Appendix D: Corporate Climate Action Plan

DISCLAIMER

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Glossary of Terms

BAU: Business-as-Usual Scenario

BEV: Battery Electric Vehicle

CAFE: Corporate Average Fuel Economy

CEEP: Community Energy and Emissions Plan

DE: District energy

EPA: Environmental Protection Agency

EV: Electric vehicle

FCM: Federation of Canadian Municipalities

GHG: Greenhouse gas

GJ: Gigajoule

HV: Heavy-duty vehicle

ICI: Institutional, commercial, and industrial

IESO: Independent Electricity System Operator

IPCC: Intergovernmental Panel on Climate Change

J: Joule

kWh: Kilowatt hour

ktCO2e: Kilotonnes carbon dioxide equivalent

MTSA: Major Transit Station Area

MW: Megawatt

NEB: National Energy Board

O&M: Operations and maintenance

OPO: Ontario Planning Outlook

PACE: Property Assessed Clean Energy

PJ: Petajoule

PV: Photovoltaics

RNG: Renewable natural gas

SCC: Social cost of carbon

tCO2e: Tonnes carbon dioxide equivalent

TGS: Toronto Green Standard

TJ: Terajoule

UNFCCC: UN Framework Convention on Climate Change

WWTP: Wastewater Treatment Plant

ZEV: Zero Emission Vehicle

Executive Summary

The Corporate Climate Action Plan (CAP) is the first part of a comprehensive climate action plan for the City, with part 2 focussing on community actions. Together, these two documents will form a comprehensive strategy, Orillia's Climate Future.

The CAP identifies a pathway to net-zero GHG emissions for City operations by 2040, including the following targets.

1. Buildings

1.1 Existing buildings:

By 2030, the City will reduce heating consumption by 50%, and by 2040, the City will reduce non-heating energy use by 20–50% through retrofit and renovation.

1.2 Recreational buildings:

By 2030, the City will reduce energy consumption in arenas and swimming pools by 20–50%, and by 2040, the City will reduce GHG emissions in arenas and swimming pools by 100%.

1.3 Building heat consumption:

By 2040, the City will meet all heating demand in corporate buildings using 100% clean electricity.

1.4 New buildings:

After 2023, all new buildings will meet Passive House or equivalent according to the building use case, and meet net-zero GHG standards.

2. Vehicle Fleet

2.1 Light-duty vehicles:

After 2023, the City will purchase electric light-duty vehicles where available/possible, with the goal of solely purchasing electric vehicles by 2030.

2.2 Medium and heavy-duty vehicles:

The City will delay procurement of medium-duty pick-up trucks until a new fleet of electric pick-ups are available in 2025.

By 2025, the City will convert 100% of utility and maintenance ATVs to electric.

By 2030, the City will convert 50% of heavy-duty vehicles (e.g. snow removal, dump truck) to electric or hydrogen-powered.

By 2040, the City will only procure zero-emission vehicles (electric or hydrogen).

3. Clean Electricity

By 2040, the City will develop the capacity to generate 6–8 MW of renewable energy, or engage in another strategy to purchase renewable energy and/or its benefits.

KEY IMPLICATION: A CARBON BUDGET

The Corporate CAP embeds the consideration of GHG emissions capital and operating budgets, infrastructure planning, and fleet management.

In order to align financial and GHG management, Orillia will apply a carbon budget. Like a financial budget, the carbon budget aims to limit the emissions the City "spends." The carbon budget is designed to be applied in 4-year intervals to line up with the City's financial budgeting process. The carbon budget assigns a cap of GHGs the City can emit in each four year period. The suggested carbon budget, which is to begin in 2021, is provided below:

Carbon Budget[2]	
4-year period	Budget
2021-2024	9,982
2025-2028	9,055
2029-2032	6,886
2033-2036	4,075
2037-2040	3,567

KEY IMPLICATION: CITY BUDGET

The transition to net-zero corporate emissions will require investments over and above what is currently allocated to the maintenance of current buildings and fleet. However, if retrofits are planned to coincide with building maintenance and upgrades already scheduled, then those costs can be reduced. For example, if a building facade needs to be updated in 2032 for structural or integrity reasons, then installing insulation at the same time would be less expensive than installing insulation at a separate time. Combining these efforts also limits the disruption to municipal staff and to the public. The CAP also identifies investments in renewable energy to ensure the availability of clean electricity by 2040.

The following table provides estimates of the investments needed to make Orillia's corporate operations net-zero by 2040. The bulk of the retrofits take place between 2031–2035. Expediting these retrofits would reduce GHG emissions more quickly and help save on energy costs.

Table 1. Estimated Total Investment Cost (2021-2040)

	2021-2025	2026-2030	2031-2035	2036-2040	Total
Twenty year investments (in millions, $2018)					
Buildings	4.6	7.9	15.2	0.2	27.9
Fleet	3.7	3.4	2.7	2.5	12.3
Renewable energy	4.5	6.1	1.0	1.0	12.6
Total investment	53				

[2] Note that this carbon budget assumes the phasing out of emissions from electricity beginning in 2030 with zero emissions from electricity by 2040.

	2021-2025	2026-2030	2031-2035	2036-2040	Total
Fuel Cost Savings (in millions, $2018)					
Buildings	0.07	0.4	1.4	1.9	3.8
Fleet	0.25	1.2	1.8	2.1	3.6
Renewable energy[3]	0.6	3.1	4.6	5.1	13.5
Total Fuel Cost Savings	21				
Carbon Cost Avoided (in millions, $2018)					
Fleet and Buildings	0.08	0.6	1.5	1.9	4.1
Renewable Energy	.03	.3	.52	.65	1.5
Total Carbon Cost Savings					5.6
20 Year-Transition Total	27				

The estimates of energy consumption, GHG emissions, and selected financial flows (i.e. fuel costs, vehicle O&M costs, carbon costs, capital investments), will inform and guide the City's efforts to reduce its corporate emissions, and can support subsequent decision-making processes for specific buildings and vehicles.

[3] The total for fuel cost savings is high-level and does not account for the nuance of hourly electricity supply and demand. This analysis is outside the scope of this report.

Introduction

The Corporate Climate Action Plan (CAP) consists of targets and actions designed to reduce the greenhouse gas emissions of the Corporation of the City of Orillia. The Corporate CAP will work in tandem with the forthcoming Community Climate Action Plan (CCAP) to create a comprehensive framework for climate action in Orillia. Together, these two documents will form Orillia's Climate Future.

The Corporate CAP addresses municipal buildings and the City's vehicle fleet. These assets use energy to keep the lights on and the engines running. In turn, these energy sources release greenhouse gas emissions into the atmosphere. For example, the City burns natural gas to keep buildings warm in the winter, and diesel to run heavy-duty vehicles; both of these energy sources release carbon dioxide.

This plan describes a pathway to decarbonize these assets. Infrastructure such as street lights and the wastewater treatment plant will be addressed in the Community CAP.

In 2018, the City's buildings and vehicle fleet emitted 2,400 tCO2e of carbon dioxide. If the City took no action on climate change and Orillia continued to grow at its projected rate, by 2040 the City's buildings and vehicle fleet would emit roughly 3,150 tCO2e.

This pathway will shift the City from its current corporate energy use and emissions trajectory to net-zero emissions by 2040. Net-zero means that Orillia either releases no GHGs or offsets the emissions it does release.[4] The actions outlined in the plan will decarbonize building and fleet assets as much as possible to reduce corporate emissions and then develop or purchase renewable energy to offset any remaining emissions.

The target aligns with changes required to keep global average temperature increases to less than 1.5 ◦C above pre-industrial levels. This goal of 1.5◦C was agreed upon by the world's countries in 2015 as the way to collectively avoid the worst climate impacts.[5] The target also supports Orillia's declaration of a climate emergency.

Though 2040 seems far from now, some aspects of this plan will need to be implemented in the very near term to meet the target. These aspects include actions like large building retrofits, which can be timed to coincide with renovations that are already scheduled. Others, like the development or purchase of renewable energy, may evolve over the next fifteen years as technologies advance and the province changes the electricity grid's energy mix.

Decarbonizing buildings and the vehicle fleet and investing in renewable energy is projected to cost about $2.9 million per year in 2018 dollars from now until 2040. However, as assets move to cleaner energy sources, the City will save money on fuel costs and carbon costs. After accounting for these deferred costs, the projected net cost of the plan is roughly $1.5 million per year.

[4] Canada has joined more than 120 countries in a pledge to move to a net-zero economy. For more information, see Canada's Climate Plan

[5] The decision to limit global warming to 1.5◦C less than pre-industrial levels was reached at the Paris Climate Agreement in 2015. For more information see the Paris Agreement: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Scope of the Corporate Climate Action Plan

The scope of the CAP considers the following corporate assets and activities:

1. Building retrofits and efficiency measures

   This includes activities related to reducing energy consumption and GHG emissions associated with municipal buildings.

2. Fuel-switching

   For buildings that require space heating and cooling and water heating, the goal is to switch to electric sources, and primarily electric air source heat pumps.

3. Electrifying the corporate fleet

   The analysis includes the light, mid-size, and heavy vehicles in the city's operations as well as equipment.

4. Generating or purchasing clean electricity

   To offset emissions associated with use of Ontario's electricity grid, the plan outlines four strategies to either generate or purchase renewable energy.

Water and wastewater, while corporate functions, are addressed in the Community Climate Action Plan.

Orillia's Current Reality: Corporate Energy and Emissions Inventory

Corporate Inventory

The City maintains 35 municipal buildings. These include buildings like fire halls, pools, arenas, and the Opera House. Smaller buildings, like the outdoor washroom facilities at Moose Beach and Couchiching Park, require very little energy.

The fleet is made up of more than 80 vehicles that include small cars for daily needs and heavy-duty machinery like snow plows and dump trucks. These heavier vehicles may not be deployed as often as the smaller cars, but they have much larger fuel tanks and burn through more gas and diesel on a per vehicle basis.

Though the graphs in this overview include energy consumption and emissions from street lights and wastewater processing, the Corporate CAP will focus on buildings and the vehicle fleet.

ENERGY CONSUMPTION

In 2018, Orillia consumed approximately 103,000 GJ of energy. Electricity accounted for 58% of this total, followed by natural gas at 33% and diesel and gas the remaining 9%.

At present, electricity is sourced from Ontario's grid. Electricity is used to light buildings, traffic lights, and street lamps and to power water filtration and wastewater treatment systems. Natural gas is primarily used to heat indoor spaces and the recreation centre swimming pool.

Diesel and gasoline were used exclusively in Orillia's corporate fleet to power light-, medium-, and heavy-duty vehicles.

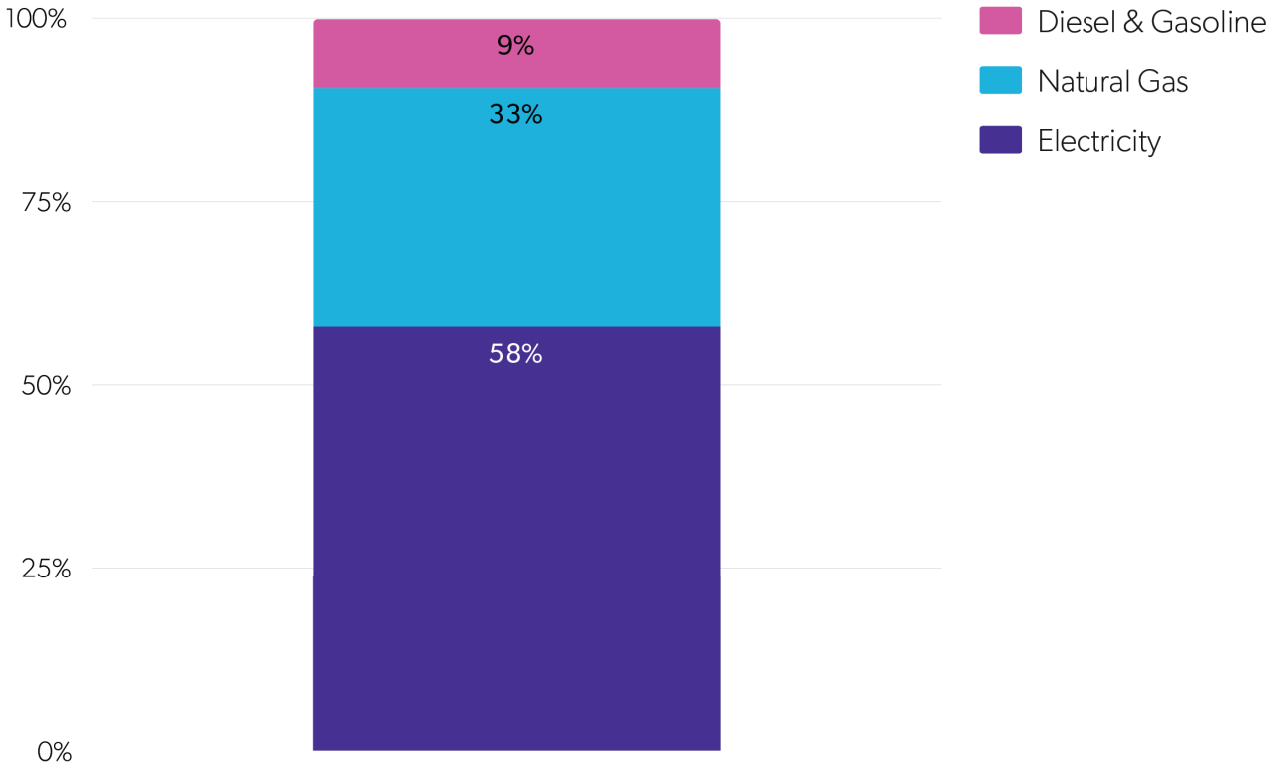

Figure 1. Orillia Corporate Energy Consumption, fuel-type, 2018.

GHG EMISSIONS

In 2018, Orillia's corporate emissions totalled approximately 2,800 tCO2e. Natural gas in buildings comprised 60% of Orillia's GHG emissions, which made it the largest emitting fuel-type in the corporate inventory. The City uses natural gas to heat indoor spaces and the recreation centre swimming pool.

Lights in buildings, traffic lights, and street lights use electricity that results in emissions from Ontario's electricity grid. Finally, diesel and gasoline consumption in the vehicle fleet made up 25% of the total emissions.

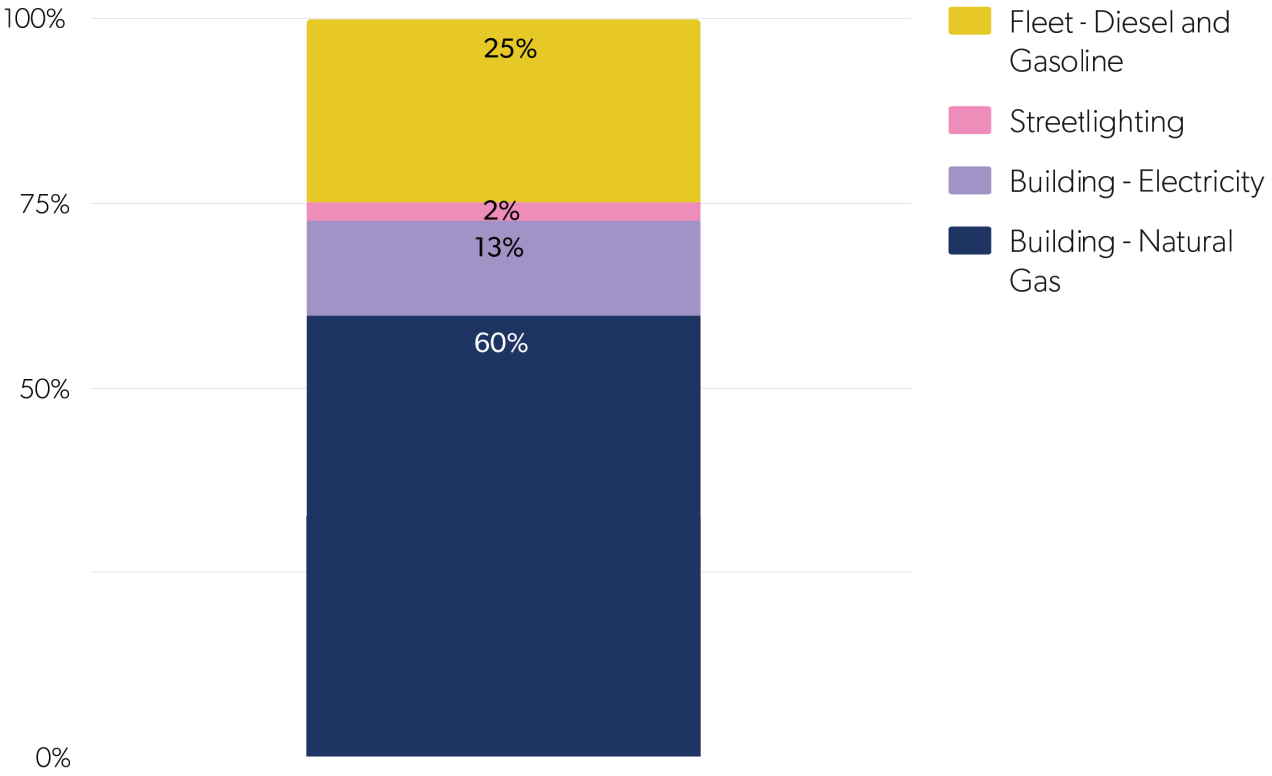

Figure 2. Orillia Corporate GHG Emissions by Sector 2018.

Business-As-Usual for the Next 20 years

The Business-as-Usual (BAU) scenario predicts a future where Orillia's population increases as projected but the City takes no action on climate change. It serves as a reference point for the City's potential energy consumption and GHG emissions in 2040. It is important to note that the BAU scenario does not include street lighting and wastewater processes as these are covered in a separate plan.[6]

[6] As a result of these items not being included, GHG emissions start approximately 200 tCO2e lower than the inventory year.

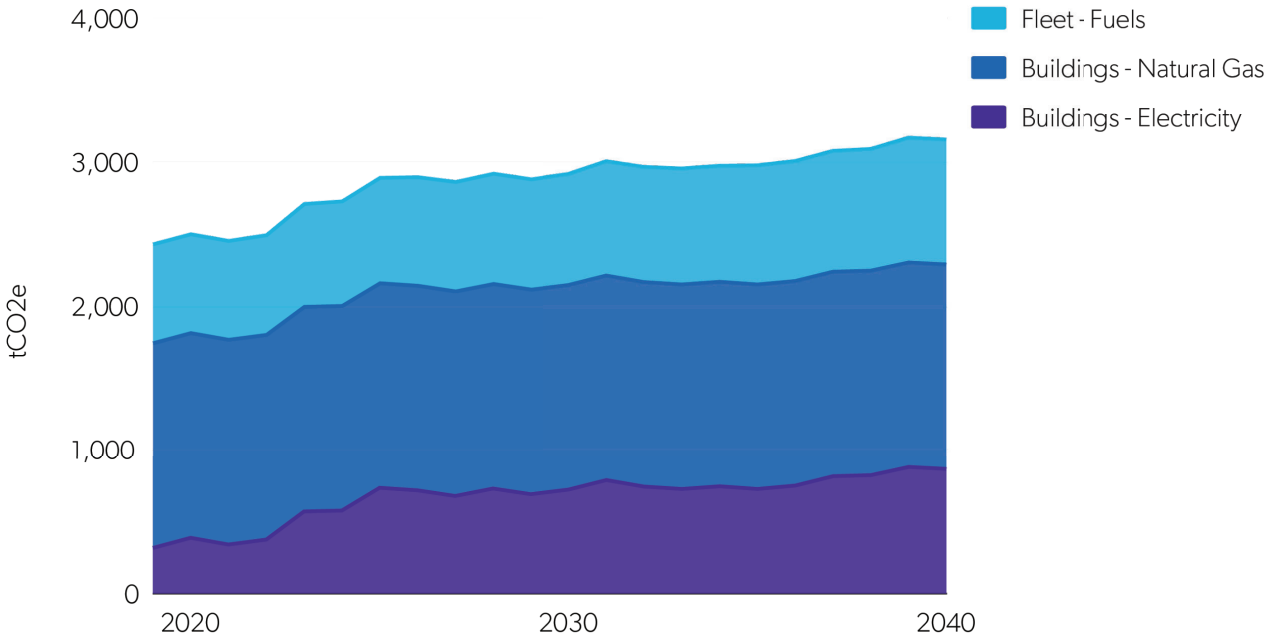

Figure 3. Business-as-usual GHG emissions for Orillia's Corporate Activities, 2018-2040. Note that street lighting and wastewater treatment are not included in this projection.

The BAU projects that GHG emissions will grow by 30% from roughly 2,400 tCO2e in 2018 to 3,150 tCO2e in 2040. This growth reflects additional vehicles needed for Orillia's fleet and increased emissions from the city's use of electricity from Ontario's grid.[7] In the BAU, natural gas continues to be the dominant emitter.

In the BAU, the City continues to buy gas and diesel rather than electric vehicles, and as such emissions from the fleet are projected to grow by 26%.

A Climate-Friendly Future: The Net-Zero Transition

Net-Zero is a short way of saying that a place, business, or organization emits as little carbon dioxide as possible, and then offsets any emissions it does produce. Balancing emissions can be thought of like balancing a bank account—in this case the City reduces its carbon "expenses" as much as possible and then either generates or purchases enough renewable energy to cover the remainder.

The Corporate CAP embeds the consideration of GHG emissions capital and operating budgets, infrastructure planning, and fleet management.

In order to align financial and GHG management, Orillia will apply a carbon budget. Like a financial budget, the carbon budget aims to limit the emissions the City "spends." The carbon

[7] The Atmospheric Fund of Ontario (and the IESO) projects that Ontario will increase its natural gas electricity generation over the next 15 years, which will lead to an increase in average GHG emissions. Grams of emissions per kilowatt hour increase from 50 to approximately 80 in 2040 and beyond. The forecasted emissions factor must be factored into the NZS to help to avoid underestimating the effects of interventions in the future.

budget is designed to be applied in 4-year intervals to line up with the City's financial budgeting process. The carbon budget assigns a cap of GHGs the City can emit in each four year period. The suggested carbon budget, which is to begin in 2021, is provided below:

Carbon Budget[8]	
4-year period	Budget
2021-2024	9,982
2025-2028	9,055
2029-2032	6,886
2033-2036	4,075
2037-2040	3,567

Decarbonizing Building and Vehicle Fleet Assets

THE BUILDINGS ENERGY AND EMISSIONS NET-ZERO TRAJECTORY

To meet the net-zero target, the City will need to retrofit its existing buildings to reach at least 50% energy savings by 2040. A retrofit timeline has been identified to ensure that the upgrade activities disrupt the public and corporate operations as little as possible. For example, retrofits are not scheduled to occur in all recreational facilities or public amenities at once. Staff buildings should remain open to ensure that municipal work is not affected.

Buildings

1.1 Existing buildings:

> By 2030, the City will reduce heating consumption by 50%, and by 2040, the City will reduce non-heating energy use by 20–50% through retrofit and renovation.

1.2 Recreational buildings:

> By 2030, the City will reduce energy consumption in arenas and swimming pools by 20–50%, and by 2040, the City will reduce GHG emissions in arenas and swimming pools by 100%.

1.3 Building heat consumption:

> By 2040, the City will meet all heating demand in corporate buildings using 100% clean electricity.

1.4 New buildings:

> After 2023, all new buildings will meet Passive House or equivalent according to the building use case, and meet net-zero GHG standards.

The timeline has also been set up to ensure that larger buildings which consume more energy and are already scheduled to undergo normal renovations are targeted first. This process identified Brian Orser Arena and Barnfield Point for retrofits by 2025. Targeting larger buildings

[8] Note that this carbon budget assumes the province will continue to decarbonize the electricity grid to zero emissions for electricity by 2040.

first can help reduce energy costs, which frees up funding to renovate buildings that come up later in the timeline.

Figure 4 illustrates the timeline for building retrofits which was evaluated in this analysis. For a list of planned municipal building retrofits, see Appendix 2.

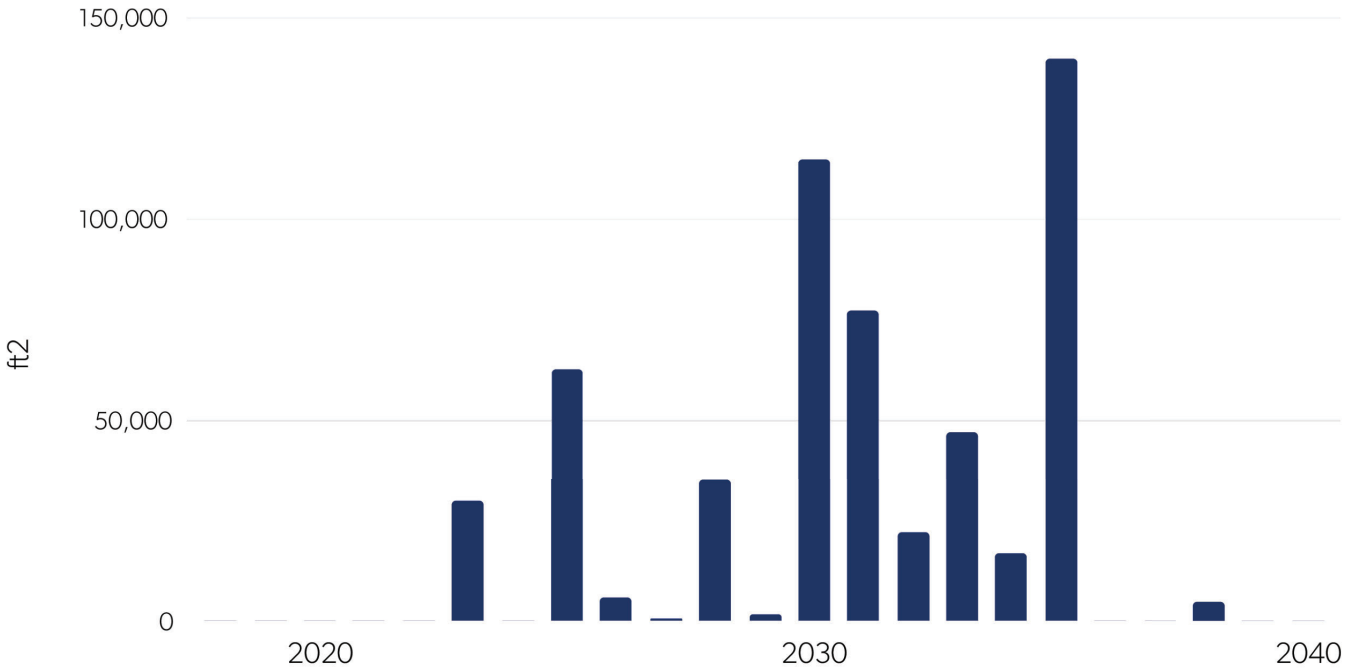

Figure 4. Building Retrofits and fuels-switching, by building type and target year, 2023-2040

Buildings energy consumption

The City's retrofit and fuel-switching activities will reduce energy consumption by 50%. By 2040, all natural gas heating systems will be replaced by air source heat pumps and an electric system will heat the swimming pool.

It is important to note that similar to the BAU scenario, the wastewater treatment buildings are not included in this analysis as they will be covered in the Community Climate Action Plan.

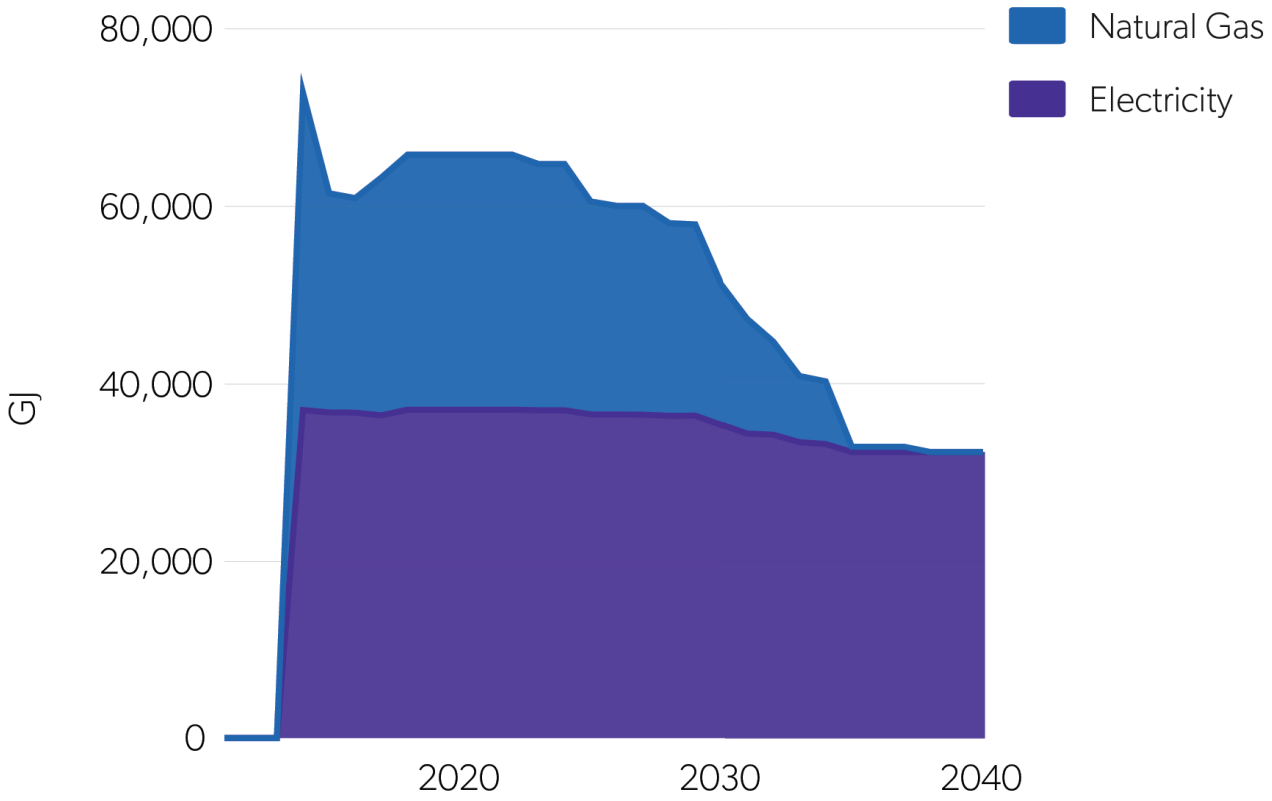

Figure 5. Buildings energy consumption (GJ), 2018-2040

Buildings GHG emissions

By 2040, the City's retrofit efforts will reduce corporate GHG emissions by 57%. Annual emissions from municipal buildings will fall below 1,000 tCO2e. These remaining emissions reflect emissions from Ontario's grid. Though heat pumps are overall much more efficient than natural gas heating systems, they still rely on electricity to power them, and that electricity comes from Ontario's grid. As Ontario has no immediate plans to decarbonize its own grid, to reach net-zero corporate emissions, Orillia will need to develop or purchase renewable energy. The four suggested clean energy options are outlined in the Clean Electricity section.

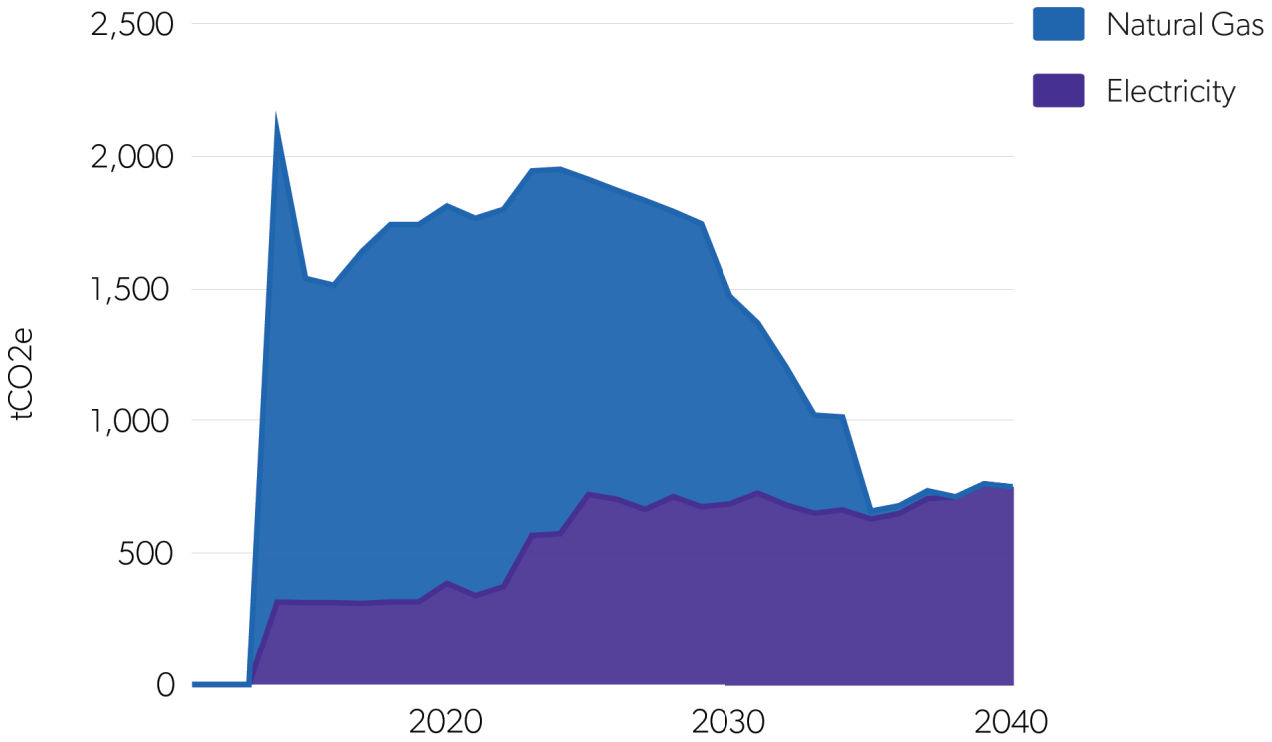

Figure 6. GHG emissions in Buildings (tCO2e), Net-Zero Transition 2018-2040.

THE FLEET ENERGY & EMISSIONS TRAJECTORY

Figure 8 shows how Orillia's fleet will grow from just under 100 vehicles in 2018 to 130 in 2050. Fleet growth is based on a simple linear projection that is aligned with overall community population growth. The assumption here is that by 2040 more vehicles will be required to meet the needs of the city.

2. Vehicle Fleet

2.1 Light-duty vehicles:

> After 2023, the City will purchase electric light-duty vehicles where available/possible, with the goal of solely purchasing electric vehicles by 2030.

2.2 Medium and heavy-duty vehicles:

> The City will delay procurement of medium-duty pick-up trucks until a new fleet of electric pick-ups are available in 2025.
>
> By 2025, the City will convert 100% of utility and maintenance ATVs to electric.
>
> By 2030, the City will convert 50% of heavy-duty vehicles (e.g. snow removal, dump truck) to electric or hydrogen-powered.
>
> By 2040, the City will only procure zero-emission vehicles (electric or hydrogen).

By 2030, the City will replace all gas powered light vehicles with electric vehicles. Though some heavy-duty vehicles still be diesel-powered, most of them will be transitioned out by 2035.

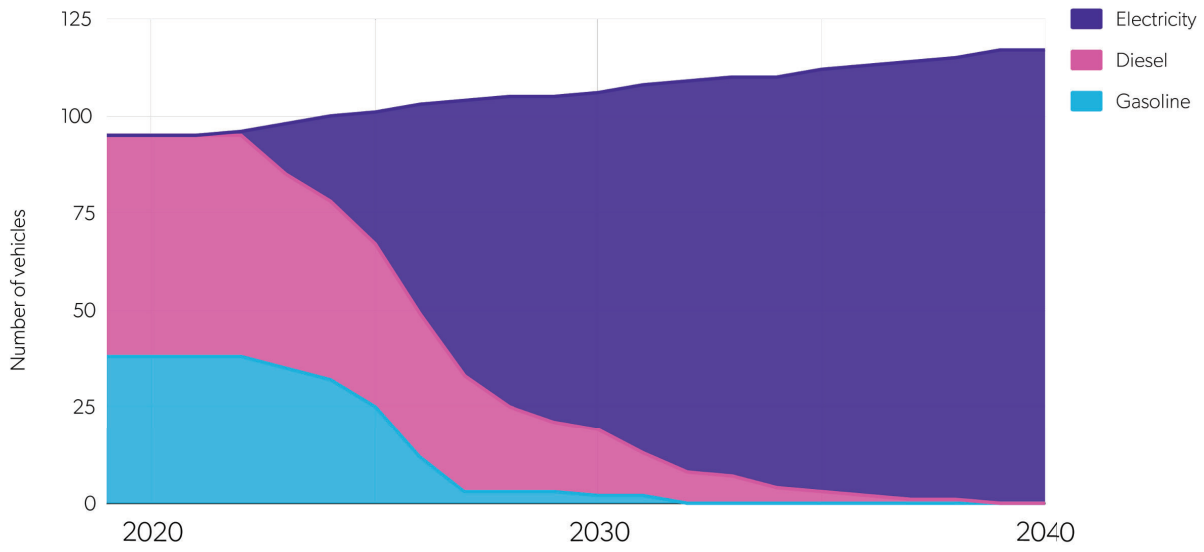

Figure 7. The fleet transition timeline, # of vehicles, 2018-2040.

Fleet energy consumption

By transitioning to electric for its light-duty vehicles, the City will reduce its energy consumption from approximately 9,600 GJ in 2018 to approximately 5,000 GJ in 2030. Once full electrification is reached, the City's energy consumption will decline further to approximately 4,000 GJ by 2050.[9] The City will reduce its energy consumption by more than 50%, which will also help reduce the City's operating costs.

[9] Some heavy-duty vehicles may remain diesel-powered after 2040 depending on whether electric heavy-duty vehicles of the necessary types have been developed and released for public sale.

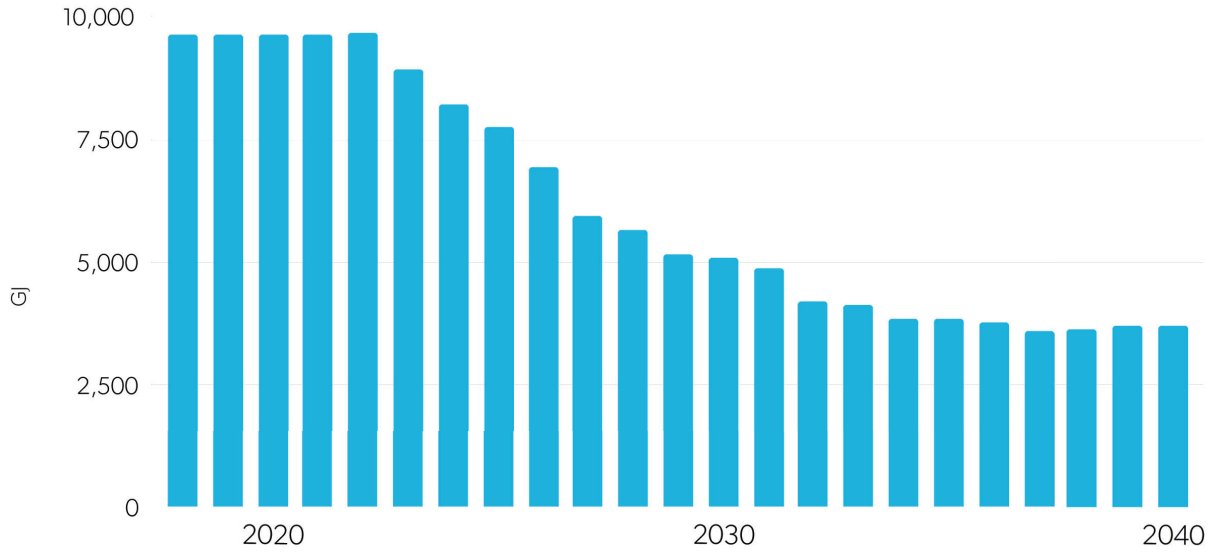

Figure 8. Corporate fleet projected energy consumption (GJ), 2018-2040.

Fleet GHG emissions

By 2030, the City's corporate fleet GHG emissions will drop by 66%. By 2035, they will drop by 85% as nearly all diesel heavy-duty vehicles are replaced. Electric vehicles are charged using Ontario's electricity grid, and as such the remaining emissions in the corporate fleet result from charging the vehicles. These emissions can be offset by pursuing one of the four clean electricity strategies outlined in the Clean Electricity section.

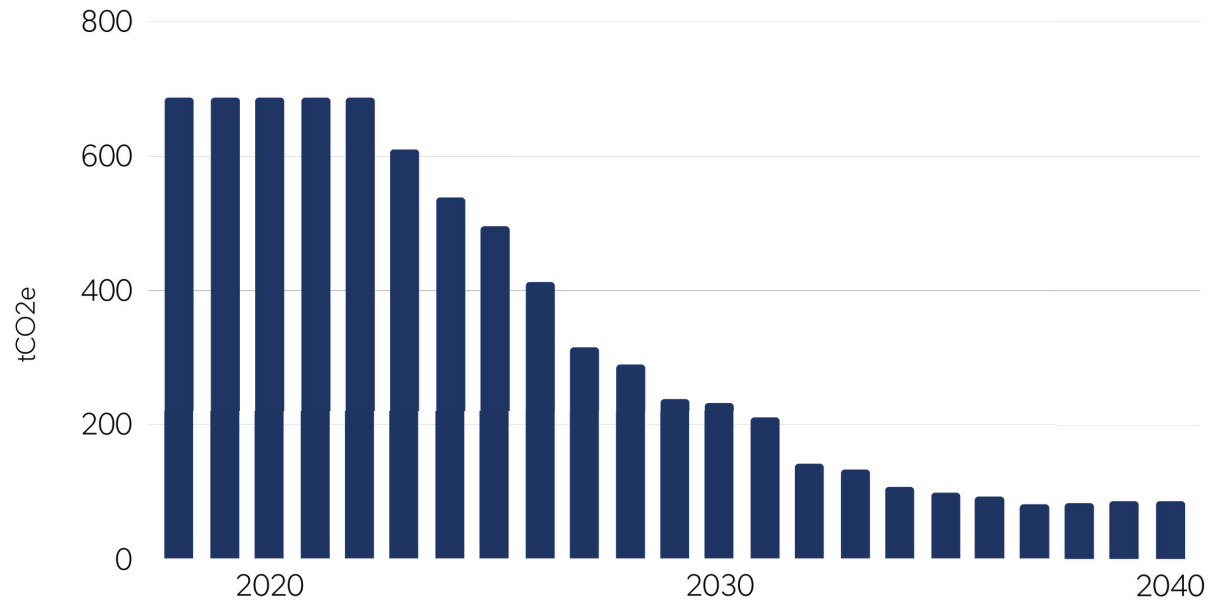

Figure 9. Corporate Fleet projected GHG emissions (tCO2e) , 2018-2040.

ENERGY AND EMISSIONS FROM ASSETS BY 2040

By 2035, the City will depend on electricity to power 92% of its buildings and vehicle fleet. By 2040 that number is closer to 100%. As the City switches to higher efficiency heat pump systems to heat buildings, the overall demand for energy will decline by 51%. Electric vehicles are also more energy efficient than their gas and diesel counterparts.[10]

Thanks to the City's fuel-switching efforts, there is virtually no natural gas in the building stock and very little diesel in the fleet.

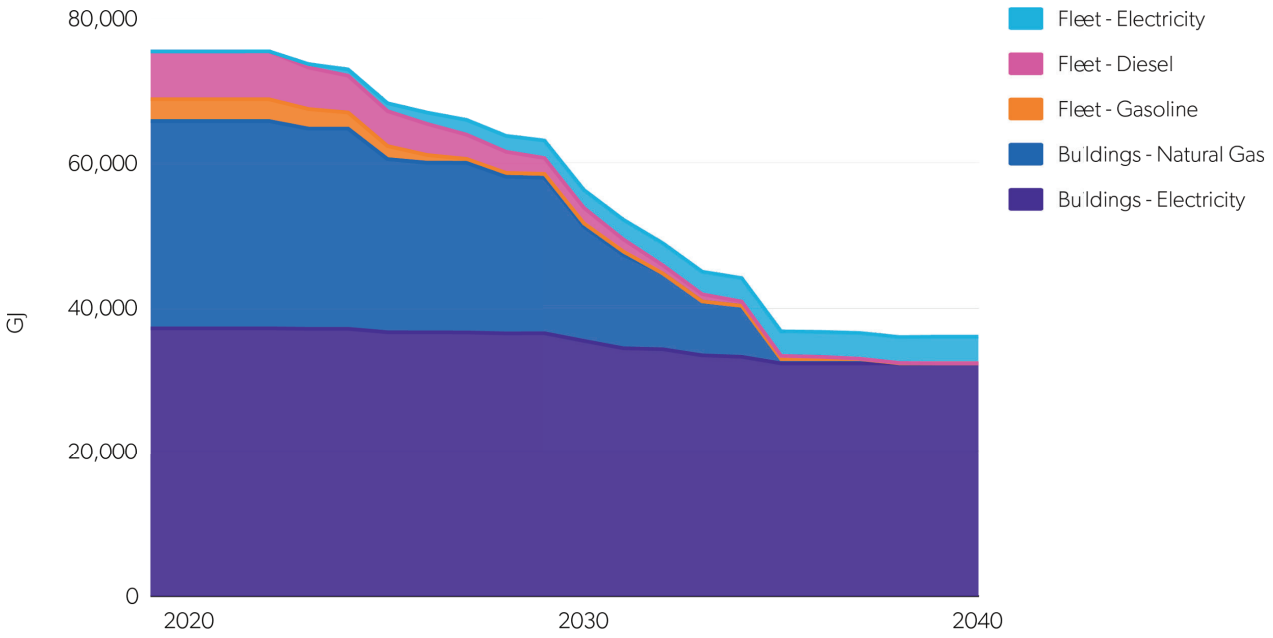

Figure 13. Energy Consumption by Buildings and Fleet (GJ) , Net-zero scenario, 2018-2040.

[10] Electric vehicles convert over 77% of the electrical energy from the grid to power at the wheels, whereas the internal combustion energy vehicles convert about 12%–30%. US Department of Energy (n.d.) All-electric vehicles. Retrieved from: https://fueleconomy.gov/feg/evtech.shtml

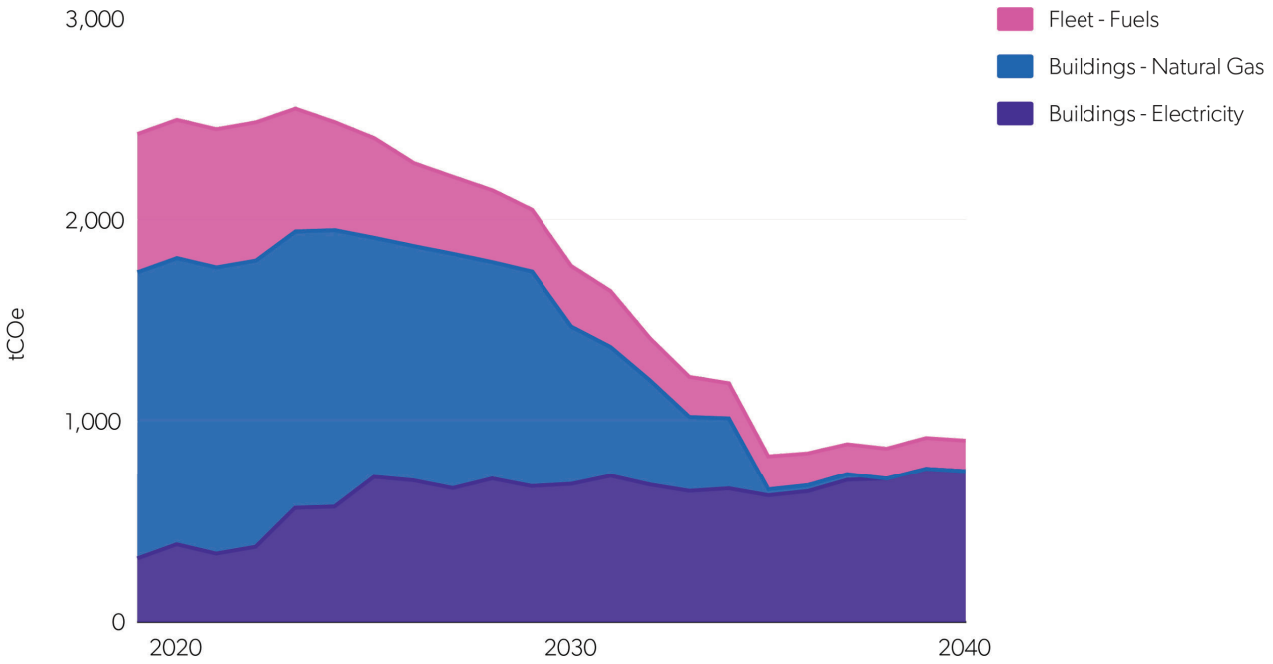

Figure 14. GHG emissions by Buildings and Fleet (tCO2e), Net-zero scenario, 2019-2040.

As the City transitions to systems that rely more heavily on the Ontario electricity grid, the emissions associated with that electricity use will go up. Ontario phased out its coal plants in 2014; aside from its reliance on natural gas plants to meet peak demand, the grid is now mostly fossil-free. For example, in 2019, only 6% of Ontario's electricity was supplied by natural gas or oil.[11] However, this percentage is expected to increase through to 2040. As Ontario's population grows and more people and municipalities switch to electric systems, natural gas plants will be called upon to meet the increased demand.[12]

The City will need to generate or procure approximately 8 MW of renewable energy to offset the remaining emissions in corporate activities and to align with the carbon budget targets. Figure 15 below shows how solar PV generation eliminates approximately 550 tCO2e by 2030, and 840 tCO2e. Clean electricity, the third pillar of the strategy, offsets the emissions left over after all efficiency improvements have been carried out.

[11] IESO, 2019 Year in Review. Retrieved on Sept. 2, 2020, from: www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data.

[12] IESO, Annual Planning Outlook (January 2020).

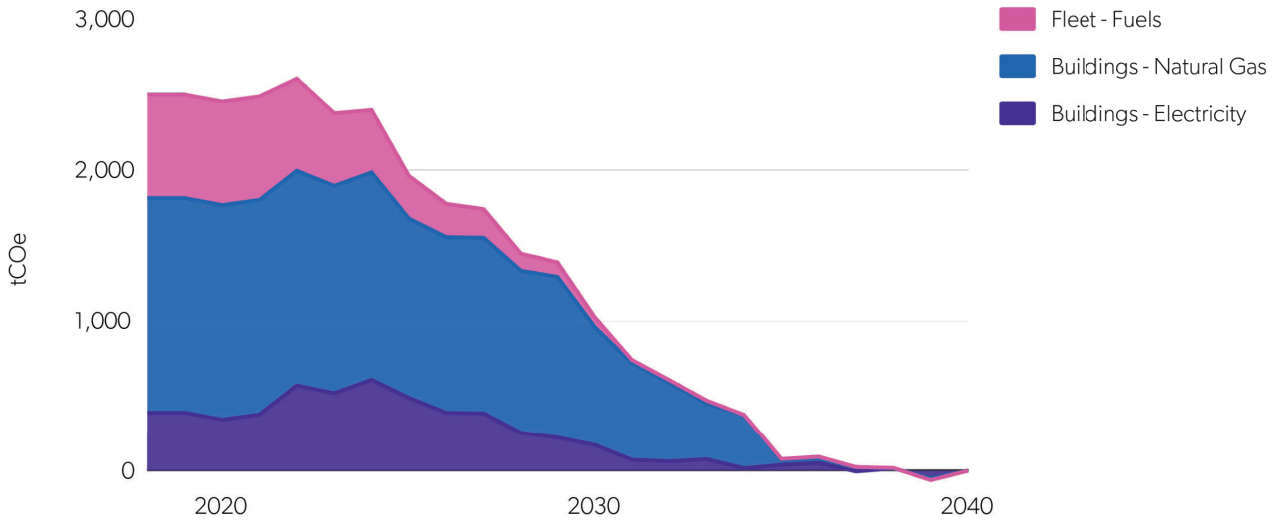

Figure 15. GHG emissions of buildings and fleet (tCO2e) with renewable energy generation, Net-zero scenario, 2018-2040.[13]

Clean Electricity

Clean electricity is a key part of the path to decarbonizing the City's operations.

To reach Orillia's target of net-zero corporate emissions, the City will need to either generate or purchase 6 MW of renewable energy by 2030, and then as much as 8MW by 2040. The steady increase between now and 2040 reflects increases in electricity demand as the City retrofits buildings and buys electric vehicles for its fleet.[14]

Clean Electricity

By 2040, the City will develop the capacity to generate 6–8 MW of renewable energy, or engage in another strategy to purchase renewable energy and/or its benefits.

[13] The small dip below zero near 2040 is a result of the staggered building retrofit schedule. As buildings are retrofitted, they over-correct, and when their systems come back online they begin to use electricity and contribute emissions.

[14] The wastewater treatment plant is not included in this analysis as biogas capture from the treatment plant itself would be a more applicable source of clean energy.

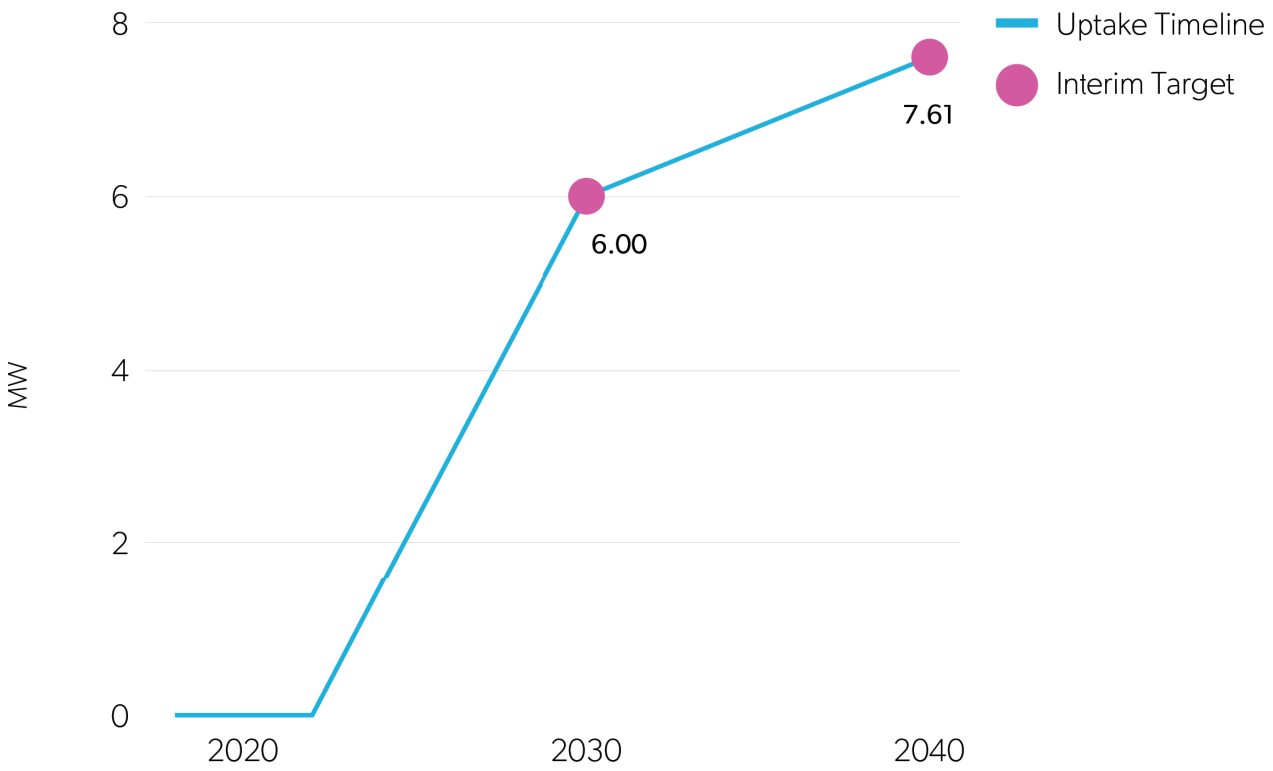

Figure 10. Suggested renewable energy targets.

There is an advantage to developing solar PV in that extra electricity can be sold for revenue. Installing solar PV can also buffer peak demand for electricity during day-time periods. As of now, the Ontario electricity grid meets Orillia's peak demand, and Ontario's electricity grid relies on its high-emitting gas plants to generate that extra power.

However, the policy framework needed to operate such a scheme is not currently in place. Ontario's "Feed-in-Tariff" (FIT) program, where extra electricity could be sold back to the grid, is currently on hold.[15]

That said, Ontario's net metering program could allow extra electricity to be fed back into the grid in exchange for a credit on the City's electricity costs.

Given this context, there are four strategies that the City can consider to either produce or purchase the clean electricity needed to reach the target.

Strategy 1. Local Generation

Local generation on municipal sites would provide the greatest financial and economic benefits for the community and the City. Local generation involves building and maintaining solar PV on roofs and other sites. Solar power does require an initial capital investment and its use is governed by provincial policy.

[15] "Feed in Tariff Program. Accessed 2021. Government of Ontario. Retrieved from: Archived - Renewable energy development in Ontario: A guide for municipalities: 4.0 Feed-In Tariff Program | Ontario.ca

Strategy 2. Advocacy for a Decarbonized Ontario Electricity Grid

At present, Ontario has no plans to decarbonize its electricity grid before 2030.[16] That said, many cities in Ontario have developed similar plans to decarbonize both their corporate and community operations and are advocating for a zero-emissions provincial electricity grid. It is possible that Ontario will phase out its gas plants by 2040, which would eliminate the emissions Orillia is responsible for when the City makes use of Ontario's electricity.

Strategy 3. Renewable energy certificates

Renewable energy credits (RECs) are a mechanism used to procure the clean attributes of renewable electricity that is being generated off-site. If the City finds that generating its own solar power is infeasible for logistical, financial, and/or policy reasons, then RECs could be used to offset the City's remaining corporate emissions. Examples of organizations that provide RECs in Ontario are Bullfrog Power and Blue Earth Renewables.[17,18]

Strategy 4. Power purchasing agreements (PPA)

A Power Purchase Agreement (PPA) is a mechanism to directly purchase electricity from an off-site provider. In this case, the desired energy would be renewable electricity. The City would have to investigate and/or create the policy conditions needed to develop a PPA. Orillia Power Generation could prove advantageous as it could enter into a PPA with a provider. Some cities have also established renewable energy cooperatives.

Investing in Orillia's Decarbonized Corporate Operations

Decarbonizing Orillia's buildings and vehicle fleet will cost money. As will investing in the development or purchase of renewable energy. However, these investments can be worked into the routine costs of operating buildings and maintaining vehicles. For instance, the City can incorporate retrofits into established building maintenance and upgrade plans, and gas vehicles can be swapped out for electric when they reach the end of their useful life.

Over the next twenty years, total investments into the decarbonization plan will cost roughly $53 million (in 2018 dollars). Though some years will see higher investments than others, particularly as large City buildings come up for retrofit, this total amounts to an average of $2.9 million per year. That said, as buildings are transitioned to electricity-powered heat pumps and as diesel and gas vehicles are phased out, the operating costs for these assets will actually decrease. After fuel cost savings and reduced carbon taxes[19], the total net investment drops to $27 million, or $1.5 million per year. Please note this assessment only takes into account Clean Electricity Strategy 1: Local Generation as it is the strategy over which the City would have the most financial control.

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[16] According to its October 2021 report, the IESO will not phase out its natural gas power plants before 2030. However, it has stated that given enough time and resources it would consider phasing them out at some point in the future. Source: Independent Electricity System Operator. (2021) Decarbonization and Ontario's Electricity System: Assessing the impacts of phasing out natural gas generation by 2030. Toronto.

[17] Power Purchase Agreements | Bullfrog Power

[18] Our Approach | BluEarth Renewables

[19] For more information on Canada's carbon pricing, see the Government of Canada's page on its carbon pollution pricing system.

For a comparison of investments and cost savings in five-year periods between now and 2040, see Table 1.

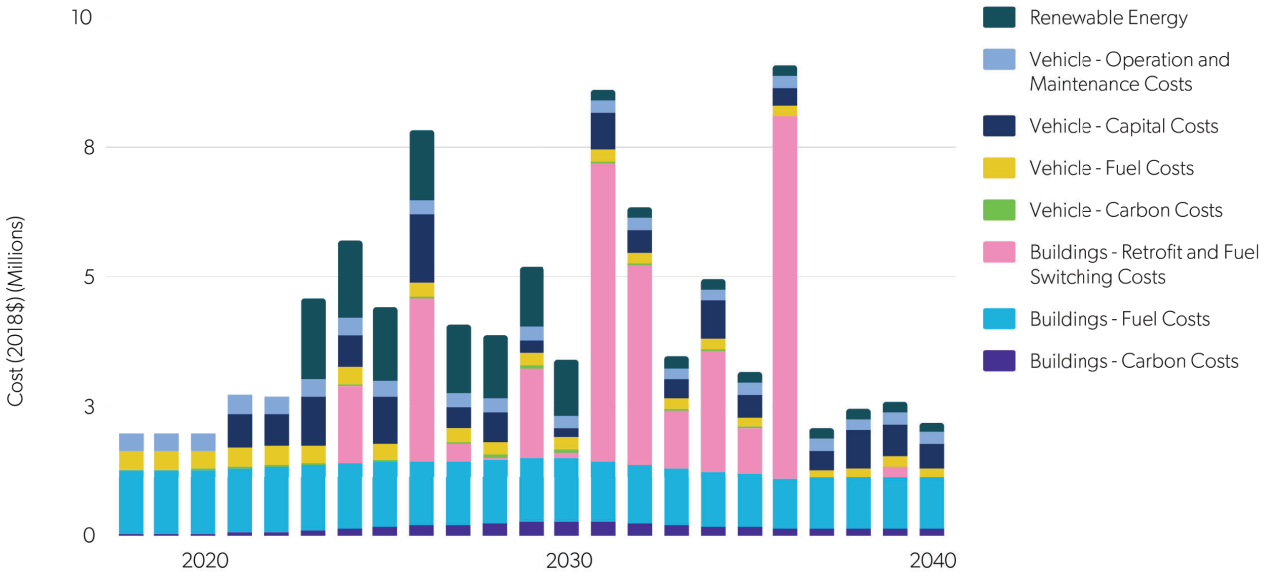

Figure 16. Costs by sector in 2018 Dollars, 2018-2040.

Table 1. Estimated total investment cost (2021-2040).

	2021-2025	2026-2030	2031-2035	2036-2040	Total
Twenty year investments (in millions, $2018)					
Buildings	4.6	7.9	15.2	0.2	27.9
Fleet	3.7	3.4	2.7	2.5	12.3
Renewable energy[20]	4.5	6.1	1.0	1.0	12.6
Total investment	53				
Fuel cost savings (in millions, $2018)					
Buildings	0.07	0.4	1.4	1.9	3.8
Fleet	0.25	1.2	1.8	2.1	3.6
Renewable energy	0.6	3.1	4.6	5.1	13.5
Total fuel cost savings	21				
Carbon cost avoided (in millions, $2018)					
Fleet and buildings	0.08	0.6	1.5	1.9	4.1
Renewable energy	.03	.3	.52	.65	1.5

[20] The total for fuel cost savings is high-level and does not account for the nuance of hourly electricity supply and demand. An analysis of this detail is outside the scope of this report.

	2021-2025	2026-2030	2031-2035	2036-2040	Total
Total carbon cost savings	5.6				
20-year transition total	27				

Financial Modelling

Table 2 breaks down the key financial items that have been modelled to arrive at these investment costs. Table 3 outlines what is not included and why. For an indepth look at key data points and assumptions used to develop the financial summary, see Appendix 4.

Table 2. Items included in the financial summary.

Asset	Expenditures
City buildings	Fuel costs Retrofit & fuel switching capital cost Carbon costs
Vehicle fleet	Fuel costs Vehicle capital costs Operations and maintenance costs Carbon costs
Renewable energy	Capital costs of solar PV generation

Table 3. Items not included in the financial summary.

Assets and investments	Rationale
Electric vehicle charging infrastructure	Charging infrastructure is often handled by a mix of private and public actors, so it is difficult to put a fixed price on its development.
Grid upgrades	The ability of the grid to incorporate these changes has not yet been evaluated.
Electricity storage equipment	The need for energy storage will depend on provincial energy policy and on the renewable energy generation approach that is chosen.
Evaluation of energy tariff structures (fixed costs vs variable costs; peak demand charges; etc)[21]	The future of the electricity tariff structure is uncertain and decided by political bodies that are beyond the scope of this report.
BAU building asset management capital costs	Routine costs of managing buildings that are not affected by the decarbonization plan have not been incorporated into the financial model.

[21] Energy costs are modelled using projected consumption and projected average energy prices.

Plan Limitations & Items Out of Scope

The quantitative analysis presented in this report is designed to support high-level strategic planning.

The likely impacts of the low-carbon pathway described in this corporate action plan are subject to a number of caveats. Financial costs and savings are, like so many municipal processes, subject to the uncertainties that come with long-term scenarios.

The analysis presented here is not an engineering study, which would likely be required as a subsequent step to inform many of the specific investments considered in this analysis.

That being said, the quantification of key variables, including energy consumption, GHG emissions, and selected financial flows (i.e. fuel costs, vehicle O&M costs, carbon costs, capital investments), acts as a guide in the City's efforts to reduce its corporate emissions, and can support subsequent decision-making processes for specific buildings and vehicles.

The following list identifies aspects of the plan that will need to be fine-tuned when the City approaches actions like specific building retrofits and vehicle purchases:

Buildings

A proposed retrofit schedule for the corporate building portfolio was developed in consultation with staff. As the city moves forward with implementation and more information becomes available, such as building energy audits, the schedule can be adapted accordingly.

The capital costs of building deep energy retrofits and fuel switches are estimated using high-level cost intensities (per floor area), without knowledge of specific building conditions, HVAC systems, asset management plans, etc. Refined retrofit costs will vary on a building-by-building basis, informed by building energy audits.

Building energy tariffs—the structures that natural gas and electricity utilities use to charge for the provision of energy—contain fixed and variable components. They can also depend on hourly demand patterns. Given the uncertainty of how these tariffs may evolve in the coming decades and the detailed analysis required to project hourly demand, this analysis uses a simplified energy consumption and average energy price approach to project energy costs.

This analysis holds climatic assumptions fixed over the time horizon considered, and does not reflect the trend of increasing cooling degree days and decreasing heating degree days.

Vehicles

Subsequent green fleet implementation plans will analyze the usage patterns of specific vehicle roles and match them with specific electric commercially-available offerings.

Conclusion

The Corporate Climate Action Plan is a viable pathway for Orillia to achieve net-zero GHG emissions by 2040 in terms of buildings, fleet, and energy generation. The driving force of this analysis is the recognition that climate change will dramatically change the quality of life for Orillia residents and businesses, while also recognizing that future generations and marginalized communities will endure greater effects of climate change.

The net-zero sectoral targets for buildings (2040), fleet (2030), and renewable energy generation (2040) are considered evidence-based targets that apply a carbon budget to ensure reductions are aligned on an appropriate downwards trajectory. The targets reflect an aggressive emissions reduction while also respecting staff and corporate capability to reasonably achieve the targets.

The financial summary indicates that the investment required to achieve the transition is challenging, but does result in positive co-benefits namely reduced fuel expenditures, reduced maintenance costs for fleet, and avoided cost of carbon pricing. Ensuring that the city financial budget is not overburdening the city financial budget and ensuring city employees and the public did not lose access to facilities was considered a priority in the transition of buildings.

Next Steps

The strategic-level analysis in this paper will need to be further substantiated by detailed analysis on a building-by-building level, more information on the availability of electric vehicles, and scoping of renewable energy generation opportunities. The guiding targets and analysis in the CAP will ensure that GHG emissions align with the decision making.

Suggested next steps:

6. Adopt a net-zero by 2040 target for corporate emissions.
7. Begin implementation planning by completing detailed analysis on buildings, fleet, and renewable energy to create a 4-year work plan in line with the city budget.
8. Identify financial instruments and grant money that can be available to help this transition.
9. Align targets and outcomes of the CAP for the Community Climate Action Plan (CCAP) for alignment.
10. Create a detailed implementation in the CCAP that further identifies corporate timelines.

Appendix 1: Glossary

Base year: the starting year for energy or emissions projections.

Biogas (renewable natural gas): methane captured from bacterial decomposition of sewage, manure, waste, plant crops, or other organic waste products. It can be used as a natural gas replacement.

Building retrofit: changes to the structure or systems of an existing building to achieve energy and water consumption reductions.

Business-as-usual (BAU): a scenario illustrating energy use and greenhouse gas emissions if no additional plans, policies, programs, and projects are implemented.

Capacity factor: the ratio of a power plant's actual output over a period of time to its potential output if it were possible to operate continuously over the same period of time.

Carbon dioxide equivalent (CO2e): a measure for describing the global warming potential of a greenhouse gas using the equivalent amount or concentration of carbon dioxide (CO2) as a reference. CO2e is commonly expressed as million metric tonnes of carbon dioxide equivalent (MtCO2e).

Cooling degree days (CDD): the number of degrees that a day's average temperature is above 18oC, requiring cooling.

Deep energy retrofit: a whole-building analysis and construction process minimizing building energy use by 50% or more compared to the baseline energy use.

Distributed generation: technologies that generate electricity on-site through solar photovoltaic (PV) systems, combined heat and power (CHP) systems, and/or other technologies.

District energy systems: provision of heating and/or cooling to multiple buildings from centralized energy systems.

Emissions: greenhouse gas emissions, measured in grams, kilograms, or metric tonnes (CO2e), unless otherwise indicated.

Emissions intensity: the ratio of emissions released per unit of electricity generated, measured in gCO2e/kWh.

Energy efficiency improvement: an improvement in the ratio of energy consumed to the output produced or service performed. This improvement results in the delivery of more services for the same energy inputs or the same level of services from less energy input.

Electric vehicles (EVs): an umbrella term describing a variety of vehicle types that use electricity as their primary fuel source for propulsion or as a means to improve the efficiency of a conventional internal combustion engine.

Energy storage: technologies that store energy for consumption at a later time. Energy storage includes electric systems such as batteries as well as thermal systems, such as hot and cold water storage tanks.

Feed-in-Tariff: A policy mechanism designed to accelerate investment in renewable energy technologies by offering long-term contracts to renewable energy producers. The energy produced is sold to the grid rather than consumed directly (termed, "net-metering").

Geoexchange energy: low-temperature thermal energy collected from soil and water near the

Earth's surface by heat pumps for use in building heating.

Geothermal energy: high temperature thermal energy collected from deep in the Earth for use in building heating and industrial applications.

Greenhouse gases (GHG): gases that trap heat in the atmosphere by absorbing and emitting solar radiation, causing a greenhouse effect that unnaturally warms the atmosphere. The main GHGs are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Heat pump: a device that transfers heat energy from a source of heat to a target area using mechanical energy.

Heating Degrees Days (HDD): number of degrees that a day's average temperature is below 18oC, requiring heating.

HVAC: heating, ventilation and air conditioning systems, referred to in the context of a building.

Indicator: an observable or measurable result that shows evidence of whether an impact has occurred and the nature of that impact. It provides a metric by which one can quantify and define the scale of a resulting change.

Net-metering: This is an electricity billing mechanism that allows consumers who generate some or all of their own electricity to use that electricity anytime, instead of when it is generated.

Passive House buildings: buildings designed and constructed to stringent standards resulting in up to 90% increased energy efficiency as compared to a typical buildings' energy use.

Re-commissioning: a process of examining and optimizing a building's HVAC systems after a building has been fully operational for a period of time.

Renewable energy: energy that comes from resources which are naturally replenished on a human timescale, such as sunlight, wind, moving water, and geothermal heat.

Solar photovoltaic (PV): also known as solar electric systems or solar panels, these are systems that convert sunlight into electricity. Any excess electricity produced that a building does not use can be sold to the utility through a process called net-metering.

Vehicle kilometres travelled (VKT): distance traveled by vehicles within a defined region over a specified time period.

GHG emissions	Energy
1 ktCO2e = 1,000 tCO2e	1 MWh = 1,000 kWh
1 tCO2e = 1,000 kgCO2e	1 MWh = 3.6 GJ
1 kgCO2e = 1,000 gCO2e	1 GJ = 278 kWh
	1 GJ = 1,000,000 J
	1 MJ = 0.001 GJ
	1 TJ = 1,000 GJ
	1 PJ = 1,000,000 GJ

Appendix 2: Orillia's Corporate Buildings Inventory

Table 1: Orillia's Corporate Buildings Inventory

#	Building Name	Primary Activity	Year of Retrofit
1	Barnfield Point	Recreation	2023
2	Brian Orser Arena	Recreation	2025
3	City Centre	Office	2031
4	Couchiching Park Concession (140 Canice St.)	Recreation/Concession	2025
5	Couchiching Park Greenhouse (140 Canice St.)	Recreation/Concession	2038
6	Couchiching Park Washroom (140 Canice St.)	Washroom	2038
7	Fire Hall 1	Office/ Operations	2028
8	Fire Hall 2	Office/ Operations	2026
9	Forest Home Community Centre (995 Memorial Ave)	Office / Recreation	2028
10	Homewood Park (68 Woodside Dr)	Utility Room	2025
11	Kitchener Park Washroom - Concession (25 Kitchener St)	Washroom	2025
12	Leacock Swanmore Hall (Café) (50 Museum Dr)	Public Facing / Recreation	2028
13	Leacock Swanmore Hall, Admin Office (50 Museum Dr)	Office	2028
14	Library - 36 Mississaga St	Public facing	2033
15	McKinnell Square Park – 135 Dunedin St.	Utility Room	2025
16	MOC - Admin / Garage (20 James St.W) (Public Works)	Operations	2025
17	MOC - Electrician / Storage (188 Jarvis St)	Utility Room	2025
18	Moose Beach Washroom (450Atherley Rd)	Washroom	2025
19	Museum (50 Museum Dr)	Office / Public	2028
20	Orillia Opera House (20 Mississaga St. W)	Public	2032
21	Parks -Garage/Equip Storage (30 James St.W)	Storage	2025
22	Port (6 Centennial Dr) (new May 2017)	Operations	2034
23	Regan House (Scouts Valley)	Recreation	2025
24	Rotary Place - Field Washroom (100 University Ave)	Washroom	2025
25	Rotary Place Arena (100 University Ave)	Arena	2030
26	Sir Sam Steele Bldg.	Public Recreation	2026

#	Building Name	Primary Activity	Year of Retrofit
27	Tudhope Park - Jerry Udell Wshrm and Rowing Club (450 Atherley Rd)	Washroom / Storage	2034
28	Tudhope Park Admin Bldg (450Atherley Rd)	Office	2025
29	WDS - Admin Office - NEW 2016 (100 Kitchener St)	Office	2025
30	WFP - Filter Bldg (188 Jarvis St) (Stripper/Air scrubber Bldg.) *	Operations	2029
31	WFP - Filtration Bldg (200BaySt)**	Operations	N/A
32	WFP - Generator Bldg (188JarvisSt)*	Operations	2029
33	WWTC - Admin Bldg (40 Kitchener St)**	Operations / Office	N/A

*These process buildings are mostly electric and a conservative 10% efficiency upgrade is considered alongside heat pumps for space heating of the buildings.

**The WWTP will be covered in greater detail in/fuel switching the Community Climate Action Plan and in consultation with the current and ongoing Wastewater Management Plan (2021).

Appendix 3: Energy and GHG transition (2018-2040)

Table A1.1. Emissions targets under a net-zero by 2045 pathway, in tCO2e.

	Net-Zero By 2040	Business as Usual
2018	2,429	2,429
2019	2,327	2,429
2020	2,226	2,499
2021	2,125	2,453
2022	2,024	2,492
2023	1,923	2,709
2024	1,822	2,727
2025	1,720	2,891
2026	1,619	2,896
2027	1,518	2,862
2028	1,417	2,920
2029	1,316	2,880
2030	1,214	2,918
2031	1,093	3,006
2032	971	2,967
2033	850	2,956
2034	729	2,975
2035	607	2,978
2036	486	3,008
2037	364	3,079
2038	243	3,092
2039	121	3,171
2040	0	3,157

Appendix 4: Summarized Financial Assumptions

Retrofit Cost Intensity for 50% retrofit intensity	
$ / sq. ft	50
Source: Frappé-Sénéclauze, T., Heerema, D., Tam Wu, K. (2017). Deep emissions reduction in the existing building stock. The Pembina Institute.https://www.pembina.org/reports/retrofit-strategy-bc-report-2017.pdf	

Cost Intensity of Heat Pump	
$ / sq. ft	Included in above figure
Source: Frappé-Sénéclauze, T., Heerema, D., Tam Wu, K. (2017). Deep emissions reduction in the existing building stock. The Pembina Institute.https://www.pembina.org/reports/retrofit-strategy-bc-report-2017.pdf	

Carbon Price																							
$/tonne CO2eq	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
	20	20	30	40	50	65	80	95	110	125	140	155	170	170	170	170	170	170	170	170	170	170	170
source:	Government of Canada. Greenhouse Gas Pollution Pricing Act																						
	Government of Canada. A Healthy Environment and a Healthy Economy. Backgrounder.																						

Electricity																							
$/GJ	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Commercial	27.78	27.78	28.34	28.48	28.62	28.78	28.92	29.06	29.20	29.35	29.51	29.65	29.79	29.83	29.86	29.88	29.93	29.95	29.97	29.99	30.04	30.06	30.09
source:	Base year informed by actual electricity bills; NEB Canada's Energy Future 2020, End - Use Prices, Reference Case																						
	*Linear extrapolation applied after 2040																						

Natural Gas																							
$/GJ	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Commercial	7.31	7.31	7.40	7.48	7.55	7.60	7.64	7.67	7.70	7.73	7.77	7.80	7.83	7.87	7.90	7.93	7.96	8.00	8.03	8.06	8.09	8.13	8.16
source:	Base year informed by actual NG bills; NEB Canada's Energy Future 2020, End - Use Prices, Reference Case																						
	Linear extrapolation applied after 2040																						