
HP	11,976	233,788	0	20	$2.1	5.1	0.0004
PoNP	11,816	336,480	0	28	$3.0	7.4	0.001

5.5 Operations

The Operations facilities have varied staff operating hours, generally between 7 am and 4:30 pm. However, the Public Works Yard maintains 24/7/365 Commissionaire coverage between 4:30 pm and 8:00 am with reduced staffing levels. The Water Treatment Plant operates with staff 24/7/365. These facilities accounted for about 9.3% of the corporate electricity use, and 1.8% of the natural gas use in 2020.

Both the Public Works Yard (PW) and the Parks Operations Yard (PY) facilities could reduce their EUI with internal lighting upgrades, but lighting upgrades will depend on future use/renewal decisions for these facilities.

Figure 10: Operations – 2008, 2016 to 2020 EUI Performance

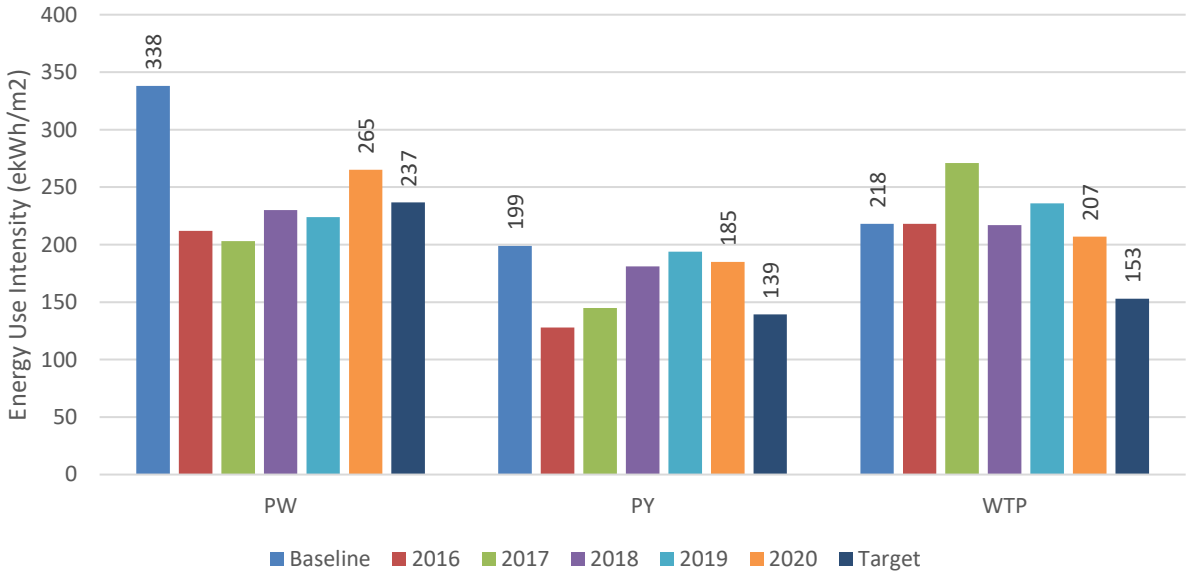


Table 7: Operations for 2020

Facility	Floor Area (m2)	Electricity (kWh)	Fossil Fuel (ekWh)	Total EUI (ekWh/m2)	Total Cost ($/m2)	Emissions (tCO2e)	Emissions (tCO2e/m2)
PW	2,837	546,803	206,389	265	$21.3	49.9	0.018
PY	537	99,240	0	185	$22.0	2.2	0.004
WTP	5,547	1,149,120	0	207	$18.4	25.3	0.005

5.6 Conference Centre and Performing Arts

These buildings generally have regular staffing between 8 am and 4:30 pm throughout the week, and varied evening hours to accommodate events and performances 7-days a week.

Due to the COVID-19 pandemic, these facilities have not been operating as usual resulting in lower EUI values.

Figure 11: Conference Centre and Performing Arts – 2008, 2016 to 2020 EUI Performance

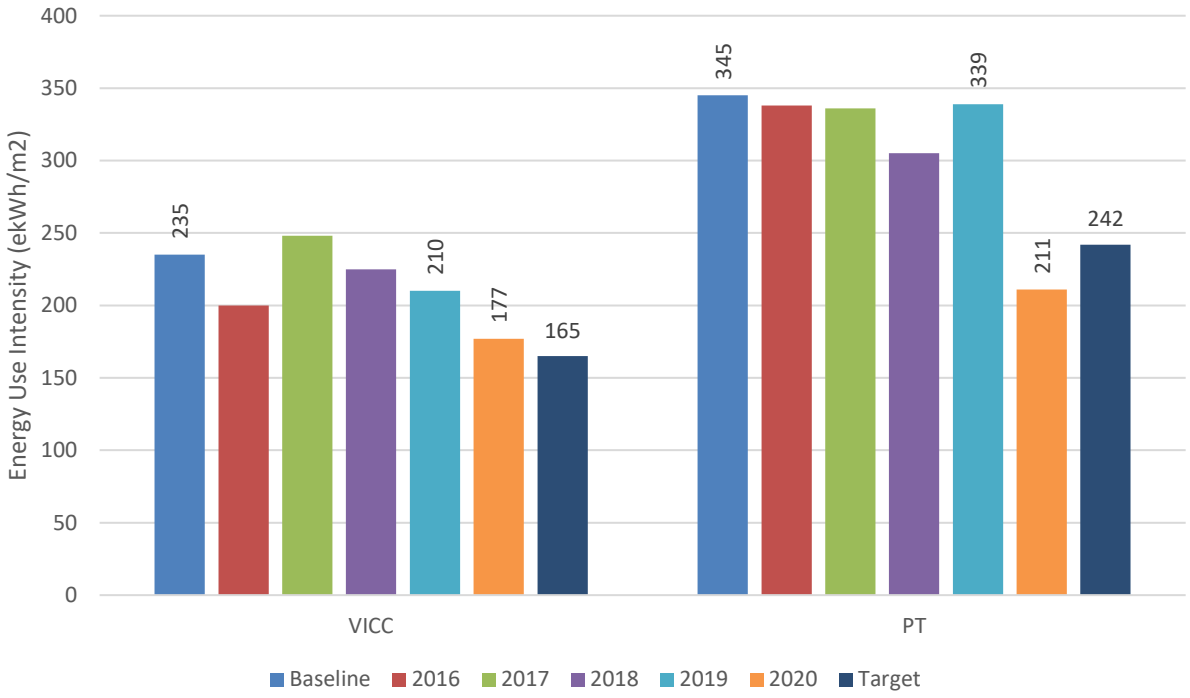


Table 8: Conference Centre and Performing Arts for 2020

Facility	Floor Area (m2)	Electricity (kWh)	Fossil Fuel (ekWh)	Total EUI (ekWh/m2)	Total Cost ($/m2)	Emissions (tCO2e)	Emissions (tCO2e/m2)
VICC	8,658	1,033,920	497,778	177	$20.4	114.1	0.016
PT	3,613	401,063	362,465	211	$15.3	81	0.019

5.7 Focus Areas

Our efforts continue to focus on opportunities which have the greatest potential to reduce energy consumption and GHG emissions. The facility type which has the largest consumption of energy are the recreation facilities which accounted for 61% of all facility energy consumption, and 75% of the total emissions in 2020. Specifically, Aquatic Facilities and Ice Arenas have the highest EUI compared with other building types within the City's inventory of buildings, followed by Emergency Services, Performing Arts, and Operations facilities.

Figure 12a shows the share of total emissions consumed by each different facility type while Figure 12b illustrates the close link between energy consumption and GHG emissions.

Figure 12a: Percentage of Total GHG Emissions by Facility Type

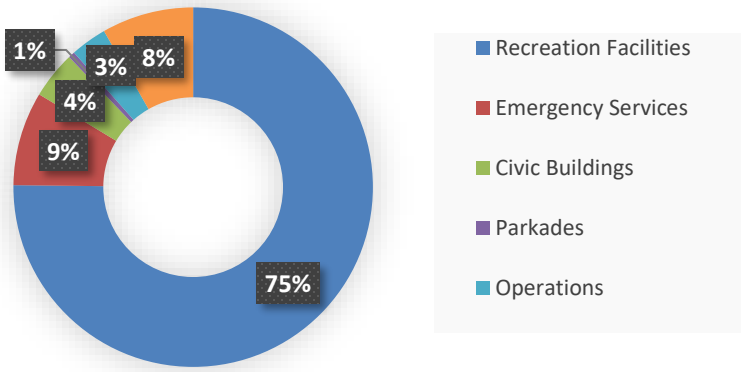
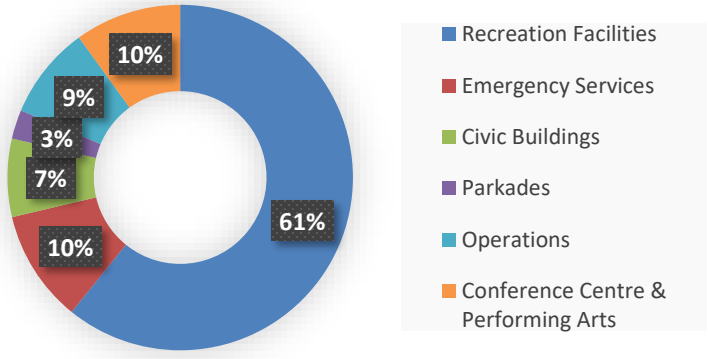


Figure 12b: Percentage of Total Energy by Facility Type



6. GHG Emission Reductions – How do we get there?

Given our progress to date, to **reduce corporate emission by 50%-58%** of our 2010 baseline by 2030, the City must **cut emissions on average by approximately 210 tCO_2e each year, from 2021 to 2030.** Fortunately, recent Low-Carbon Electrification studies for heating, ventilation and air conditioning (HVAC) systems have identified some very significant renewal opportunities which can nearly reach this target. Along with further electrification of our fleet vehicles, **these improvements should enable the City to reach the 2030 emissions target**. The opportunities identified to date are listed in Table 9, and the Master Project Plan in Appendix B.

In order to reach our established targets for 2050 **significant investments** in the following areas will be required:

Optimize Existing Assets	•Maintain an aggressive continuous optimization program with staffing to ensure equipment and systems are operating as per design
Efficiency & Electrification	•Replace end-of-service life equipment with more efficient models •Retrofit mechanical systems to more efficient designs •Switch to "electric" heating system to displace the use of fossil fuels
Deep Retrofits	•Convert to lower temperature heating systems, where possible •Upgrade building envelopes when deemed appropriate
Renewables	•Install renewables like solar photovoltaic, geo-exchange, and wastewater heat recovery and cooling systems where suitable •Secure Renewable Natural Gas for 2030 and beyond to cover shortfall in GHG reductions

The Energy Team has been working diligently to implement and influence the first two items outlined above. In addition, a building energy modelling study was completed in 2020 for Beban Park Recreation Complex which included options and respective costs for building envelope upgrades. This facility was build in 1976 and is the second highest consumer of energy and emitter of GHG emissions.

Increasing the electrical load through fuel conversion, electrification projects may appear contrary to the goal of achieving electrical savings to meet BC Hydro's targets however, electrification is required to reduce carbon emissions. Electrification highlights the need for conserving electricity. By conserving electricity in other areas of operations, electrical capacity can be freed up to ensure there is sufficient

power for the systems that replace those driven by fossil fuels. Overall, energy conservation still remains a core component of the City's energy management program however it is being strategically balanced with emission reduction. Switching from using fossil fuels to clean electricity will help reduce carbon taxes being paid, which are expected to rise from $45/tCO$_2$e in 2021 to $170/tCO$_2$e by 2030. Electricity reduction will offset operating costs. Both initiatives are required to be fiscally prudent.

To be effective in achieving results the following needs to be addressed:

6.1 Funding

The funding required to implement projects to achieve the 2030 emissions target of 50% reduction for existing facilities, is estimated between $5M and $10M, in current day dollars, and represents a premium on asset renewal work of approximately 25%. As with most things, the costs for implementing energy consumption and emission-reduction initiatives are expected to increase over time. Renewal of assets is required to maintain levels of service within our facilities. While the renewal costs are required, the intensity and scope of the climate lens used to review the design can very. As this varies, so will the cost.

6.2 Planning and Analysis

Short and longer term plans must be carefully developed and include more detailed study, preliminary design, and probable construction cost estimates to facilitate prioritization of projects within the 10-Year Capital Plan. Verification of completed projects through monitoring and analysis will also be key to ensure that our investments are preforming as designed, and steps towards our goals are being taken.

Developing guidelines for decision making on all capital projects with energy and emissions-implications is critical to applying the correct climate lens to each capital project, including asset renewal as well as new construction. Planning is key to ensuring consistency in prioritizing project risks and implementation schedules to meet required goals and targets.

Full life-cycle financial analysis, along with input from operations and maintenance personnel should be considered in the decision making process. To allow a more accurate financial analysis, the use of carbon pricing in alignment with senior government's plan to increase carbon tax from $45/tCO2e in 2021 to $170/tCO$_2$e by 2030 should be included, as it presents a more accurate life-cycle cost considering the entirety of the fuel costs.

6.3 Prioritizing Projects

Over a longer time horizon, the Energy Team and stakeholders need to identify additional projects that can lower GHG emissions. Identifying low and zero-carbon initiatives in varying states of readiness to implement provides value and considered-investments when funding is made available. Strategic project planning is a key component of decarbonizing the City's facilities and assets however, the **availability of funds to implement low-carbon solutions, will ultimately be a challenge**. Limited

resources further emphasizes the importance of the prioritization and timing of asset renewals to ensure maximum, economical service lives are realized without impacting levels of service at facilities or necessitating the premature renewal of assets to meet energy and emission targets.

Typically, energy reducing projects are funded from General Revenue. In 2021, Council approved renaming the Emissions Reduction Reserve to the *Climate Action Reserve Fund, Bylaw No. 7330,* which supports emissions reducing projects. As emissions reducing projects typically have a higher price tag than regular efficiency renewals, the careful planning and strategic withdrawal of funds should be an important consideration when prioritizing projects.

6.4 New Facilities

6.4.1 Fire Station No.1

The newest facility currently under construction is Fire Station No.1, which will include 2,140m^2 of floor space. The existing Fire Station No.1 will be demolished for a net floor area increase of approximately 750m^2. Occupancy is expected by April 2022. It will house Fire Rescue Command, Fire Dispatch, Office and Administration/Business Centre, and the City of Nanaimo's Emergency Coordination Centre.

The building was designed to be very energy-efficient and uses best practices for sustainability. It received financial support from BC Hydro's New Construction Program to complete energy modelling as part of the design process to identify and select Energy Conservation Measures (ECMs). In addition, construction funds are being provided for implementation of the ECMs.

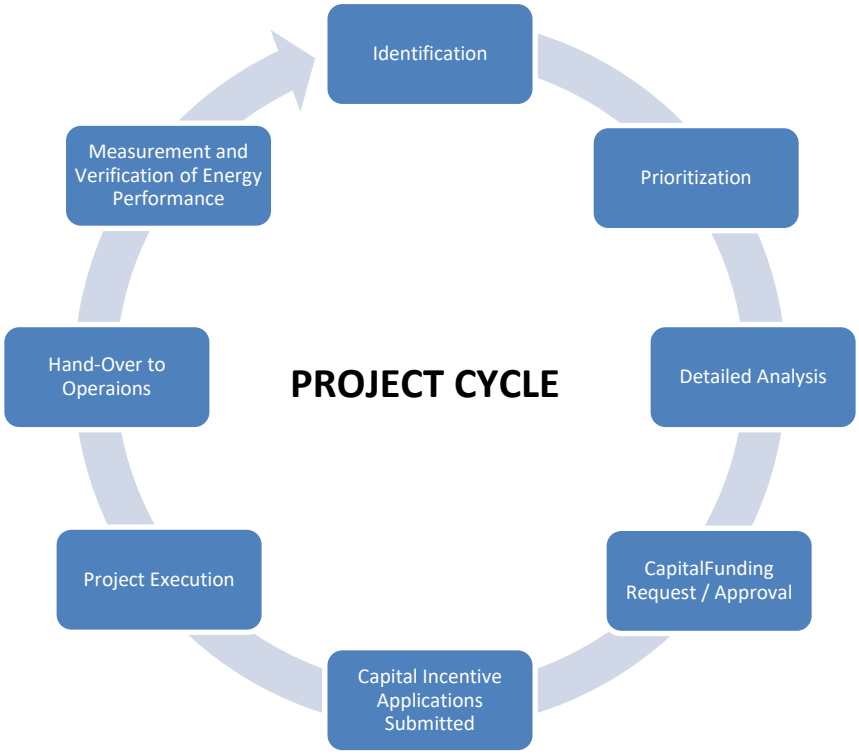
The new facility will use an electric heat pump system for space heating, and is expected to save approximately 67,500 kWh/year of electricity and an additional 2,317 ekWh/year in fuel savings compared to the base design for this project. The existing Fire Station is the last City facility to use a home heating fuel (HHF, diesel) boiler system. In 2020, 25,633 L of HHF were consumed, which produced approximately 81 tCO_2e. Once the new station is operational in 2022, City facilities will no longer rely on HHF and emissions in the Emergency Serves building category will be substantially reduced (approximately 40%).

6.4.2 Nanaimo Operations Centre

As of September 2021, this project is in the concept design phase. If the project is approved to proceed, steps will be taken to ensure operational efficiency, low and zero-carbon solutions, environmental sustainability, and accommodations to transition to an electrified fleet are incorporated into this facility.

Opportunities to participate in incentive or grant programs will be sought for this project.

7. Project Planning



7.1 Identification of Energy Projects

Energy projects are identified through several streams:

- Energy Audits: A detailed analysis of building operations carried out by a qualified engineering consultant that seeks opportunities and assesses the technical and financial viability of energy and emissions saving opportunities.
- Capital Projects: The Energy Team applies an energy-efficiency and emissions reduction lens to renovations, retrofits and asset replacements. This lens is made up of the City's green and sustainable building objectives, our policies, and our climate objectives.
- Facility Operators: Integration of staff knowledge and experience with energy consuming systems, building components, unique facility use circumstance.

7.2 Prioritization of Energy Projects

Projects need to be prioritized to match the needs, service levels, and climate action targets set by the City. Some of the key elements considered are:

1. End of life and asset renewal cycles.
2. Risk associated with of failure of the asset.
3. GHG reductions available.
4. Energy savings potential.
5. Fiscal performance (operations and maintenance savings, marginal capital cost increase, total cost of ownership)

Upon identification and prioritization of projects, a more detailed engineering and preliminary costing analysis is carried out to confirm technical feasibility, and quantify energy savings and emission reductions in an effort to minimize risks and uncertainty. This further analysis ultimately lends itself to improved strategic project planning, selection, and delivery. Study costs can sometimes be supported with financial assistance by BC Hydro, FortisBC, Natural Resources Canada, CleanBC, and other programs. Once a study is complete and the project benefits have been confirmed, further capital incentive funding are sought through available application processes. Next steps are to complete preliminary design work, obtain probable construction costs, and secure project funding, then transition into detailed design, procurement, and construction phases.

As projects are executed, the Energy Team supports the project management and liaises with Operations to prepare for the new equipment and systems being installed. Once the project is complete and turned over to Operations, the Energy Team reviews operational data to confirm the energy savings align with projected targets, and completes close out activities to finalize any rebates or incentive agreement requirements. After implementation and some time in service, the Energy Team ensures the calculated energy and emission savings is in accordance with the actual performance and records the progress towards meeting targets and contractual obligations to outside agencies.

The City's overall performance is measured by trending our *key performance indicators* over time. The Energy Team also evaluates the performance of individual projects based on avoided energy consumption (reductions in kWh or GJ of energy); comparing the energy consumption values before and after construction. This then allows calculation of the emissions reductions resulting from the project.

7.3 Multi-Year Action Plan

Each year, the Energy Team meets with Facility Managers and Operations and Maintenance staff to discuss strategic prioritization, and provide updates to the Multi-Year Action Plan (MYAP). The MYAP lists identified electrical and fossil fuel energy saving opportunities, and the projected GHG[6] emissions

[6] GHG is based on energy reduction calculated for each project. EUI changes for each year are based on the net effect of energy reductions calculated for each project, divided by the total 2020 total floor area of 25 largest buildings (113,787 m^2).

reduction from currently approved capital projects. The MYAP evolves as new and potentially better opportunities are uncovered through energy studies and advances in technology.

Budgets shown in the first year of the MYAP have already been approved through the City's Financial Plan. Capital requests have been submitted for projects in future years, but approval is uncertain until Council completed the budgetary cycle. Funds for approved projects, are usually in place by the middle of January each year.

Table 9 highlights the projected results from planned initiatives from 2022 to 2024.

Table 9: Multi-Year Action Plan – Projected Results

Multi-Year Action Plan Projected Results					
Key Performance Indicators	Annual Target	2022	2023	2024	3-Year Average
TRADITIONAL SERVICES					
GHG Emission Reductions (tCO2e)	210	2.1	187	1,056	415
Energy Use Index (EUI) Reduction (kWh/m^2)	9.4	0.8	6.7	38	15
Electrical Savings (kWh/year)	300,000	165,918	132,575	51,986	131,222
Fossil Fuel Savings (GJ/Year)	4,315	0	2,145	15,200	5,782
NON-TRADITIONAL SERVICES					
GHG Emission Reductions (tCO2e)		106			
Electricity Savings (kWh/year)		-135,897			
Fossil Fuel Savings (GJ/Year)		2,145			

These goals are set using SMART (specific, measureable, achievable, realistic, time-bound) methodology, and **while attainable, will not be achieved without operational changes and additional capital funding.**

As inferred from Table 9, additional effort is required with the Electrical Savings category to meet the targeted 300,000 kWh reduction per year. As the City focuses on GHG emission reductions, also meeting electrical saving targets becomes more and more challenging without undergoing deep energy retrofits, including upgrades of the building enclosure.

Table 10 is the current project list of the MYAP. Projects highlighted in yellow fall into the "low carbon electrification" category and may qualify for current provincial incentives under the new Clean BC program.

Table 10: Multi-Year Action Plan – Project List

Multi-Year Action Plan Detailed Project List				Activity: D = Design C = Construction S = Study B = Behavioural					
Year	**Program Type**	**Location & Project Description**	**In Cap. Plan?**	**Estim'd Project Cost**	**Year Costed**	**Activity Type**	**Saved kWh/yr**	**Saved GJ/yr**	**Saved tCO2e/yr**
2021	CleanBC Custom	PT - Replace Chiller with VRF HP System	Y	$680,079	2020	D			
	BCH Custom	NIC - Replace all interior lighting with LED	Y	$156,000	2019	C	80,034	0	1.8
	City Funded	BPRC - Replace lighting in Gym, Stairs, Family Change Rm., Hallway, Male Change Rm and Female Change Rm	Y	$25,000	2021	C	15,140	0	0.3
	City Funded	NAC - Replace MAU #1 - Wet Side	Y			C			
	BCH CNC	FS 1 - Replace Fire Station #1 - ECMs developed New Construction Program Energy Modelling Agreement with BC Hydro	Y	$90,000	2019	C	Claim in 2022		Claim in 2022
		2021 Total		**$951,079**			**95,174**	**0**	**2.1**
2022	BCH Funded	Energy Wise Network - Engage people in your workplace in energy savings				B			
	CleanBC Custom	PT - Replace Chiller with VRF HP System	Y	$680,079	2020	C	-135,897	2,145	106
	CleanBC Custom	NAC - Install a Water-to-Water Heat Pump for Dehumidification and Heat Recovery	N	$200,000	2021	Design			
	BCH CNC	FS-1 Replace Fire Station #1 - ECMs developed New Construction Program Energy Modelling Agreement with BC Hydro	Y			C	67,425		78.5
	City Funded	FS 2 - Replace RTU #1	Y	$15,800		D & C			
	City Funded	FS 3 - Replace RTU #1	Y	$13,900		D & C			
	BCH Custom	NAC - Interior Lighting Upgrade (remaining areas)	Y	$63,570	2019	D & C	28,896	0	0.6
	BCH Custom	BP - Interior Lighting Upgrade	Y	$123,544	2021	D & C	38,530	0	0.8
	City Funded	BPRC - Leisure Pool Air Handling Units - Replace HV-3 and HV-5 with single larger system	Y	$850,000	2020	D & C	-199,371	2,848	140
	City Funded	Drainage - Replacement of Unit 244 (GMC Canyon Extra cab 2 wd) with EV	Y						
	City Funded	Drainage - Replacement of Unit 245 (GMC Canyon Extra cab 2 wd) with EV	Y						
		2022 Total		**$1,946,893**			**-200,417**	**4,993**	**326**

Multi-Year Action Plan Detailed Project List				Activity: D = Design C = Construction S = Study B = Behavioural					
Year	Program Type	Location & Project Description	In Cap. Plan?	Estim'd Project Cost	Year Costed	Activity Type	Saved kWh/yr	Saved GJ/yr	Saved tCO2e/yr
2023	City Funded	NAC - Install a Water-to-Water Heat Pump for Dehumidification and Heat Recovery	N	$1,620,000	2021	C			916
	City Funded	BPRC - Replace Boiler No.1	Y	$50,000		D			
	City Funded	CMA - Interior Lighting Upgrade	Y	$162,300	2020	C	54,624	0	1.2
	City Funded	150 Commercial St - Replace RTU #1 - serves basement	Y	$22,900		C			
	City Funded	BP - Upgrade Parking Lot Lighting - (Pool, SC and entrance)	Y	$142,100	2020	C	8,718	0	0.19
	City Funded	OWCC - Interior Lighting Upgrade - remaining areas	Y	$152,900	2019	C	69,233	0	1.52
	City Funded	Envir. - Replacement of Unit 154 (Dodge Journey) with EV	Y						
	City Funded	RCMP - Replacement of Unit 155 (Dodge Grand Caravan) with EV	Y						
	City Funded	Roads - Replacement of Unit 215 (Dodge Ram 1500) with EV	Y						
	City Funded	Roads - Replacement of Unit 297 (Toyota Tacoma Pickup) with EV	Y						
	City Funded	Water - Replacement of Unit 298 (Toyota Tacoma Pickup) with EV	Y						
		2023 Total		**$2,200,200**			**132,575**	**0**	**1,247**
2024	City Funded	CH - Interior Lighting Upgrade	Y	$98,100	2019	D & C	20,239	0	0.45
	City Funded	FS 2 - Interior Lighting Upgrade	Y	$51,200	2019	D & C	7,481	0	0.16
	City Funded	FS 3 - Interior Lighting Upgrade	Y	$43,000	2019	D & C	4,699	0	0.1
	City Funded	FS 4 - Interior Lighting Upgrade	Y	$78,200	2019	D & C	19,567	0	0.43
	City Funded	NAC - Replacement of 3 Boilers	Y	$125,100	2019	D			
	City Funded	CMA - Replace 2 Natural Gas Furnaces	Y	$33,000		C			
	City Funded	NIC - Replace 2 Natural Gas Boilers	Y	$47,400		D & C			
	City Funded	PT - Replace 2 Natural Gas Boilers	Y	$124,800		D & C			
	City Funded	Parks Ops - Replacement of Unit 104 (Nissan NV200) with EV	Y						
	City Funded	Parks Ops - Replacement of Unit 108 (Nissan NV200) with EV	Y						
	City Funded	Bylaw - Replacement of Unit 117 (Nissan Leaf) with EV	Y						
	City Funded	Engineering - Replacement of Unit 151 (Dodge Journey) with EV	Y						
	City Funded	Construction - Replacement of Unit 246 (GMC Canyon Extra Cab 2 wd) with EV	Y						
	City Funded	Water - Replacement of Unit 250 (GMC Canyon Extra Cab 4 wd) with EV	Y						
	City Funded	Parks Ops - Replacement of Unit 254 (Ford F150 Ext Cab 2 wd) with EV	Y						
	City Funded	Sewer - Replacement of Unit 282 (Ford F150 Ext Cab 2 wd) with EV	Y						
		2024 Total		**$600,800**			**51,986**	**0**	**1.14**

Multi-Year Action Plan Detailed Project List				Activity: D = Design C = Construction S = Study B = Behavioural					
Year	**Program Type**	**Location & Project Description**	**In Cap. Plan?**	**Estim'd Project Cost**	**Year Costed**	**Activity Type**	**Saved kWh/yr**	**Saved GJ/yr**	**Saved tCO2e/yr**
2025	City Funded	Large Rec Centres - Buildings - Recommissioning Studies	N	TBD		S			
	City Funded	BP Kin Pool - Replace Boiler	Y	$175,600	2019	C			
	City Funded	NAC - Replace Boilers	Y	$674,100	2019	C			
	City Funded	BPRC - Replace Boiler #1	Y	$367,000	2019	C			377
	City Funded	BPRC - Interior Lighting Upgrade - remaining areas	Y	$222,000	2019	C	74,594	0	1.64
	City Funded	Interior Lighting Upgrade (remaining areas)	Y	$196,700	2019	C		0	
		2025 Total		**$1,635,400**			**74,594**	**0**	**379**
2026	City Funded	NIC - Replace RTU	Y	$134,100		C			
	City Funded	PT - Interior Lighting Upgrades - Theatre House Lights	Y	$293,100	2021	C	63,905	0	1.41
		2026 Total		**$427,200**			**63,905**	**0**	**1.4**
2027	City Funded	PS - Replace Boiler	Y	$30,600		D & C			
	City Funded	NAC - Replace AHU #1 - Lap Pool	Y	$43,600		D & C			
	City Funded	NAC - Replace AHU #2 - Leisure Pool	Y	$43,600		D & C			
	City Funded	NAC - Replace AHU #3 - Change Room	Y	$43,600		D & C			
	City Funded	NAC - Replace AHU #4 - Kitchen/Cafeteria	Y	$43,600		D & C			
	City Funded	NAC - Replace MAU #2	Y	$66,300		D & C			
	City Funded	BPRC SC - Replace Chiller #1	Y	$113,700		D & C			
	City Funded	BPRC SC - Upgrade Theatrical Lighting	Y	$62,400	2021	D & C			
		2027 Total		**$447,400**			**0**	**0**	**0**
2028	City Funded	Animal Shelter - Replace Oil Furnace	Y	$25,000	2017	C			
	City Funded	PT - Interior Lighting Upgrade - Theatre Common Areas	Y	$290,000	2021	D & C	21,967		
	City Funded	BPRC SC - Replace Chiller #2	Y	$116,000		D & C			
		2028 Total		**$431,000**			**21,967**	**0**	**0**
2029	City Funded	BP Kin Pool - Replace Hot Water Tank	Y	$11,500	2020	C			
		2029 Total		**$11,500**			**0**	**0**	**0**
2030	City Funded	FS 3 - Replace Natural Gas Furnace	Y	$13,500		C			
	City Funded	NAC - Replace AHU #6 - Fitness Gym	Y	$47,000		D			
	City Funded	BP - Replace AHU #1	Y	$54,000		C			
		2031 Total		**$114,500**			**0**	**0**	**0**

8. Risks & Challenges

There are several risks and challenges that should be considered in planning and executing initiatives within this SEMP, namely:

Table 11: Risk Matrix

Risk	Issue	Impact	Response
Increasing Building Use Hours or Occupancy	Increasing use of facilities increases the EUI, offsetting the positive impact of energy efficiency measures	LOW: Not able to meet EUI reduction goal	Accept: Higher asset utilisation is a good thing when paired with delivery of programs.
Growth of Operational Area	Growth increases FTEs and floor areas and increases total energy use, offsetting positive impact of energy efficiency measures	LOW: Increasing building areas and number of FTEs is expected to occur over the coming years	Accept: Additional operational area and FTEs can be quantified. However new buildings should ideally be designed to be net zero GHG emissions.
Locking in to Fossil Fuel Infrastructure	Installing new equipment reliant on fossil fuels locks in consumption and required carbon tax payments for the life of the new equipment	HIGH: Prevents deep reductions in GHG emissions required to meet targets	Avoid: New energy policy should be structured to minimize the types and quantity of natural gas consuming equipment installed.
New High Efficiency Boiler Efficiency Realization	High efficiencies are only realized during specific operating conditions	LOW: Operational savings required to offset additional cost might not be realized	Mitigate: Ensure that required design modifications are completed to allow boilers to operate at design efficiency. May result in additional capital cost for modifications
Deteriorating Performance of Existing Assets	Existing building systems operating in an inefficient manner due to failing equipment and	MEDIUM: Lowest cost approach to improving energy	Mitigate: A sustained effort to optimize existing building systems is required.

Risk	Issue	Impact	Response
	sub-optimal control sequences	efficiency and lowering GHG emissions is to make the most of the assets we currently have.	
Limited Capital	Major retrofits of existing facilities, as well as other measures, will be required to achieve the GHG reduction goal and these are costly	MEDIUM: Capital will always be limited	Mitigate: Leverage all facilities-based capital projects to lower energy and GHG emissions by ensuring the most efficient equipment and system designs are adopted.

9. Energy Studies & Other Professional Services

Knowing the source of the greatest emissions and energy consumption within the organization is key it addressing them. In 2019, on a 3-year trial basis, the City engaged the services of Prism Utility Monitoring and Analysis Utility Monitoring Inc. (PUMA) and provided internet-based access to all natural gas and electricity consumption data, allowing PUMA to undertake comprehensive analytics of the provided data. PUMA enables the City to monitor, analyze, track changes, and report on energy use and building performance using actual consumption data. This service is invaluable for comparing the performance of building sites, energy use, emissions generated, and utility rate costs. These can be regularly reported to Facility Managers using this service. The Energy Team is working to source ways to permanently implement this monitoring program, and to expand it to all our major facilities and those with the greatest energy consumption.

As part of the engagement, three years of historical billing data from BC Hydro and FortisBC were added to the platform, providing comparative monitoring since 2016 for the following 11 sites:

- Nanaimo Aquatic Centre
- Beban Park Recreation Complex – including Beban Pool, Frank Crane Arena and Beban Social Centre
- Beban Park – including Beban Fieldhouse, Centennial Building and Beban Sports Fields
- Nanaimo Ice Centre
- Cliff McNabb Arena
- Service and Resource Centre
- Port Theatre
- Oliver Woods Community Centre
- Bowen Park – Administration Building and Bowling Club
- City Hall
- Bowen Park – Kin Outdoor Pool

The City engages professional consultants to conduct studies, preliminary and detailed designs, and cost estimates to assist in analyzing, and clearly defining the potential for energy and emissions reductions opportunities. Generally, these studies can hone in on specific opportunities and should be completed for sites with a high Energy Use Intensity. Studies are a critical part of the planning process of energy management as they provide the details required for sound decision making and enable prioritization of resources.

Often, studies can be eligible for up to 50% funding to a maximum of $20,000 or $30,000 from either BC Hydro, CleanBC, or FortisBC. With the CleanBC Custom Incentive programs, the completion of the study and design, can lead to potential construction incentives as well. The CleanBC current maximum incentive limit is $750,000 per corporation, and up to $200,000 construction incentive per site.

Table 12a: Professional Services and Studies completed in 2020

No.	2020 Professional Consulting Services	Cost	Incentive Amount	Source of Incentive	Completion
1	FS No.1 - Energy Modelling Study	$28,004	$28,004	BC Hydro	24-Apr
2	NIC Lighting (design, tendering, and construction services)	$7,500	$8,515	BC Hydro	15-Apr
3	OWCC - Low Carbon Electrification Study	$16,500	$0		14-Jul
4	OWCC - Lighting (design and construction services)	$2,500	$0		15-Jul
5	BPC - Building Envelope Energy Modelling Study	$41,500	$0		14-Dec
6	BPC Remaining Lighting Areas - Design	$7,000	$0		15-May
7	NAC Main Pool Lighting - (design, tendering & construction services)	$12,376	$0		18-Aug
8	PT - Interior Lighting Design	$6,500	$0		13-Nov
9	CMA - Lighting Design	$2,500	$0		10-May
10	FCA - Ice Sheet Lighting Renewal (design, tendering & construction serv.)	$2,500	$0		20-Jul
11	Prism Utility Monitoring Analysis (PUMA) - *3 year contract ends July 2022*	$6,480	$0		
12	Beban Park Complex Sub-metering (study of options)	$12,750	$0		
13	BPC Leisure Pool - Low Carbon Electrification Study	$18,500	$0		14-Sep

Table 12b. Energy Studies & Other Professional Services Underway in 2021

No.	2021 Professional Consulting Services	Cost	Incentive Amount	Source of Incentive	Completion
1	NAC & BPC - Heating Plants Options and Feasibility Analysis and Geo-exchange Assessment	$49,500	$12,971	CleanBC	18-Jun
2	PT - Low Carbon Electrification Study	$16,600	$8,289	CleanBC	17-Mar
3	PT - Chiller Replacement (design, tendering & construction services)	$58,400	$74,650	CleanBC	30-Apr
4	Prism Utility Monitoring Analysis (PUMA) - *3 year contract ends July 2022*	$6,480	$0		
5	Beban Park Complex Sub-metering (design, pricing, construction)	$12,750	$0		
6	Condition Assessment for Field Lighting (7 sites)	$10,000	$0		20-Apr
7	Harewood Skate Park Lighting Design	$4,500	$0		30-Apr

10. Awareness and Behaviour Change (Engagement Plan)

With training, encouragement and feedback on their efforts, City staff can impact energy and emission reductions.

Both BC Hydro and FortisBC offer training opportunities that can be utilized to promote these behavioural actions. The BC Hydro's Energy Wise Network Program (EWNP) and FortisBC Conservation and Outreach Program, both provide webinars and workshops with operators, lead through the Energy Team and management staff.

Focusing specifically on Facilities Maintenance, Custodial and Operations staff could have the most cost effective means of reducing energy and emissions. Recognizing we have our own, in-house staff who are motivated to provide excellent service can be key to sharing their best practices across the organization. This should include recognizing and acknowledging the work these staff do, and providing energy and emissions reports to illustrate the corporate benefits of their efforts.

10.1 Energy Wise Network Program

BC Hydro offers an Energy Wise Network Program (EWNP) to promote increased awareness and behavioural change towards energy and emissions conservation efforts. This EWNP can provide funding for prizes and food, support from an engagement consultants, and educational opportunities through webinars and workshops.

11. Energy Management Assessment

Usually held every 2 years, the Energy Management Assessment (EMA) is a stakeholder-based workshop to comprehensively review the City's energy management program. The purpose is to identify aspects of the program than can be strengthened in order to deliver even higher levels of energy efficiency and conservation. The outcome of the last workshop and review (held July 15, 2019) was a report with the following five areas of focus and associated recommendations:

1. Strategy & Direction	
Status: Proposed for 2022	**Recommendation:** *Ensure correlation and integration between the goals of the energy conservation initiatives and the broader long term strategy for the organization.*
	Action: Work with an executive sponsor to fully understand key business drivers for the organization, identify specific and quantifiable contributions that the energy management program can make to organizational sustainability goals, and reposition the Energy Management Program as a broader operational improvement initiative that delivers total value, far beyond just lower operating costs.

2. Target Setting	
Status: In progress	***Recommendation:*** *Set energy performance reduction targets that account for both capital and non-capital activities, preferably based on Energy Use Intensity.*
	Action: Work with staff to set consumption reduction targets that are both project and behavioral based "stretch" initiatives. Provide training for operating personnel to have them understand how optimizing behavioral and operational processes can contribute to meeting performance targets.

3. Operational Integration	
Status: Proposed for 2022	***Recommendation:*** *Ensure standard operating procedures instruct personnel to make appropriate adjustments in energy-using equipment aimed at maintaining proper conditioned space while optimizing energy consumption.*
	Action: Support operating personnel that will be involves in meeting energy consumption objectives with appropriate training and tools. Create Standard Operating Procedures and check-lists that personnel can use as tools to monitor and control specific actions required for managing energy consumption.

4. Messaging & Communication	
Status: Proposed for 2022	**Recommendation:** *Tailor communication of the energy management initiatives to each key stakeholder group to improve participation in conservation activities.*
	Action: Evaluate effectiveness of past energy awareness activities, and make adjustments to improve. Tailor energy awareness messaging to the specific behavioral modification desired of each stakeholder group. Determine and utilize optimum avenues for communicating to staff and management. Provide regular updates on progress towards established expectations. Disseminate energy consumption information in a format that is simple to understand and meaningful.

5. Performance Tracking & Reporting	
Status: Proposed for 2022	**Recommendation:** *Regularly deliver performance reports to management and operations personnel. Establish protocols that require operations personnel to promptly troubleshoot identified variations in energy intensity.*
	Action: Construct energy trend analysis templates/reports. Develop data capture and information distribution plan. Identify site operations personnel for distribution of energy intensity reports. Present monthly energy intensity reports as a regular agenda item in operations meetings. Develop response procedures for out-of-variance in monthly report.

12. Opportunities

Within most facilities, there can be various opportunities for optimizing energy use and reducing emissions, as well as, improving performance and reducing maintenance, namely:

12.1 Optimize Asset Renewals

When making plans to renew any asset that consumes or can affect energy use, consider improved products, designs, and control options. The consideration, study and evaluation of options, whether simple or detailed, is an important step in aligning best practices in both asset management and energy and emissions management.

12.2 Optimize Asset Operations

12.2.1 Recommissioning and Continuous Optimization (C-Op)

Regular verification and documentation of proper equipment and system operation, calibration, and optimization opportunities, should be a high priority because they can provide immediate benefits, and are usually achieved without incurring major capital expense.

Previous C-Op studies have shown there can significant opportunities to save energy simply by optimizing existing building systems. These efforts require skilled staff, diligence, and a continuous improvement approach to achieve and sustain results.

12.3 Efficiency & Electrification

12.3.1 Heat Recovery

Heat recovery will continue to be a primary means of reducing energy and GHG emissions in both retrofit and new construction projects. By harvesting waste heat from building exhaust and other sources with heat pumps, we can substantially lower natural gas consumption and associated GHG emissions.

12.3.2 High Efficiency and Low-Carbon Heating Plants

To achieve GHG emission reduction targets, it is paramount that heating systems transition from fossil fuel as the energy source, to electric or other low-carbon heating systems. Typically, natural gas was the cheapest form of energy for creating boiler heat however recognizing City Council's proclamation of a Climate Emergency, more benign heating systems are required to meet environmental goals.

12.3.3 Deep Retrofits

Converting existing high-temperature HVAC systems, present in all but the newest facilities, to lower temperature designs would allow for existing boiler plants to be replaced with air or ground-source heat pumps for example. Upgrading building envelopes presents another opportunity to lower energy consumption and GHG emissions, but must be balanced with appropriate consideration for the long term plans for a facility and capital cost.

12.4 New Construction

All new City facility designs should strive for lowest possible energy use and GHG emissions, which meet applicable standards and meet user comfort needs.

It is recommended that all new construction and major renovation projects participate in new construction incentive funding programs to help ensure a high level of performance is balanced with cost considerations. An example of this would be the benefits from the BC Hydro New Construction Program received following the planning and design of the new Fire Station No.1.

12.5 Renewables

Solar thermal, solar photo-voltaic, biomass heating, geo-exchange and wastewater energy recovery are some of the renewable energy choices potentially applicable for some City facilities.

To differing degrees, these systems can offset natural gas and purchased electricity use; however, a site specific feasibility and financial analysis should be completed in evaluating their benefits.

13. Stakeholders for Success and Acknowledgments

Acknowledging and collaborating with stakeholders is essential in ensuring a successful Strategic Energy Management Plan is executed. The following are some of the key stakeholders:

13.1 The Government of British Columbia

The Government of British Columbia is a leader in promoting a greener economy and one of the first jurisdictions in the world to establish carbon pricing and reduction targets.

13.2 City Council

City Council's commitment to environmental responsibility is key to supporting energy and emissions management, and meeting our organization's carbon reduction targets. We thank City Council's support for access to capital, and the priority given to energy conservation and GHG emission reduction efforts.

13.3 BC Hydro

We thank BC Hydro for their support in providing seminar and webinar opportunities for Energy Managers and supporting team members, peer networking, and incentive funds for energy managers, studies, capital projects, and access to their technical experts. The funding provided by BC Hydro for our Energy Manager position is critical in the success of our program.

Thank you to Meredith Toward, Key Account Manager, for her guidance and support in the local government sector, and for providing assistance to move initiatives forward.

13.4 Facilities Maintenance and Operations

As best practices in Energy Management become more embedded in building maintenance, operations, and project management, we appreciate Facility Maintenance and Operations staff willingness to collaborate and share expertise.

13.5 Finance

Thank you to the Finance Department for providing ongoing support to the Energy and Emissions Management Program and team activities, and for securing the necessary funding to keep things moving forward.

13.6 City of Nanaimo Employees

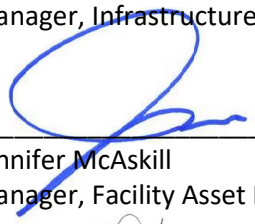
Thanks to all City of Nanaimo employees for the actions you take – such as turning off lights and computer monitors and contributing to a culture of sustainability.

14. Management Approval

By signing below, the City of Nanaimo management acknowledges receipt and approval of this Strategic Energy Management Plan.

_____ January 14 _____, 2022

Scott Pamminger
Manager, Infrastructure Planning & Energy



_____ January 14 _____, 2022

Jennifer McAskill
Manager, Facility Asset Planning

_____ January 25 _____, 2022

Art Groot
Director, Facility & Parks Operations

_____ January 25 _____, 2022

Poul Rosen
Director, Engineering

_____ January 25 _____, 2022

Bill Sims
General Manager, Engineering & Public Works

Appendix A – Site Acronyms

NAC	Nanaimo Aquatic Centre
BPC	Beban Park Complex
NIC	Nanaimo Ice Centre
CMA	Cliff McNabb Arena
OWCC	Oliver Woods Community Centre
BoPC	Bowen Park Complex
BH	Beban House, Centennial Building and Field House
PS	Police Station/Annex
SARC	Service and Resource Centre
CH	City Hall
CSB	Community Services Building
FHQ	Fire Headquarters
FS1	Fire Station 1
FS2	Fire Station 2
FS3	Fire Station 3
FS4	Fire Station 4
BP	Bastion Parkade
HP	Harbourfront Parkade
PoNCP	Port of Nanaimo Centre Parkade
PW	Public Works
PY	Parks Yard
WTP	Water Treatment Plant
VICC	Vancouver Island Conference Centre
PT	Port Theatre
HAC	Harewood Activity Centre

Appendix B – Master Project List

MASTER PROJECT LIST (Ideas / Concepts not yet in 10 Year Capital Plan)									
						Savings (Negative numbers equals an increase)			
#	Site / Department	Project Description	Estimated Project Cost	Year Costed	Recomm'd Implement'n	kWh/yr	GJ/yr	tCO2e/yr	Incentive Potential
		BUILDINGS							
1	NAC	Replace MAU #1 - Wet Side, RTU #6 (Gymnasium), and RTU #8 (Physiotherapy)	TBD	2020	2021	TBD	TBD	TBD	TBD
2	2020 Labieux Rd	NEW Nanaimo Operations Centre Facilities	TBD	2021	TBD	TBD	TBD	TBD	TBD
3	NIC	Supply and install 100 kW Solar PV system	$155,450	2021	2023	111,175	0	2.45	TBD
4	BPC	Leisure Pool Air Handling Units - Replace HV-3 and HV-5 with single larger system	$850,000	2020	2023	-199,371	2,848	140	Y
5	NAC	Install a Water-to-Water Heat Pump for Dehumidification and Heat Recovery + 300 kW Electric Boiler	$2,025,000	2021	2023	TBD	TBD	1009	Y
6	BPC	Exhaust Air Heat Pump for Heat Recovery with 450 kW electric boiler	$881,300	2018	TBD	TBD	TBD	769	Y
7	OWCC	Replace Nat. Gas boiler with electric	$217,800	2019	2028	-167,400	938	45	TBD
8	500 Bowen, 741 Third St., or 2300 Bowen	Wastewater Heat Recovery - Feasibility Review (study) of Sewer Heat Recovery with HP	TBD	TBD	TBD	TBD	TBD	TBD	Y
9	2235 Dorman Rd	Merle Logan & Second Artificial Turf Fields - Lighting Upgrade	$280,000	2021	TBD	43,200	0	0.95	TBD
10	Beban Social Centre	Install Ductless Split Heat Pumps - Rooms 1 to 3	TBD	TBD					
11	Beban Social Centre	Install Dustless Split Heat Pumps - Rooms 4 to 6	TBD	TBD					
12	Beban Social Centre	Install Ductless Split Heat Pumps - Rooms 7 and 8	TBD	TBD					
13	Various locations	Renewal of HPS Street Lights to LED (Phases 4, 5)	TBD	TBD					

Appendix C - Fleet Renewal Initiatives

Vehicle Unit # or Location	Renewal Initiative	Department	Planned Replacement Year	Planned Replacement Type
107	Replaced Unit #107 with new Hyundai Kona, Unit #124	Parks	2021	EV
209	Replaced Unit #209 with new Hyundai Kona, Unit #125	Public Works	2021	EV
210	Replaced Unit #210 with new Hyundai Kona, Unit #126	Public Works	2022	EV
154	Replace Dodge Journey	Environment	2023	EV
155	Replace Dodge Grand Caravan	RCMP	2023	EV
215	Replace Dodge Ram 1500	Roads	2023	EV
244	Replace GMC Canyon Extra cab 2 wd	Drainage	2023	EV
245	Replace GMC Canyon Extra cab 2 wd	Drainage	2023	EV
297	Replace Toyota Tacoma Pickup	Roads	2023	EV
298	Replace Toyota Tacoma Pickup	Water	2023	EV
104	Replace Nissan NV200	Parks	2024	EV
108	Replace Nissan NV200	Parks	2024	EV
117	Replace Nissan Leaf	Bylaw	2024	EV
151	Replace Dodge Journey	Engineering	2024	EV
246	Replace GMC Canyon Extra cab 2 wd	Construction	2024	EV
250	Replace GMC Canyon Extra cab 4wd	Water	2024	EV
254	Replace Ford F150 Ext cab 2wd	Parks	2024	EV
282	Replace Ford F150 Ext cab 2wd	Sewer	2024	EV
Public Works	Replace (3) existing EV Charging Stations with intelligent Charge Point CT – 4023 Dual Head units		2021	

Appendix D - Glossary of Terms

This glossary defines terms as they are intended to be interpreted in the context of climate change.

Biomass: organic matter used as a fuel, especially in a power station for the generation of electricity.

Business-as-Usual: where no measures are taken to reduce carbon footprint, to shift to sustainable practices, and to mitigate cumulative greenhouse gas emissions.

Carbon Neutrality: achieving carbon neutrality refers to reducing a local government's greenhouse gas emissions as much as possible and balancing the remaining emissions through the purchase of qualified offsets or GHG reduction projects.

Carbon Offset: a carbon offset is a credit for GHG reductions achieved in one location that can be purchased to counterbalance emissions generated in another location.

Climate: the average weather in a given region over a long period of time, typically 30 years or longer.

Climate Change: statistically significant variations in the climate that can be caused by natural Earth processes (e.g., volcanic eruptions and ocean currents), external factors (e.g., changes in solar intensity), or by human activity (e.g. greenhouse gas emissions and changes in land use).

CO2e: carbon dioxide equivalent. Universal measurement for GHG emissions reporting. All individual GHG emitting gases are converted to an equivalent amount of carbon dioxide using their respective global warming potential.

De-carbonization: removing carbon from our energy supply by shifting to efficient and renewable sources that emit zero carbon emissions.

Electrification: the process of replacing systems and equipment that use fossil fuels with technologies that use electricity, an energy source that has a much lower carbon intensity. Electrification projects are becoming more prevalent within the master project list which provides significant opportunities to reduce carbon emissions.

Energy Retrofit: the process of upgrading a building's energy-consuming systems. It may involve improving or replacing lighting fixtures, ventilation systems or windows and doors, or adding insulation where it makes economic sense. It also means including energy efficiency measures in all your renovation and repair activities.

Geo-exchange System: an electrically powered heating and cooling system for interior spaces that utilizes the earth (or pond or lake) for both a heat source and a heat sink.**Greenhouse Gas (GHG):** gases that trap heat in the atmosphere.

Gigajoule (GJ): is the typical unit used for measurement of natural gas consumption. It is approximately equivalent to 27 litres of fuel oil, 39 litres of propane, and 26 litres of gasoline or 277 kilo-Watts-hours of electricity. One GJ is equal to 277.78 kWh.

Hydro-electricity (or Hydropower): electricity that is generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water.

Kilowatt-hour (kWh): The kilowatt-hour is a unit of energy equal to one kilowatt of power sustained for one hour or 3600 kilojoules. It is commonly used as a billing unit for energy delivered to consumers by electric utilities. 1000 kWh is equal to 3.6 GJ.

Low Carbon Energy Sources: a shift away from coal and gas as a source of energy and using instead, lower carbon-emitting energy sources like electricity (specifically, in BC) renewables (solar, wind, and tidal), nuclear and biomass, to name a few.

Mitigation: Reducing greenhouse gas emissions using policy, regulatory, and project-based measures. Also refers to measures that enable natural systems to naturally sequester greenhouse gases (e.g. preventing forested areas from being developed into to urban cities). These actions prevent future climate change from happening so that fewer adaptation measures are needed by local municipalities. Examples include: renewable energy programs, energy efficiency frameworks, and land-use policies.

Net-Zero Ready: a building built to high energy-efficiency standards such that it could (with additional measures) generate enough onsite energy to meet its own energy needs.

Resilience: the capacity of a system, community, or society exposed to hazards to adapt, by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure.

Risk: a measure of the expected outcome of an uncertain event, which is estimated by combining an event's likelihood with the expected consequences. The concept of risk helps to grapple with uncertainty and allows for the comparison of potential impacts.

Solar Energy: radiant energy generated by the sun that is converted to electricity, hot air, or hot water.

Strategic Energy Management Plan (SEMP): a long-term plan for the city to manage the energy and emissions generated by operating municipal services and facilities. The strategy is built on a framework of conservation, efficiency, and integrated planning.

Uncertainty: a state of incomplete knowledge that can result from a lack of information or from disagreement about what is known. It can have various sources from imprecision in the data, to ambiguously defined concepts or terminology, to uncertain projections of human behaviour.

Appendix E – Corporate Emissions Data

Corporate Emissions (Traditional Services [1])	Historical Data															Aspirational Reductions								
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Corporate Emissions Target [3] (tCO2e)	4,696	4,577	4,458	4,338	4,219	4,100	3,981	3,862	3,742	3,623	3,504	3,385	3,266	3,146	3,079	3,012	2,946	2,879	2,812	2,745	2,678	2,612	2,545	2,478
Actual Corporate Emissions [4] (tCO2e)	4,696	6,142	5,625	4,955	5,181	4,842	4,765	4,859	4,718	4,854	5,007	5,132	5,416	4,559		4,479		3,563		3,142		2,701		
Estimated Emission Reductions in Buildings [5] (tCO2e)	0	0	136	46	242	93	67	6	133	38	215	355	66	9	2	80		916		421		441		40
Estimated Emission Reductions in Fleet [6] (tCO2e)																								
Estimated Total Annual Reductions (tCO2e)	0	0	136	46	242	93	67	6	133	38	215	355	66	9	2	80	0	916	0	421	0	441	0	40
Cumulative Total Estimated Reductions (tCO2e)	0	0	136	182	424	517	584	590	723	761	976	1,331	1,397	1,406	1,408	1,488	1,488	2,404	2,404	2,825	2,825	3,266	3,266	3,306

Corporate Emissions (Non-Traditional Services [2])	Historical Data															Aspirational Reductions								
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Estimated Emission Reductions (tCO2e)																105				1.4		0.5		
Cumulative Total Estimated Reductions (tCO2e)																105	105	105	105	106	106	107	107	107

[1] **Traditional Services** - defined as services that are most commonly provided by the majority of local governments - (i.e. Administration & Governance; Drinking, Storm and Waste Water, Solid Waste Collection; Transportation & Diversion; Roads & Traffic Operations; Art, Recreation and Cultural Services; Fire Protection; and Contracted Services.)

[2] **Non-Traditional Services** - defined as services NOT commonly provided by the majority of local governments - (i.e. RCMP; leased facilities; processing of waste, recycleables; new construction; landfills and associated buildings and equipment ; airports or court houses; business travel; and employee commuting.)

[3] BC Climate Action Target 33% reduction of emissions (2007 Baseline) by 2020. **In April 2019, City of Nanaimo established new targets of 50% to 58% reduction of corporate emissions (2010 baseline) by 2030, and 94% to 107% reduction by 2050.**

[4] Includes Stationary Sources (buildings) + Mobile Sources (fleet fuels) + Contracted Emissions + growth in assets.

[5] Estimated Reductions (calculated or modelled) achieved through behavioural change, process changes, renewals with more efficient and/or different energy sources for buildings.

[6] Estimated Reductions (calculated or modelled) achieved through behavioural change, process changes, renewals with more efficient and/or different energy sources for vehicles.

Appendix F – Energy Project Investments and Cumulative Savings (Cost Avoidance)

Energy Project Investments and Cumulative Savings (Cost Avoidance)

Year	Projects Electrical Energy Savings (kWh)	Energy Production (kWh)	Natural Gas (GJ)	Oil (Litres)	GHG (tCO2e)	Projects Electrical Energy Savings $	Energy Production Revenue $	Power Factor $	LGS Credits $	MGS Credits $	Natural Gas $	Oil $	GHG Offsets Saved $	Total Cost Avoidance $	Sustainability Funded Project Costs	Other Dept Funded Project Costs $	Incentives Received For Projects $	Total Energy Project Costs $	Net Project Costs After Incentives	% of Electric Target	% of Nat Gas Target	% of GHG Target
2009	183,092	0	2,578	0	136	11,901	0	6,485	0	0	36,092	0	3,388	57,866	88,058	58,441	64,627	146,499	81,872	78	450	45
2010	521,875	0	420	4,679	46	33,922	0	957	0	0	5,880	3,509	1,155	45,423	95,718	73,871	134,350	169,589	35,239	223	73	15
2011	814,468	0	3,984	7,388	242	57,013	0	0	44,980	0	55,776	5,541	6,052	169,362	397,084	272,825	220,692	669,909	449,217	348	695	80
2012	859,307	0	950	9,083	93	60,151	0	1,724	38,462	0	13,300	6,812	2,329	122,779	151,875	975,295	205,712	1,127,170	921,458	172	166	31
2013	347,992	0	327	14,892	67	27,839	0	0	69,600	0	4,578	3,723	1,666	107,406	301,143	138,510	83,653	439,653	356,000	70	57	22
2014	77,488	511,220	4	1,527	6	6,974	52,877	0	18,291	0	56	1,573	156	27,050	94,040	112,532	119,295	206,572	87,277	33	1	2
2015	990,063	686,720	2,185	0	133	89,106	74,323	2,240	23,091	27,575	22,943	0	3,330	168,284	551,053	1,424,464	44,555	1,975,517	1,930,962	423	381	44
2016	261,223	803,440	624	0	38	23,510	86,454	750	44,581	29,617	6,552	0	939	105,949	166,507	338,584	180,391	505,091	324,700	112	109	12
2017	787,878	880,510	3,250	0	215	70,909	99,149	842	23,337	18,182	34,125	0	5,375	152,770	158,422	404,317	129,108	562,739	433,631	337	567	71
2018	597,096	801,620	5,929	0	355	53,739	91,458	0	0	0	62,255	0	8,875	124,868	208,009	809,721	98,515	1,017,730	919,215	255	1035	117
2019	814,089	755,760	450	0	41	73,268	87,797	0	0	0	4,725	0	1,021	79,015	281,331	321,197	58,660	602,528	543,868	348	79	13
2020	426,584	698,600	0	0	9	40,525	81,767	0	0	0	0	0	328	40,854	42,700	537,943	21,378	580,643	559,265	182	0	3
2021	107,732		0	0	2	10,235		0	0	0	0	0	107	10,341						46	374	
2022			2,145																			
Subtotal	6,788,887	5,137,870	22,846	37,569	1,383	559,092	573,826	12,998	262,341	75,374	246,281	21,159	34,286	1,201,624	2,535,940	5,467,700	1,360,936	7,422,997	6,083,439			
Cumulative Totals	**48,175,466**	**24,990,950**	**157,353**	**374,494**	**10,357**	**3,742,165**	**-**	**124,419**	**-**	**-**	**1,715,389**	**196,118**	**224,428**	**7,765,280**								

NOTES:

1. **Energy Production Revenue** NOT included in Total Cost Avoided; Energy Production site is at Reservoir No.1 ERF.
2. **Non-cumulative** - Energy Production, LGS and MGS credits
3. **Incentives for Projects** DOES NOT include incentives received for BCH - EM Agreement
4. ***Phase 3: Street Lighting*** *- Savings of 217,721 kWh included in 2020 kWh above. BCH doesn't include this in their reported savings.*

Appendix G – Electricity Savings

Electrical Savings

Fiscal Year	Estimated Savings (kWh)	Cumulative Estimated Savings (kWh)	Target (kWh)	Cumulative Target (kWh)
2009	183,092	183,092	234,000	234,000
2010	521,875	704,967	234,000	468,000
2011	814,468	1,519,435	234,000	702,000
2012	859,307	2,378,742	234,000	936,000
2013	347,992	2,726,734	234,000	1,170,000
2014	77,488	2,804,222	234,000	1,404,000
2015	990,063	3,794,285	234,000	1,638,000
2016	261,223	4,055,508	234,000	1,872,000
2017	787,878	4,843,386	1,000,000	2,872,000
2018	597,096	5,440,482	550,000	3,422,000
2019	814,089	6,254,571	300,000	3,722,000
2020	426,584	6,681,155	300,000	4,022,000
2021	108,510	6,776,204	300,000	4,322,000
2022	165,918	6,843,630		
2023	132,575 *	6,976,205		
2024	51,986 *	7,028,191		
2025	74,594 *	7,102,785		
2026	63,905 *	7,166,690		
2027	21,968 *	7,188,658		
2028				
2029				
2030				

* Projected in Multi-Year Action Plan based on applicable projects listed.

Appendix H – Natural Gas Savings

Natural Gas Savings

Fiscal Year	Natural Gas Estimated Savings (GJ)	Cumulative Estimated Natural Gas Savings (GJ)	Annual Reduction Target (GJ)	Cumulative Target (GJ)
2009	2,578	2,578	573	573
2010	420	2,998	573	1,146
2011	3,984	6,982	573	1,719
2012	950	7,932	573	2,292
2013	327	8,259	573	2,865
2014	4	8,263	573	3,438
2015	2,185	10,448	573	4,011
2016	624	11,072	573	4,584
2017	3,250	14,948	573	5,157
2018	5929	21,648	573	5,730
2019	450	22,583	573	6,303
2020	0	22,583	573	6,876
2021	2	22,585	573	7,449
2022	2,145 *	24,730	4,315	11,289
2023			4,315	15,129
2024			4,315	18,969
2025			4,315	22,809
2026			4,315	26,649
2027			4,315	30,489
2028			4,315	34,329
2029			4,315	38,169
2030			4,315	42,009

* Projected in Multi-Year Action Plan based on applicable projects listed.