



KPU CARBON REDUCTION PLAN

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Executive Summary

This document outlines Kwantlen Polytechnic University's (KPU's) comprehensive plan to reduce greenhouse gas emissions and align with British Columbia's climate targets. The initiative focuses on transitioning from natural gas to more sustainable energy sources, improving energy efficiency across campuses, and addressing asset lifecycle management. KPU's carbon emissions primarily stem from the use of natural gas for heating, hot water, and other energy needs. The institution's infrastructure, while essential for educational purposes, contributes significantly to its carbon footprint, necessitating urgent action to meet regulatory and environmental standards.

This initiative is integrated into KPU's asset lifecycle replacement plan, ensuring that energy-efficient alternatives are used as aging equipment is replaced. By coordinating these efforts, KPU aims to enhance operational efficiency while simultaneously reducing carbon emissions and maximizing the benefits of each investment. This plan relies on four main drivers to lower carbon emissions:

1. Upgrading the electrical infrastructure. This will ensure sufficient capacity for new technologies, including air source heat pumps (ASHPs) and electric boilers.
2. Electrification of heating systems. Replace existing natural gas-fired heating systems with heat pumps and electric boilers.
3. Implementing energy conservation measures alongside equipment upgrades. This includes retro-commissioning building management systems and optimizing ventilation and heating systems to maximize energy efficiency.
4. Using Renewable Natural Gas (RNG) for KPU's campuses to meet the university's carbon-neutral goals while the existing infrastructure is replaced. This transition will help mitigate the carbon impact of existing natural gas consumption while KPU implements more permanent electrification solutions.

The total estimated budget for this carbon reduction initiative is approximately \$60 million over the next eight years, plus inflation. This includes both dedicated funding for carbon emissions reductions and funds from the maintenance, modernization, and renewal (MMR) budget.

The anticipated carbon reductions from these initiatives are substantial, projecting a decrease of approximately 2,200 tonnes of CO₂ per year by 2032. This aligns KPU with provincial emissions reduction targets and demonstrates the University's commitment to sustainability.

Potential risks associated with the initiative include fluctuating costs of renewable energy sources, variability in the electrical grid's carbon intensity, capital asset inflation, and implementation delays due to design and permitting processes. Additionally, the necessity for ongoing funding and commitment from stakeholders will be critical to the successful execution of this plan.

In summary, KPU is taking a proactive approach to reducing its carbon footprint through strategic investments in energy efficiency and sustainable energy solutions, positioning the institution as a leader in environmental stewardship within the educational sector. Under this plan, KPU will achieve the mandated 2050 reduction targets eighteen years ahead of schedule.

Introduction

This plan has been developed in response to the Government of British Columbia's Climate Change Accountability Act, which mandates carbon emissions reductions for all public institutions. These reductions are based on using 2007 as the baseline year with steady decreases in emissions through to 2050. The Act mandates the following emissions reductions:

- 16% below 2007 levels by 2025
- 40% below 2007 levels by 2030
- 60% below 2007 levels by 2040
- 80% below 2007 levels by 2050

In addition to these targets, KPU has established more aggressive reduction goals of 50% by 2025, 60% by 2030, and 100% by 2050.

In 2020, KPU began researching different pathways through which these targets would be achieved. Since then, several consulting studies have been initiated to understand the source and quantity of KPU's carbon emissions and identify practical approaches to reducing them. These studies were used to develop KPU's carbon reduction plan, which prioritizes energy conservation where practical and then focuses on replacing fossil-fueled infrastructure with equipment that utilizes clean electricity.

Although this plan focuses on reducing carbon emissions at KPU campuses, it is part of a more robust asset replacement plan. Most of the buildings on KPU campuses are at the midpoint in life expectancy and will soon require major infrastructure upgrades. The heating systems, most of which consume carbon-emitting natural gas, will reach their end of life by the early 2030s and will need to be replaced. This coincides with the timing of the carbon reduction targets outlined in the Climate Change Accountability Act. The necessary asset replacements will be tied to the required carbon emission reductions, leading to KPU's buildings having minimal carbon emissions while at the same time having new highly efficient heating systems fueled by clean electricity.

KPU is required to calculate its carbon emissions annually using the Clean Government Reporting Tool (CGRT). Throughout the year, KPU tracks the consumption of various fuel types and applies the carbon emission factors (determined by the Ministry) to each type, resulting in a calculated total tonnage of CO₂ emitted. These results are reported to the BC Government's Ministry of Environment and Climate Change Strategy and made public through its website. In 2023, the reported emissions were 9.3% below the 2007 baseline.

This plan will reduce carbon emissions before the BC Government's target dates by utilizing a variety of proven technologies, but will also leave opportunities to adopt new technologies, such as carbon capture, as they become commercially viable.

Carbon Emissions at KPU

This section outlines the sources of carbon emissions and the corresponding annual tonnage, which were calculated using the CGRT. Using the CGRT data, a comparison chart of carbon emissions for all post-secondary institutions was developed.

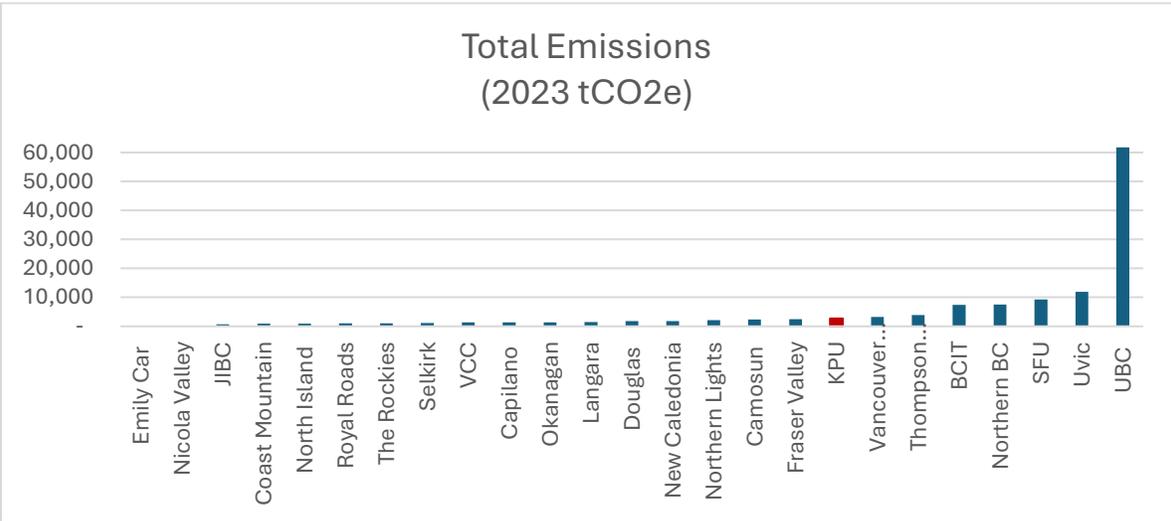
Sources of Carbon at KPU

The following table outlines the sources of carbon emissions at KPU campuses in 2023 and the activities/uses that result in emissions. Natural gas is the greatest source of carbon emissions, which is driven primarily by space heating and the production of domestic hot water.

Source	Typical Uses	Annual CO2 Emissions (tonnes - 2023)	Percentage
Natural Gas	<ul style="list-style-type: none"> Space heating Hot water Cooking Programming 	2243 tCO ₂ e	91.24%
Electricity	<ul style="list-style-type: none"> Air conditioning Lighting IT equipment Ventilation 	140 tCO ₂ e	5.59%
Gasoline	<ul style="list-style-type: none"> Fleet vehicles Small equipment 	37.7 tCO ₂ e	1.53%
Paper	<ul style="list-style-type: none"> Office use Teaching 	37.7 tCO ₂ e	1.53%

Comparison of PSI's

The following chart displays the total carbon emissions from all post-secondary institutions in British Columbia in 2023.



Analysis & Exploration

Since 2020, a number of studies were initiated to help inform this plan. A variety of external consultants were hired to investigate and evaluate the current internal situation at KPU, as well as external factors with respect to carbon emissions.

Internal Studies

A summary of the studies that were performed is as follows:

2020 - Existing Buildings Emissions Analysis (Dialog): This study provides an analysis of HVAC equipment and identifies strategies to reduce carbon emissions for all main campuses.

2021 - GHG Reduction Prefeasibility Study (Stantec): This study's objective was to develop feasible engineering solutions to achieve significant greenhouse gas emissions reductions at Richmond, Cloverdale, and Langley Campuses.

2021 - Greenhouse gas emissions and Geothermal Pre-Feasibility Study (Stantec): The objective of this study was to develop feasible engineering solutions to achieve significant greenhouse gas emissions reductions at Surrey Campus. The potential to expand the geothermal system at the Surrey Campus was also analyzed as part of the study.

2021 - Baseline Study for Electrification of Heating Systems (Stantec): This study analyzes the electrical capacity required to convert heating systems from natural gas to electricity.

2021- District Energy Systems Analysis – Cloverdale Campus (Kerr Wood): This is a high-level strategic planning study for implementing a district energy system.

2021 - Decarbonisation and Low Carbon Electrification Planning (Prism): This study reviews and compares technical options that have been explored and recommends any additional options that should be explored.

2023 - ASHRAE Level Two Energy Audit – Richmond Campus (Stantec): The purpose of this audit is to identify energy savings and GHG emissions reduction measures.

2023 - ASHRAE Level Two Energy Audit - Langley Campus (Stantec): This audit identifies energy savings and GHG emissions reduction measures.

2023 - Electrical Capacity Forecast – All Campuses (Stantec): This study identified the current electrical usage and forecasted needs of each campus in comparison with existing capacity (transformer and BC Hydro supply).

2023 - Low Carbon Feasibility Study – Cloverdale Campus (Dialog): The purpose of this study is to assist KPU in developing a strategy to reduce GHG emissions and meet emissions reduction targets.

2024 - Low Carbon Feasibility Study – Langley Campus (Dialog): The purpose of this study is to assist KPU in developing a strategy to reduce GHG emissions and meet emissions reduction targets.

2024 - Low Carbon Feasibility Study – Richmond Campus (Dialog): The purpose of this study is to assist KPU in developing a strategy to reduce GHG emissions and meet emissions reduction targets.

2024 - Low Carbon Feasibility Study – Surrey Campus (Dialog): The purpose of this study is to assist KPU in developing a strategy to reduce GHG emissions and meet emissions reduction targets.

2024 - EV Charging Infrastructure Study – All Campuses (RAM Consulting): This study identified the electrical infrastructure requirements, equipment, requirements forecast, and location for EV charging stations at each campus

2024 - Asset Condition Assessments – All Campuses (VFA): This study was a comprehensive review of all mechanical equipment at each KPU campus to evaluate current conditions and predict the end of useful life in order to determine when each asset (and system) would need replacement.

The results of these studies revealed that there is a viable and cost-effective pathway for KPU to achieve and exceed the carbon reduction targets mandated by the BC Government. Most of the structures on KPU campuses are now at the midpoint in their life expectancies and will need upgrades to their heating, cooling, and other major systems in order for them to continue to operate. This presents a substantial opportunity to dovetail the carbon reduction requirements with the asset replacement plan, thereby accomplishing both needs simultaneously. There is also an opportunity to significantly reduce overall energy consumption through a variety of conservation efforts, which will result in lower emissions, lower operating costs, and prolonged longevity of the replacement assets.

All of these measures will be a burden to the existing electrical capacity. The current electrical capacity at most campuses is not sufficient to support future growth, electrification, EV charging and other initiatives that tax the electrical supply. For this reason, the electrical capacity at each campus will need to be upgraded to support future demand.

Studies of External Factors

A summary of the studies that were performed is as follows:

2022 – Emerging Sustainable Technologies Study (BES): This study provides a high-level review of emerging sustainable building energy technologies that could be considered for reducing GHG emissions.

2022 – RNG Feasibility Study: This study identifies and evaluates the benefits of using renewable natural gas (RNG) to reduce greenhouse gas emissions.

2023—Preliminary Climate Adaptation Study (Introba): This Preliminary Climate Adaptation Strategy is the first step towards identifying and assessing climate-related hazards and identifying opportunities to enhance resilience incorporated with planned decarbonization actions.

Although the Low Carbon Feasibility Studies identified several viable technologies to reduce carbon emissions with immediate effect, the Emerging Sustainable Technologies Study identified other technologies that could be adopted one day to provide the same or better results. These

technologies are not yet commercially ready; however, this is flexible in that these technologies could be adopted once they become viable.

Renewable Natural Gas is a term used to classify gasses that are produced from the decomposition of organic materials. RNG is deemed to be carbon-neutral by the BC Government with no emissions attributed to its usage. Fortis-BC, the gas supplier for most of British Columbia, plans to add 15% RNG to the natural gas supply by 2030, which will provide emissions savings of 15%, which is 1% from achieving the BC Government 2030 target if we do nothing. There is also the possibility that Fortis may add additional RNG to the natural gas supply in future. Currently, KPU has the option of contracting with Fortis to supply 100% RNG, which would cost approximately \$261K annually.

One of the impacts of climate change is increasing temperature. The earth's temperature is expected to continue to increase well beyond 2050. This will result in a reduced number of heating days, which are the days required to heat our spaces and will increase the number of cooling days, which are the days required to cool our spaces. Reducing the amount of heat needed for spaces will result in fewer carbon emissions.

For the purposes of this plan, the effects of RNG on the gas supply and reduced heating requirements from global warming have not been included in the forecasted carbon reductions.

Approach

The following principles were established due to the internal and external studies and were used in developing this plan.

Asset Replacement

The current heating and cooling infrastructure at all KPU campuses will reach end-of-life over the next 8-10 years. This equipment will need to be replaced to mitigate the risk of sudden failure, which would significantly impact the KPU community, including interruption to teaching and learning. The requirement to replace this equipment within this timeline provides an opportunity to methodically install new carbon-neutral equipment in its place.

Energy Conservation

Several studies identified opportunities to reduce energy consumption, both natural gas and electricity. Reducing energy consumption will reduce emissions and operating costs.

Business Continuity

KPU is in the business of providing teaching and learning experiences at the campuses it operates. Shutting down buildings for long periods of time to implement carbon reduction technologies would negatively impact ongoing teaching and learning experiences. Additionally, gas-fired equipment replacement needs to be evaluated against other significantly impactful and disruptive end-of-life infrastructure such as roofs, elevators, and life safety systems.

Operational Viability/Reliability

Heating and cooling infrastructure is critical equipment and vital to positive teaching and learning experiences. Emission-reducing equipment must be reliable and capable of maintaining comfortable space temperatures during regular and peak times.

Funding

Based on the asset replacement timeline of 8-10 years and KPU's ability to implement large retrofit projects, an annual dedicated capital budget of \$5.0M was used for developing the plan.

Electrical Capacity

Currently, there is a limited supply of electricity on each campus. The electrical infrastructure and supply will need to be upgraded to support this plan, as well as many other future projects. Upgrading this equipment impacts the timelines and timing of the carbon reduction measures being considered. The availability and capacity of electricity from BC Hydro could constrain the ability to fully implement this plan.

Renewable Natural Gas

KPU will need the gas supply in the foreseeable future, even with the carbon reduction efforts outlined in this plan. Gas will continue to be used in labs, cooking, and ancillary equipment, as well as to fuel redundant/emergency heating equipment. For this reason, RNG is planned as an alternative to natural gas.

Resourcing

The success of this plan will require adequate resourcing and expertise over and above current levels in the Facilities Services and Procurement departments. It is unrealistic to expect the sheer quantity of projects identified in the plan to be executed without additional support. These projects are complicated and would have significant negative impacts on the KPU Community if not properly managed. Each full project cycle from concept to delivery, through consultant/engineer team selection, design development and key partner engagement, general contractor award, and project construction phases, is an enormous commitment by Facilities and Procurement teams.

Equipment Categories

The equipment that is within the scope of this plan has been separated into two categories:

1. Carbon-reducing
2. Supporting infrastructure

Equipment that reduces carbon emissions (Emission Reduction Measures) replaces natural gas-burning assets with various technologies that primarily use electricity to accomplish the same result. The equipment in this category is required to be installed due to the expected end-of-life of the existing legacy equipment.

Supporting infrastructure is equipment that is needed to support electrification of KPU campuses and does not directly result in carbon reductions. Much of the existing equipment is near end-of-life or does not have sufficient capacity.

Emission Reduction Measures

This section outlines specific Emission Reduction Measures (ERMs) aimed at significantly lowering greenhouse gas emissions across KPU campuses. Each measure is strategically designed to align with KPU's sustainability goals and funding utilization.

Use of Renewable Natural Gas at Each Campus

KPU will implement the use of Renewable Natural Gas (RNG) as a transitional energy source across all campuses. RNG is produced from organic waste and has a much lower carbon footprint compared to conventional natural gas. By sourcing RNG, KPU can maintain its existing natural gas infrastructure while reducing emissions during the transition to more sustainable energy sources. This measure supports the gradual phasing out of fossil fuels and helps mitigate the immediate impact of carbon emissions associated with natural gas consumption. RNG will be needed to achieve KPU's carbon reduction goal of 50% by 2025.

Cloverdale Campus

ERM 1 – Retro-CX (2024)

This is a review of the building automation system (BMS) sequences to confirm they align with and achieve the original design intent, ensuring the buildings and equipment operate optimally in relation to energy efficiency and user comfort.

- CO₂e Reduction: 9 tonnes per year
- Annual Operating Cost Impact: \$8,437 reduction
- ERM Cost: \$22,000

ERM 6 – Replace Domestic Hot Water (DHW) Heater (2024)

Replace the existing natural gas domestic hot water tank with an electric hot water tank. This work is timed with the remaining life of this equipment, which will be 14 years old in 2025.

- CO₂e Reduction: 25.2 tonnes per year
- Annual Operating Cost Impact: \$9,600 increase
- ERM Cost: \$100,000

ERM 5 – Dedicated Outdoor Air Supply (DOAS) HRV Replacement (2027)

Replace the existing Dedicated Outdoor Air Supply (DOAS) that utilizes heat recovery technology with higher-performance heat recovery ventilation (HRV) units using improved technology to improve energy efficiency. This work is timed with the capital renewal of this equipment, which will be 27 years old and at the end of life in 2034.

- CO₂e Reduction: 46.8 tonnes per year
- Annual Operating Cost Impact: \$12,381 reduction
- ERM Cost: \$2,974,300

ERM 2 – Main Heating Plant Air Source Heat Pump (ASHP) + Gas Boiler (2029)

Add an ASHP for the first stage of heating and primary cooling for this campus. The work will require replacing the existing chiller, which will be near the end of its life when this measure is implemented with an ASHP. The second stage of heating will use the existing gas boilers fueled by RNG if conditions require them to operate until this measure is implemented. The main electrical capacity will need to be evaluated and upgraded.

- CO2e Reduction: 219.2 tonnes per year
- Annual Operating Cost Impact: \$17,506
- ERM Cost: \$2,317,700

ERM 3 – Main Heating Plant Air Source Heat Pump (ASHP) + Electric Boiler (2032)

Remove the existing natural gas boilers and install electric boilers to provide the second stage of heating; the ASHP provides the first stage of heating. This work is timed with the capital renewal of this equipment, which will be 30 years old and at the end of life in 2037.

- CO2e Reduction: 286.6 tonnes per year
- Annual Operating Cost Impact: \$35,588 increase
- ERM Cost: \$2,873,600

Langley Campus (Main)

ERM 1 – Retro-CX (2024)

This is a review of the building automation system (BMS) sequences to confirm they align with and achieve the original design intent, ensuring the buildings and equipment operate optimally in relation to energy efficiency and user comfort.

- CO2e Reduction: 18 tonnes per year
- Annual Operating Cost Impact: \$13,820 reduction
- ERM Cost: \$45,000

ERM 6 – Heat Recovery Added to Variable Air Volume (VAV) Ventilation System (2025)

Add HRV recovery coils to the existing VAV ventilation system Air Handling Units (AHU) or new dedicated HRV roof-mounted fan systems ducted to serve multiple AHU units. Further evaluation will be needed to determine the most effective approach that provides the best value for this upgrade work. This work is timed with the capital renewal of this equipment, which will be 34 years old and past end of life in 2027.

- CO2e Reduction: 50 tonnes per year
- Annual Operating Cost Impact: \$26,733 reduction
- ERM Cost: \$1,950,400

ERM 2 – Main Heating Plant Air Source Heat Pump (ASHP) + Gas Boiler (2027)

Add an ASHP as the first stage of heating. The second stage of heating will use the existing gas boilers fueled by RNG if conditions require them to operate until this measure is implemented.

- CO2e Reduction: 248.6 tonnes per year
- Annual Operating Cost Impact: \$20,487 increase
- ERM Cost: \$3,597,900

ERM 3 – Main Heating Plant Air Source Heat Pump (ASHP) + Electric Boiler (2031)

Remove the existing natural gas boilers and install electric boilers to provide the second stage of heating; the ASHP provides the first stage of heating. This work is timed with the capital renewal of this equipment, which will be 41 years old for the non-condensing boilers and past the end of life and 24 years old for the condensing boiler, which will be near the end of life in 2034.

- CO2e Reduction: 63.1 tonnes per year
- Annual Operating Cost Impact: \$23,096 increase
- ERM Cost: \$2,841,500

Langley Campus (Horticulture)

ERM 4 – Air Source Heat Pump (ASHP) + Gas Boiler (2032)

Add an ASHP as the first stage of heating. The second stage of heating will use the existing gas boilers fueled by RNG if conditions require them to operate until this measure is implemented. The main electrical capacity must be upgraded before this measure can be implemented.

- CO2e Reduction: 151.1 tonnes per year
- Annual Operating Cost Impact: \$12, 247 increase
- ERM Cost: \$1,609,300

ERM 5 – Air Source Heat Pump (ASHP) + Electric Boiler (2033)

Remove the existing natural gas boilers and install electric boilers to provide the second stage of heating; the ASHP provides the first stage of heating. This work is timed with the capital renewal of this equipment, which will be 31 years old and past the end of life in 2038.

- CO2e Reduction: 36.1 tonnes per year
- Annual Operating Cost Impact: \$13, 202 increase
- ERM Cost: \$595,000

Richmond Campus

ERM 4 – Heat Recovery Ventilators (HRV) on 85% of Roof Top Units (RTU) (2024)

Add HRV recovery coils and upgrade the existing Roof Top Units (RTUs) that serve the variable air volume ventilation (VAV) system.

- CO2e Reduction: 50 tonnes per year
- Annual Operating Cost Impact: \$12,333 reduction
- ERM Cost: \$1,000,000

ERM 1 – RTU Heating by Air Source Heat Pump (ASHP) (2026)

Add an ASHP as the first stage of heating. The second stage of heating will use the existing gas boilers fueled by RNG if conditions require them to operate until this measure is implemented.

- CO2e Reduction: 202.1
- Annual Operating Cost Impact: \$10,502 increase
- ERM Cost: \$3,650,000

ERM 5 – Electric Boiler Heating and Domestic Hot Water (DHW) (2030)

Remove the existing natural gas boilers and install electric boilers to provide the second stage of heating; the ASHP provides the first stage of heating. This work is timed to coincide with the capital renewal of this equipment, which will be 40 years old and reach end of life in 2032.

- CO2e Reduction: 250.2 tonnes per year
- Annual Operating Cost Impact: \$89,767
- ERM Cost: \$4,518,900

Surrey Campus

ERM 1 – Retro-CX (Surrey) (2024)

This is a review of the building automation system (BMS) sequences to confirm they align with and achieve the original design intent, ensuring the buildings and equipment operate optimally in relation to energy efficiency and user comfort.

- CO2e Reduction: 29.1 tonnes per year
- Annual Operating Cost Impact: \$21,194 reduction
- ERM Cost: \$45,000

ERM 3 – Main Heating Plant Air Source Heat Pump (ASHP) (2027)

Add an ASHP as the first stage of heating. The second stage of heating will use the existing gas boilers, but they can operate on RNG, if necessary, until this measure is implemented. It will be necessary to evaluate the most practical and beneficial approach and whether to install centralized ASHP units adjacent to the existing boiler room or install them in a distributed manner adjacent to each building.

- CO2e Reduction: 250 tonnes per year
- Annual Operating Cost Impact: \$52,438 increase
- ERM Cost: \$4,384,400

ERM 4 – Main Heating Plant Air Source Heat Pump (ASHP) + Electric Boiler (2031)

Remove the existing natural gas boilers and install electric boilers to provide the second stage of heating; the ASHP provides the first stage of heating. This work is timed with the capital renewal of this equipment, which will be 41 years old for the non-condensing boilers and past the end of life and 24 years old for the condensing boiler, which will be near the end of life in 2034.

- CO2e Reduction: 162.5 tonnes per year

- Annual Operating Cost Impact: \$59,490 increase
- ERM Cost: \$902,400

Supporting Infrastructure

Funding from the Ministry of Post-Secondary Education and Future Skills is a critical component in KPU's strategy to maintain and upgrade its infrastructure while aligning with sustainability goals. Funding is provided in various Certificates of Approval (COA), such as the Major Maintenance and Capital Renewal (MMR) program. The MMR program evaluates the replacement of end-of-life equipment and essential upgrades that support energy-efficiency and emissions-reduction initiatives across all campuses, while also ensuring that other critical built-infrastructure replacement needs are addressed (e.g., roofs, elevators, major civil systems, life safety).

The MMR budget enables KPU to implement necessary improvements to the existing infrastructure, ensuring that facilities not only meet operational needs but also comply with current environmental standards. By synchronizing supporting infrastructure projects with carbon emissions-reduction measures, KPU can achieve significant long-term energy cost savings and reduce greenhouse gas emissions. Some of these projects, but not all, could be funded within the MMR program.

EV Chargers & Electrification of KPUs Fleet

The installation of EV chargers across all campuses is essential to supporting the transition to electric vehicles (EVs) within KPU's fleet. This measure will facilitate the replacement of existing gasoline or diesel-powered vehicles with electric alternatives.

The EV charger installation will not only reduce greenhouse gas emissions from the fleet but also encourage staff and students to adopt electric vehicles, promoting a culture of sustainability within the KPU community. By investing in this infrastructure, KPU can effectively transition to a cleaner, more sustainable transportation system that complements its broader carbon reduction strategy.

Overall, this initiative emphasizes KPU's commitment to environmental responsibility and aligns with the province's objectives for reducing carbon emissions. The estimated cost to install EV chargers at all campuses is \$1,400,000.

Cloverdale Campus

Upgrade Transformer Equipment (2033)

Dialog reports determined in 2024 that there is sufficient electrical capacity to electrify the heating and domestic hot water systems with the current building configurations. However, there is insufficient capacity for additional EV chargers, electrified heating systems, and programs.

- CO2e Reduction: 0
- Annual Operating Cost Impact: 0
- ERM Cost: \$4,500,000

Langley Campus (Main)

Upgrade Main Campus Primary Transformer Equipment (2029)

The Dialog reports determined in 2024 that there is sufficient electrical capacity for the electrification of the heating and domestic hot water systems with the current building configurations. However, there is insufficient capacity for additional EV chargers, electrified heating systems, and programs.

- CO2e Reduction: 0
- Annual Operating Cost Impact: 0
- ERM Cost: \$4,500,000

Langley Campus (Horticulture)

Upgrade Transformer Equipment (2026)

The Dialog reports indicate the electrical capacity for the Horticulture site is heavily loaded and will need evaluation before any upgrade work is performed. It is anticipated that an electrical capacity evaluation and upgrade will be required before any electrification work on the heating system can be performed.

- CO2e Reduction: 0
- Annual Operating Cost Impact: 0
- ERM Cost: \$1,000,000

ECM 7 – C02 HP Domestic Hot Water (DHW)Heaters (2033)

This project entails replacing the DHW heaters with conventional electric hot water heaters at the end of their useful life. The revised project has an estimated cost of \$100,000. In the 2038 replacement year, the cost of natural gas will be roughly the same as electricity due to the carbon tax, resulting in no impact on annual operating cost vs using natural gas.

- CO2e Reduction: 31.8 tonnes per year
- Annual Operating Cost Impact: \$0
- ERM Cost: \$100,000

Richmond Campus

Replace BMS (2024/25)

This project will replace the existing building automation system (BMS), which is at the end of its life, with a new, enhanced system that will include the following to reduce energy consumption and associated greenhouse gas emissions. The project will include adding demand ventilation where possible and practical to optimize ventilation for the occupant load, rather than providing a fixed volume based on maximum occupancy. Adding equipment that currently has standalone control and is not connected to the BMS. Enhancing the lighting controls will increase energy efficiency. The new equipment will also allow improved algorithms to reduce energy consumption and GHG emissions. This project has been tendered for construction, a contractor has been selected, and the project is about to start. Fortis will provide incentive funding on completion.

- CO2e Reduction: 54 tonnes per year
- Annual Operating Cost Impact: \$0
- ERM Cost: \$2,275,000

Upgrade Main Campus Primary Transformer Equipment (2031)

The Dialog reports determined in 2024 that there is sufficient electrical capacity for the electrification of the heating and domestic hot water systems with the current building configurations, with the exception of ECM 5. However, there is not enough capacity for additional EV chargers, electrified heating systems, and programs.

- CO2e Reduction: 0
- Annual Operating Cost Impact: 0
- ERM Cost: \$4,500,000

Surrey Campus

Cedar Building Heating System Replacement (2024)

The first stage of this project is in progress and replaces 5 of the 7 Roof Top Units (RTUs) heated by natural gas with ASHP equipment that uses electricity for heating. This project is already funded, and the values are not included in the cost estimates for this ECM. This ECM is for the second phase of this project, which replaces the remaining 2 of 7 RTU units with ASHP technology. This project's second phase cannot be implemented until the main electrical vault upgrade and capacity increase are completed.

- CO2e Reduction: 68 tonnes per year
- Annual Operating Cost Impact: \$2,344 increase
- ERM Cost: \$1,180,690

Cedar Building Heating System Replacement (2025)

The first stage of this project is in progress, and it replaces the remaining 2 of the 7 Roof Top Units (RTU) that are heated by natural gas with ASHP equipment that uses electricity for heating; this project is already funded, and the values are not included in the cost estimates for this ECM. This ECM is for the second phase of this project, which replaces the remaining 2 of 7 RTU units with ASHP technology. This project's second phase cannot be implemented until the main electrical vault upgrade and capacity increase are completed.

- CO2e Reduction: 60 tonnes per year
- Annual Operating Cost Impact: \$5722
- ERM Cost: \$1,800,000

Upgrade Main Campus Primary Transformer Equipment (2024/25)

The main electrical system design is being upgraded from 2.5 MW to 7 MW, which is an increase in capacity of 4.5 MW to allow for future changes such as finalizing the electrification of the Cedar heating system, electrification of the main heating system, adding a new daycare building, possibly adding a new student residence building, adding electric car chargers, buildings, etc. BC Hydro's

local infrastructure constraints will limit the initial increase in capacity to 1.1 MW, with the balance of the requested 4.5 MW to follow at a later date, the timing of which is unknown at this time.

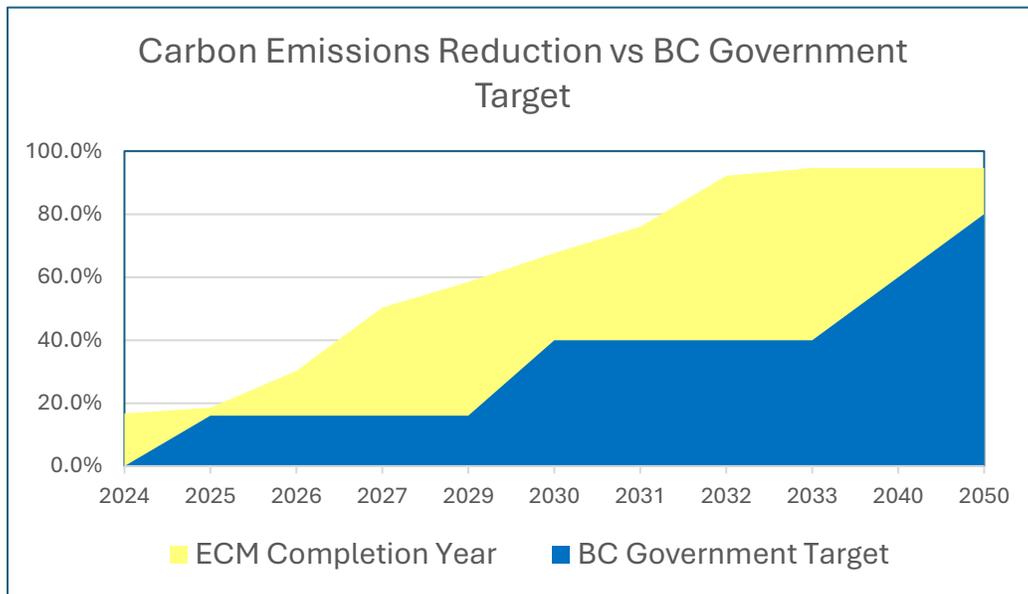
- Estimated Cost: \$4,300,000

Carbon Emissions Forecast

The graph below illustrates the yearly incremental reduction in tCO₂e values from 2024 to 2050 compared to the BC Government's Target for reductions.

The yellow area of the graph represents the work identified in this plan to reduce carbon emissions; the blue area represents the current BC Government emissions-reduction targets.

This information is illustrated by the years from 2024 to 2050.



An important consideration in interpreting this information and the graph is that the Government changes the emissions factors from time to time, and these changes in emissions factors will impact the calculated value of the greenhouse gas emissions reductions should they change in future.

Another consideration is that the current electrical grid is not green, and the emission factor for electricity varies from year to year, depending on how much electricity the province imports.

It is anticipated that the electrical grid will eventually have no emissions as more hydro and other green power sources are added in the future.

Budget and Cash Flow

Overview

Key factors related to the project's budget and anticipated cash flow are summarized below.

- A budget value of \$5,000,000 per year is anticipated in addition to the funding provided by the MMR program to reduce carbon emissions.
- The existing MMR budget will be evaluated to replace end-of-life equipment and to provide upgrade work that will support the work to reduce carbon emissions, where other significant non-gas-fired infrastructure is not also a risk to KPU.
- The initial cash flow for the new budget was kept lower than the cost estimates to allow for design fees, contingency amounts, and other factors that are not included in the estimates, such as modifications to the buildings to accommodate the revised equipment, taxes, etc.
- The Class D estimates in the Dialog reports will be plus/minus 20% accurate.
- BC Government “Climate Accountability Act” specifies the target dates and CO2e reductions required, which affects projects selected and associated cash flow.
- Prioritization of ERMs that reduce energy consumption first, where possible.
- The Dialog reports did not include the costs of upgrading electrical system capacity. If KPU adds buildings, EV charging stations, etc., in conjunction with electrifying heating systems, additional electrical capacity may be needed, and this has been added to this implementation plan.
- Project costs are estimated in today's dollars with no escalation, and the final costs will vary depending on the year the work is performed.

Cash Flow

The following tables illustrate the anticipated cash flow for project work.

Emissions Reduction Measures

2024	2025	2026	2027	2028	2029	2030	2031	2032
\$1,712,000	\$1,950,400	\$3,650,000	\$4,384,400	\$3,597,900	\$5,292,000	\$4,518,900	\$3,743,900	\$4,482,900

Supporting Infrastructure

2024	2025	2026	2029	2031	2033
\$4,180,690	\$5,375,000	\$2,450,900	\$4,500,000	\$4,500,000	\$4,600,000

The actual cash flow is anticipated to vary and may be impacted when more detailed design work is completed for each ECM.

The cash flow for the ERM projects does not include consulting fees, taxes, contingency funds, or building modifications for project work.

Financial Impact

Overview

The BC government's goal of reducing carbon emissions, and the annual increases in the carbon tax to advance this goal, will significantly impact the cost of energy and associated carbon emissions for heating at KPU.

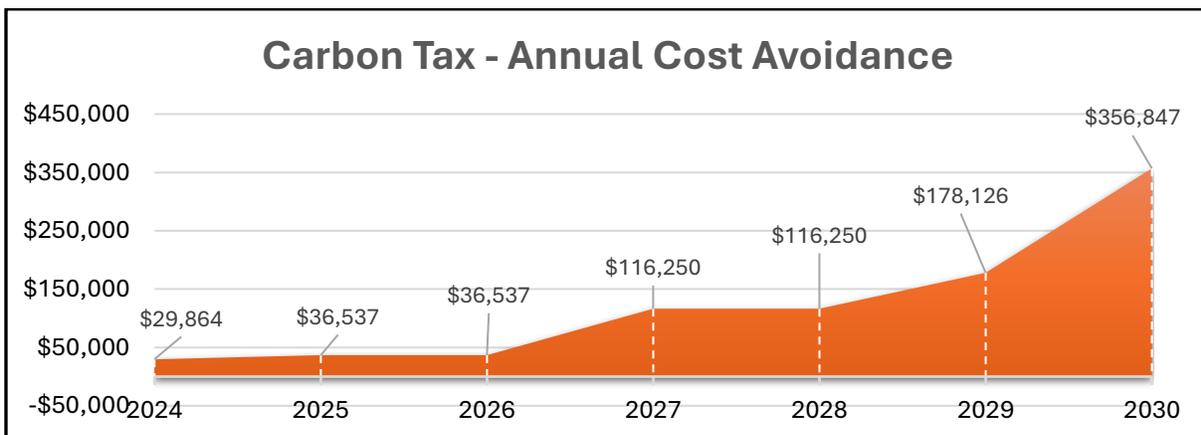
This plan uses a multi-phase approach that first reduces energy consumption and associated energy costs and then electrifies heating systems. There are several issues to consider related to the financial impact in relation to this plan:

- The work performed to increase energy efficiency.
- The escalation of the carbon tax, which will increase annually.
- Natural gas cost reductions due to the electrification of heating systems.
- Electricity costs increase due to the electrification of heating systems.

The expense related to writing off existing assets (assuming there will still be a book value) and the annual depreciation expense from adding new assets have not been accounted for in this analysis.

Carbon Tax

On April 1, 2024, B.C.'s carbon tax rate rose from \$65 in 2023 to \$80 per tCO₂e in 2024 and will increase by \$15 per tonne increments to \$170 per tonne in 2030. The graph below shows the increasing amount of the carbon tax that will be payable per year if we do not electrify the heating systems and continue to use natural gas.

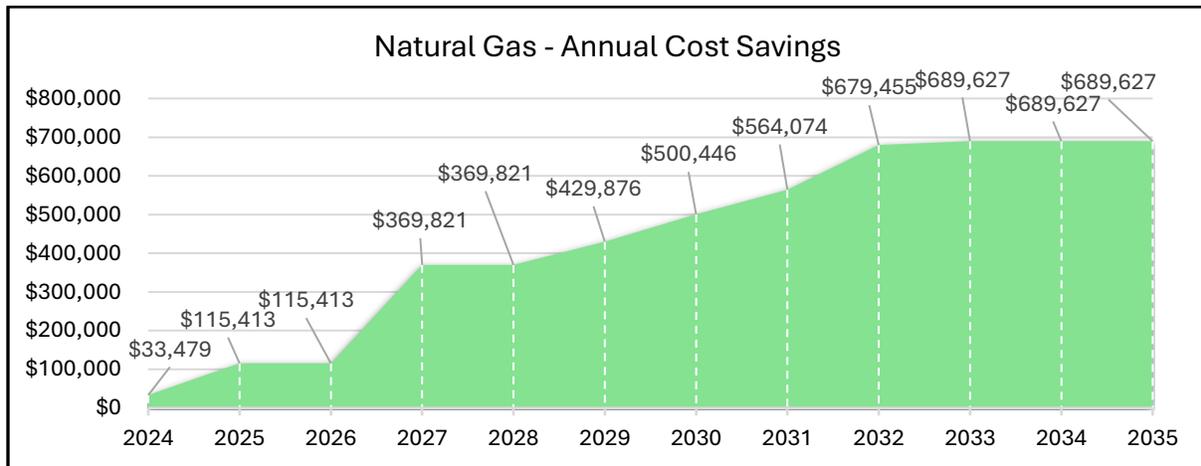


If we do nothing to perform the work indicated in this plan to switch heating fuel from natural gas to electricity, the carbon tax will increase to \$356,847 per year in 2030 due to continued carbon emissions from using natural gas. There is discussion about ending the carbon tax, both federally and provincially, which could impact this calculation.

Natural Gas Savings

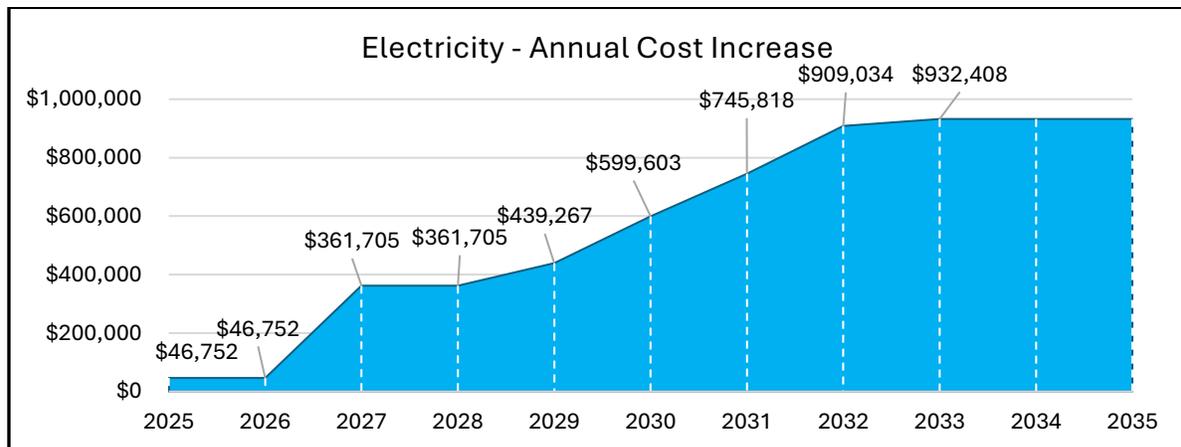
Electrification of heating systems by fuel switching from natural gas to electricity will reduce natural gas costs. It will also provide cost avoidance on future carbon tax costs, which would be an added cost of continuing to use natural gas. This graph represents current market conditions. The liquefied natural gas (LNG) plant in Kitimat, BC, is now in the testing phase and could, once fully operational, take up to 2,000,000 gigajoules per day of natural gas out of the domestic supply, which could result in significant price increases.

The graph below illustrates the cost savings associated with this plan to reduce carbon emissions based on the current market rates.



Electrical Cost Increase

Electrification of heating systems by switching from natural gas to electricity will increase electricity costs, as heating will be provided by electricity rather than natural gas.



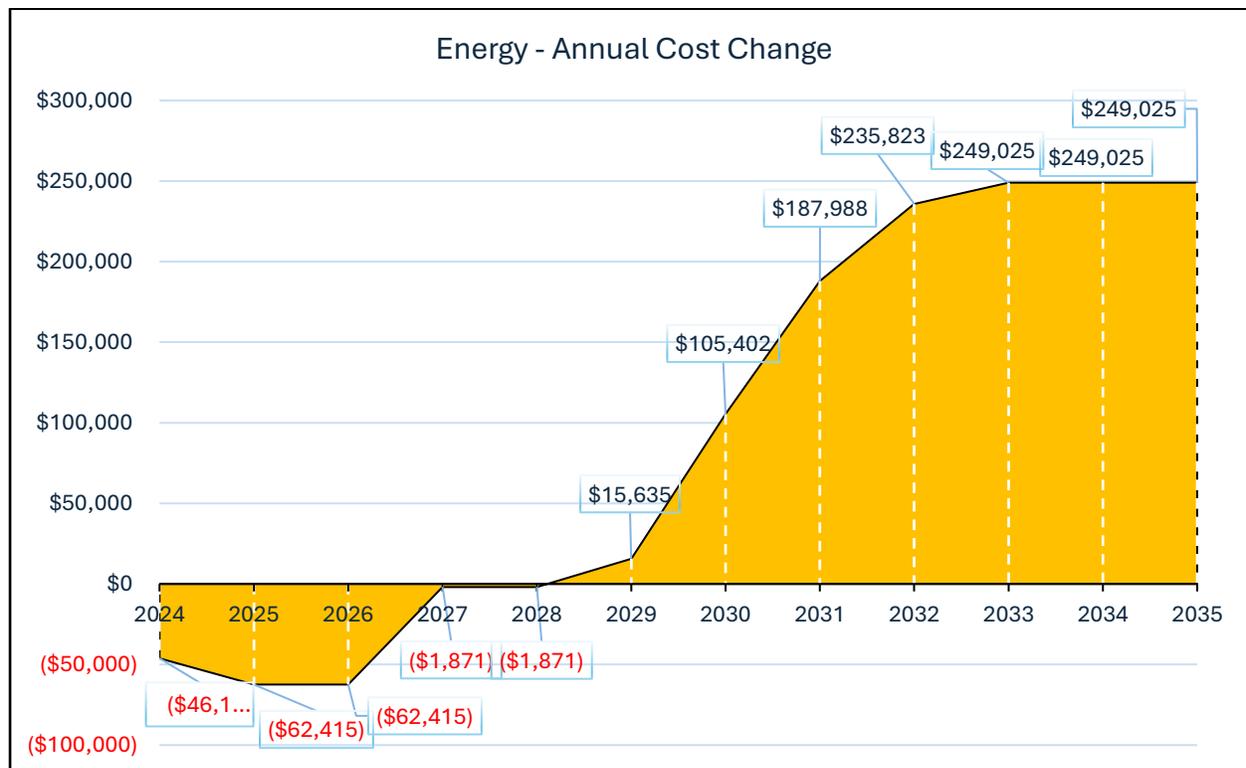
Annual Energy Cost Change Summary

There are several factors to consider regarding the annual heating cost when switching fuel from natural gas to electricity.

- RNG will be needed to achieve KPU’s carbon reduction goal of 50% by 2025.
- Natural gas costs will be reduced, notwithstanding unknown supply and demand cost impacts from LNG.
- Electricity costs will increase.
- Carbon tax costs on natural gas will be avoided.

The graph below illustrates the impact of work to increase energy efficiency at the start of the plan's implementation, showing a reduction in annual costs through 2029, when electrification of the heating system equipment begins.

As heating systems switch from natural gas to electricity, energy costs will increase because electricity costs more per unit of heating energy than natural gas.



The cost of having 50% of the natural gas be RNG to achieve KPU’s 2025 goal is estimated at an additional \$130,500 per year, which is not included in the annual cost changes shown in the graph above.

Implementation Funding

This implementation plan is funded from two separate budget sources to accelerate the reduction in carbon emissions. The first source is dedicated Emissions Reduction Measures (ERM) funding, and the second source is a portion of the MMR budget funding and any other COA's that are issued to KPU for this plan.

The ERM funding will focus directly on projects to reduce carbon emissions, and the MMR budget funding will be prioritized for supporting infrastructure that facilitates the carbon emissions reduction projects, such as electrical infrastructure upgrades. The work identified in both budgets is synchronized with the replacement of end-of-life equipment where possible and practical.

The projects that will be funded from each budget stream are summarized in the two sections below.

Emissions Reduction Measures Funding

The average annual estimated budget value for construction costs from 2024 to 2033 is \$3,648,044 per year; design costs, contingencies, permits, and taxes are not included. Many projects are anticipated to be multi-year, so the cash flow rate per year will be able to be increased closer to \$5,000,000 once project work is started and other costs, such as design fees, are determined.

The annual expenditures are anticipated to vary from year to year due to the complexity of the work, possible supply chain issues, and the overall time frame for designing, tendering, and performing the work.

The proposed projects, estimated project costs, and annual total estimated costs are in the table below.

Campus	ERM #	Project Name	Tonnes CO2e	Estimated Cost
2024				
Surrey	ERM 1	Retro-CX	29	\$45,000
Langley	ERM 1	Retro-CX	18	\$45,000
Cloverdale	ERM 1	Retro-CX	9	\$22,000
Richmond	ERM 4	HRV on 85% of RTU (all except 2/5)	50	\$1,000,000
Cloverdale	ERM 6	Electric Hot Water Heater	25	\$100,000
				\$ 1,712,000
2025				
Langley	ERM 6	HRV Added to VAV	50	\$1,950,400
				\$1,950,400

2026

Richmond	ERM 1	RTU Heating by ASHP (heating coils)	202	\$3,650,000
				\$3,650,000

2027

Surrey	ERM 3	Main Heating Plant ASHP	250	\$4,384,400
				\$4,384,400

2028

Langley	ERM 2	ASHP +Gas Boiler (Main)	249	\$3,597,900
				\$3,597,900

2029

Cloverdale	ERM 5	HRV Added to DOAS (RTU units)	47	\$2,974,300
Cloverdale	ERCM 2	ASHP +Gas Boiler	219	\$2,317,700
				\$5,292,000

2030

Richmond	ERM 5	Electric Boiler Heating & DHW	251	\$4,518,900
				\$4,518,900

2031

Surrey	ERM 4	Main Heating Plant ASHP +Electric Boiler	163	\$902,400
Langley	ERM 3	ASHP +Electric Boiler (Main)	63	\$2,841,500
				\$3,743,900

2032

Cloverdale	ERM 3	ASHP +Electric Boiler	287	\$2,873,600
Langley	ERM 4	ASHP +Gas Boiler (Horticulture)	151	\$1,609,300
				\$4,482,900

2038

Langley	ERM 5	ASHP +Electric Boiler (Horticulture)	36	\$595,500
				\$595,500

Supporting Infrastructure Funding

The annual expenditures are anticipated to vary from year to year due to the complexity of the work, possible supply chain issues, and the overall time frame for designing, tendering, and performing the work.

The proposed projects, estimated project costs, and annual total estimated costs are outlined in the table below.

Campus	ECM #	Project Name	Estimated Cost
2024			
Surrey		Cedar RTU Replacement (5/7)	\$1,180,000
Surrey		Transformer Upgrade (Start)	\$2,000,000
Richmond		BMS Replacement Project Starts	\$1,000,000
			\$4,180,000
2025			
Surrey		Transformer Upgrade (Completion)	\$2,300,000
Surrey		Cedar RTU Replacement (2/7) (remainder)	\$1,800,000
Richmond		BMS Replacement Project Completion	\$1,275,000
			\$5,375,000
2026			
All Campuses		EV Charger Infrastructure	\$1,400,000
Langley		Upgrade Transformer Equipment (Hort)	\$1,000,000
Langley	ECM 9	Polyhouse Electric Heat (Hort)	\$50,900
			\$2,450,900
2029			
Langley		Upgrade Main transformer equipment	\$4,500,000
			\$4,500,000
2031			
Richmond		Upgrade transformer equipment	\$4,500,000
			\$4,500,000

2033

Cloverdale		Upgrade transformer equipment	\$4,500,000
Langley	ECM 7	Electric Hot Water Tank	\$100,000
			\$4,600,000

Conclusion

KPU’s carbon reduction plan is driven by four main goals: using Renewable Natural Gas (RNG), upgrading electrical infrastructure, electrifying heating systems, and implementing energy conservation measures. These goals are designed to transition the university away from fossil fuels and towards more sustainable energy solutions, reducing greenhouse gas emissions and ensuring compliance with British Columbia’s climate targets.

The plan includes a range of energy conservation measures, such as retro-commissioning building automation systems, optimizing ventilation and heating systems, adding heat recovery systems to reuse waste heat, and switching heating systems from natural gas to electricity. It is also integrated into KPU’s asset lifecycle replacement plan, ensuring that energy-efficient alternatives are used as aging equipment is replaced.

With a budget of approximately \$60 million over eight years, KPU’s plan is expected to reduce carbon emissions by about 2,300 tonnes of CO₂e annually by 2032. By achieving these reductions, KPU will meet its carbon reduction targets well ahead of schedule.