Town of Okotoks Greenhouse Gas Inventory Baseline

Okotoks
Historic Past, Sustainable Future

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Report prepared by

Firefly GHG consulting

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Executive summary

The 2018 Town of Okotoks Environmental Master Plan lays out a vision for how the Town will achieve environmental excellence over the coming decades. This includes a commitment for the community to achieve carbon neutrality by 2050 – a bold, ambitious target that puts Okotoks at the forefront of actions to reduce its climate impacts.

To achieve this target, the Town will need to develop a local emissions reduction action plan. For this action plan to be effective, it needs to be based on an understanding of current and projected future climate impacts.

The Town has therefore prepared this GHG inventory, which characterizes the magnitude of impacts from various activities, both as a municipal organization, and as a community as a whole. These are identified as the “corporate inventory”, which represents emissions from the Town’s municipal government operations, and the “community inventory”, which represents emissions from the residential, commercial, industrial and institutional sectors. The inventories have been prepared following the Partners for Climate Protection (PCP) 5-Milestone Framework, which represents good practice for the preparation of municipal-scale GHG inventories in Canada.

A baseline year of 2018 has been used, as this represents the year in which the Town’s Environmental Master Plan was published and the goal of achieving carbon neutrality was announced; this “baseline” represents the starting point against which Okotoks’ progress will be measured.

The corporate inventory for 2018 is 24,335 metric tonnes of carbon-dioxide equivalent (tonnes CO_2e). This includes emissions from municipally-owned buildings, streetlights, fleet, water and wastewater infrastructure, as well as a share of waste emissions from the regional landfill. The community inventory for 2018 is 379,747 tonnes CO_2e. This includes emissions from private residences, the industrial, commercial and institutional sector, and from transportation. Total emissions for Okotoks are therefore 404,082 tonnes CO_2e, or 13.93 tonnes CO_2e per resident.

A Business-As-Usual forecast of future emissions indicates that emissions are expected to increase with population and other major structural changes which the Town does not control. The population is expected to grow from its current size of 29,002 residents to reach 54,474 by 2050. The corporate and community inventories are projected to increase to 35,372 tonnes CO_2e and 504,802 tonnes CO_2e, respectively, in 2050, without further actions to curb GHG emissions.

The largest emitters in each corporate sector have been identified, as well as the Top 10 largest emission sources for the whole corporate inventory.

The Town now plans to work with stakeholders to develop a Municipal Climate Change Action Plan, which will outline specific strategies and actions the Town will take to reduce its corporate emissions and to support the community in reducing its emissions footprint. This process will take place during 2020 with the first Municipal Climate Change Action Plan scheduled to be completed and implemented in 2020.

1 Climate change and Okotoks

In 2018, the Town of Okotoks published its Environmental Master Plan (EMP), a 30-year visionary document for how the Town will deliver on its commitment to environmental excellence.

The EMP includes seven major action areas, which are:

- Ecosystems & Agriculture
- Land Use & Urban Design
- Energy, Emissions & Air Quality
- Waste Systems
- Water Systems
- Climate Adaptation and Resilience, and
- Fostering a Green Economy.

The issue of climate change is connected to each of these themes, but in terms of policy, the EMP's most important statement on climate change is in the Energy, Emissions & Air Quality action area, where the Town set the following target:

Achieve carbon neutrality by 2050.

This means the Town and the community will collectively reduce its net greenhouse gas emissions (GHGs) to zero, primarily through prevention and reduction of emissions of GHGs.

An ambitious, leading target, carbon neutrality is in line with recommendations from the Intergovernmental Panel on Climate Change's (IPPC), who have calculated that a 45% reduction in

What does "carbon neutrality" mean?

"Carbon neutrality" and "net zero emissions" are often used interchangeably. They do not mean that 0 emissions of GHG emissions can be released (which would be "absolute zero"). Rather, the terms acknowledge that carbon sinks, such as forests and industrial carbon capture solutions, which remove GHGs from the atmosphere, are also part of the solution to climate change. For example, if 100 tonnes CO_2e of GHGs are released into the atmosphere from fossil fuel combustion, but 100 tonnes CO_2e of GHGs are removed from the atmosphere by forests, this would be "carbon neutral" or "net zero".

GHG emissions is required by 2030, based on 2010 levels, and that "net zero" emissions must be achieved by 2050 in order to limit global warming to less than 1.5°C. This places Okotoks alongside leading countries such as New Zealand, Germany and the UK, as well as Canadian jurisdictions such as Vancouver and Toronto. Corporately, Amazon has committed to net zero by 2040, oilfield services provider Baker Hughes, has committed to cut its GHG emissions by 50% by 2030, and to reach net zero by 2050, and oil and gas major CNRL announced in 2019 that it will target net zero emissions also, though without a target year. Locally, the City of Calgary set a target of 80% reduction in GHGs from 2005 levels, by 2050. The Canadian government has also committed to an 80% reduction by 2050 (based on 2005 emissions levels).

This document – the Town of Okotoks Greenhouse Gas Inventory Baseline ('the Inventory') – is a critical part of the journey to carbon neutrality.

Climate Change 101 – Understanding Key Concepts

What are Greenhouse Gases (GHGs)?

Simply put, GHGs are gases that trap heat from the sun in the atmosphere. Utilizing the same process as a pane of glass in a greenhouse, they allow the sun's heat to enter the atmosphere but prevent a portion of that heat from escaping back into space.

The GHG that most people are familiar with is carbon dioxide (CO_2) – the gas that animals exhale as a waste product but that plants use to grow. Concentrations of atmospheric CO_2 are commonly measured and reported on at an international level. However, this is not the only GHG – there are seven that are typically reported on at an international and national level. Some occur as a result of both natural and artificial processes; others are entirely artificial. For example, CH_4 and N_2O are created as a by-product of fossil

Commonly reported GHGs

CO_2 - Carbon dioxide

CH_4 - Methane

N_2O - Nitrous Oxide

HFCs - Hydrofluorocarbons

PFCs - Perfluorocarbons

SF_6- Sulphur hexafluoride

NF_3 - Nitrogen Trifluoride

fuel combustion, and CH_4 is created when organic material decays in the absence of oxygen, such as in landfills, and when cattle digest food (a process known as “enteric fermentation”). HFCs and PFCs are synthetic gases which commonly occur in refrigeration, air conditioning and fire suppression systems. SF_6 and NF_3 are other manufactured gases, usually only found in industrial applications – for example, SF_6 is used as an anti-arcing agent in high-voltage electricity transmission equipment and NF_3 is used in the manufacture of many electronics.

What is Climate Change and what are its impacts?

Without GHGs, the Earth would be a much colder and very inhospitable place; equally, with too many GHGs, the Earth would be a much hotter and very inhospitable place.

Since the advent of the industrial revolution, society has combusted vast quantities of fossil fuels (such as oil, natural gas and diesel). Fossil fuels are stores of dense, carbon-based energy. Burning these fuels releases that energy, which can then be used to heat homes, power industries and transform transportation infrastructure. However, this also causes carbon to be released into the atmosphere. While fossil fuels are not the only human-induced contributor to climate change (others include, for example, land-use change and waste disposal), combustion emissions account for 74% of Canada’s overall emissions.

Since 1750, the concentration of atmospheric carbon has increased by 45% according to the World Meteorological Organization (WMO). It is now at a higher concentration than at any point in the last 800,000 years – when global temperatures were 2-3°C higher and sea levels 10-20 meters higher. As a consequence, the planet is warming up and is now warmer than at any point in the last 10,000 years. The Federal Parliament in Canada declared climate change a "national emergency" on June 18, 2019. Many other Canadian jurisdictions have done the same, such as Edmonton, Ottawa, Victoria, Vancouver and Canmore.

How is Climate Change likely to affect Okotoks?

Annual temperatures are expected to increase, to the point where Okotoks' climate in 2050 will be equal to today's climate in Great Falls, Montana – a city 500km south of Okotoks. Precipitation is also expected to increase, though not equally throughout the year, and overall available moisture levels will fall as the increased temperature leads to additional evaporation. This rapid change to the local climate will stress native ecosystems and is likely to lead to changes such as reducing wetland area and depth, and forests being replaced by grasslands.

The region will benefit from a longer growing season as a result of the increase in annual temperatures. Although annual heating demands will fall, annual cooling demands will increase.

Future climate effects and some of the key risks from climate change can be characterized as follows:

Hotter, dryer summers, which will increase the risk potential for:

- Summer droughts and wildfires, impacting agricultural productivity and increasing risk to life and property;
- Severe summer thunderstorms, which will lead to increased risks of damage from hail, flash flooding and potentially tornados;
- Direct health-related risks (such as heat stroke) and indirect health-related risks (such as respiratory distress from airborne smoke due to longer and more severe forest fire seasons);
- Increased summer electricity prices, and possibly even electricity brownouts, as peak summer energy loads increase in line with building cooling demands;
- Increased stress on water supplies as summer flow to reservoirs drops and losses from evaporation increase while demand for water for landscaping and agriculture simultaneously increases with the higher temperatures.

Warmer, wetter springs and winters, which will increase the risk potential for:

- Increased activity of pest and invasive species, posing risks to natural and agricultural

ecosystems;

- Increased risk of flooding;
- Reduced snow and ice cover, impacting winter recreational activities such as skiing and ice-fishing.

A comprehensive analysis of how climate change is likely to affect Okotoks has already been completed and is presented in our Town of Okotoks Climate Resilience Express Action Plan, March 2018.

What is a Global Warming Potential (GWP)?

With many GHGs to consider, how can resources be properly directed for greatest effect? How can the effects of different gases be compared? The answer is by using a value called a Global Warming Potential (GWP), which works in a similar fashion as currency exchange rate. Imagine a wallet with three currencies in it – such as Canadian dollars, US dollars and Mexican Pesos. To calculate the total value of the money in it, you would select the currency you want to express that value in (i.e. Canadian dollars), and then use the exchange rate to convert the currencies into that single, common currency.

GWPs work the same way. Each GHG has a scientifically developed GWP value and multiplying the mass of any GHG by its GWP allows scientists and policymakers to equate different GHGs in the common unit of metric tonnes of carbon dioxide equivalents (tonnes CO_2e).

GWP values are essentially a combination of two important characteristics of any GHG: one, its radiative forcing impact, and two, its longevity. Radiative forcing is a measure of how much heat the GHG traps in the atmosphere. Longevity refers to the length of time the GHGs persist in the atmosphere. Some continue for only a few years while others may persist for hundreds (or even thousands) of years before being broken down or absorbed by natural processes. A GWP value melds these two characteristics to indicate how potent a particular GHG is over a defined period of time (usually 100 years), with all gases being compared against carbon dioxide, which is given a GWP of one.

How GWPs work

Industrial Site A emits 10,000 tonnes of CO_2 in a year, but only 1 tonne of SF_6. The GWP of CO_2 is 1 but the GWP of SF_6 is 23,900. Thus, the site actually emits:

(10,000 tonnes CO_2 * 1) + (1 tonne SF_6 * 23,900) = 33,900 tonnes CO_2e.

As such, reducing or removing the source of SF_6 emissions would have a much larger impact on Industrial Site A's carbon footprint than tackling direct releases of CO_2.

2 What is the greenhouse gas inventory?

Okotoks has established itself as a leader in the area of climate change mitigation by setting a target of "net zero" GHG emissions by the year 2050. However, this target can be compared to the finish line in a race - to get to the finish line, a runner needs to know how long the race is, and what routes can be taken to get there. In other words, the Town needs to understand how big its current climate impact is, what is causing that impact, and whether or not those impacts are caused by activities over which it has direct control or influence.

Completing a greenhouse gas inventory, which catalogues and quantifies emission sources in Okotoks in a structured, disciplined manner, allows the Town can identify what is within its control.

This inventory will allow Okotoks to plan emission reduction activities – such as energy efficiency, clean energy and advanced waste management – that make sense in the local context. Interim targets will be set based on the baseline, and changes from year to year can be compared in order to monitor progress.

The Partners for Climate Protection (PCP) 5-Milestone Framework

The Town has been a member of the Partners for Climate Protection (PCP) Program, which has developed a compehensive 5-Milestone Framework for climate change action planning, since 2010. This framework is the Canadian component of ICLEI's

global Cities for Climate Protection (CCP) campaign. ICLEI is an international organization representing and supporting local governments for sustainability across the world. Over 350 Canadian municipalities are already participating in PCP, including Calgary, Edmonton, Lethbridge, Cochrane, Canmore, Banff and others in Alberta. The 5 Milestones are:

- Milestone 1: Create a Baseline Emissions Inventory and Forecast
- Milestone 2: Set Emissions Reduction Targets
- Milestone 3: Develop a Local Action Plan
- Milestone 4: Implement the Local Action Plan
- Milestone 5: Monitor Progress and Report Results

This inventory covers both Milestone 1 and Milestone 2, and has been developed using the following methodology documents:

- International Local Government Emissions Analysis Protocol (IEAP), Version 1.0 October 2009;
- PCP Protocol: Canadian Supplement to the International Emissions Analysis Protocol, and
- ISO 14064-1:2019 (which is the international standard for greenhouse gas emissions inventories).

By following this framework, the Town is ensuring that its inventory is: following international best practices; high-quality and credible, and broadly comparable to other Canadian municipalities using the same framework.

As previously mentioned, there are many types of greenhouse gas. This inventory focuses on the three most relevant to Okotoks: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). These are by-products of combusting fossil fuels – such as natural gas, oil or gasoline – and methane is also produced when organic material decomposes in a landfill. In addition, some hydrofluorocarbons (HFCs) – which are used in commercial building cooling systems – are included.

The PCP framework splits reporting into two sections: a “corporate” inventory, which considers the emissions from the Town’s municipal government operations; and a “community” inventory, which considers emissions from private citizens, businesses, institutions and industries.

The Corporate Inventory

The PCP framework requires that the Town report its own operational footprint following the principle of “operational control”. This means the corporate inventory must include both GHG emissions that it owns and those it does not own, but where it has the authority to implement changes to operational and environmental policies.

The PCP framework also requires the Town to report on emissions from contracted services that are “a traditional local government service”.

Using the PCP framework, the corporate inventory includes five mandatory sectors and one voluntary sector.

Buildings and Facilities

18 fully Town-owned buildings are included in the inventory. In addition, the Town reports half of the emissions from the Crescent Point Field House and Champion Park, as it is a 50% owner of each.

GHG emissions from this sector come from natural gas for building space heating and hot water, electricity for lighting and power, diesel for emergency generators and leakage of refrigerants from building cooling systems.

Town Buildings

8 McCrae Street Commercial - Champion Park (50%) - Crescent Point Field House (50%) - Dawgs Stadium - Drake Landing Energy Centre - Eco Centre - Fire Hall - Foothills Centennial Centre - Library - Municipal Centre - Museum & Archives - Okotoks Art Gallery - Okotoks Performing Arts Centre - Okotoks Recreation Centre - Operations Centre Administration and Fleet Building - Operations Shop - Pason Centennial Arena - Southridge Emergency Services - Southside Community Programs - Stockton Block

Solid Waste

Waste in Okotoks is sent to the Foothills Regional Landfill & Resource Recovery Centre (LRRC), which is operated by the Foothills Regional Services Commission (FRSC), jointly owned and operated by:

- Town of Okotoks
- Foothills County
- Town of High River
- Town of Black Diamond
- Town of Nanton
- Town of Turner Valley

Emissions from this source have been included in the corporate GHG inventory relative to the Town’s proportion of ownership of the FRSC, which is equally split (16.67 %) between the six partners.

GHG emissions from this sector come mainly from decomposing organic matter in the landfill. In anaerobic conditions (without oxygen) decaying organic matter produces methane, which is a potent GHG, and a small volume of N_2O. CO_2 emissions associated with decaying organic matter are considered to be biogenic (i.e. part of the natural carbon cycle), and therefore are not included in the GHG inventory. Emissions from this sector include the total methane and nitrous oxide generated in 2018 from all waste ('waste-in-place') at the LRRC.

Water and Wastewater

A variety of infrastructure is required to provide clean water to the town, and to properly dispose of wastewater. This includes a Water Treatment Plant, a Sewage Treatment Plant, and a variety of ancillary infrastructure such as lift stations, booster stations and reservoirs and wells. 20 accounts are included in this Sector.

GHG emissions from this sector come from electricity required for pumps, motors, lighting, etc. and from natural gas consumed for ancillary heating.

Street Lighting and Traffic Signals

This sector includes all of the street lights in Okotoks, as well as other lights such as park lighting, traffic lights and miscellaneous power sources such as the Clock Tower and the Westmount Fountain. A total of 38 individual lighting accounts are included in the inventory. GHG emissions from this sector come from the consumption of electricity.

Fleet Vehicles

The Town operates a variety of different vehicles and mobile equipment, which are used for many purposes, such as parks maintenance, snow-clearing and garbage collection. There are additional vehicles that are not currently owned or operated by the Town, including Green for Life (GFL) (the Town's composting contractor), EPCOR (the Town's current water contractor), and the Foothills Regional Services Commission (FRSC) (the landfill operator). However, in line with the PCP framework, emissions from these fleets are included as these organizations are providing services that would otherwise be provided by a municipality (organics collection, water management services, and landfill operation). Twelve fleets are included in the corporate inventory.

Town Fleets

Community Services - EPCOR (Water) - Facilities Maintenance - Fire - FRSC - GFL - Municipal Enforcement - Parks - Recreation Centre - Town - Transportation - Waste Management

Note that the EPCOR Fleet vehicles are currently owned and operated by the water management contractor (EPCOR). This municipal service is being transitioned back to full municipal ownership during 2019 so, in future

inventory years, the EPCOR Fleet may be referred to as the Water fleet.

As well, one-sixth of the emissions associated with the FRSC vehicles are included in the Town's corporate inventory in alignment with the Town's proportion of ownership.

GHG emissions from this sector come from gasoline and diesel combustion in vehicle engines and other equipment such as snow-blowers.

Commuting

The Town has also chosen to quantify commuting as an additional sector on a voluntary basis. Employees must travel to/from work and a commuting survey was conducted in 2019 to gather information on the mode of transport used and the distances travelled by staff. Emissions from this sector come from gasoline and diesel combusted in vehicles including cars, motorcycles and buses.

The Community Inventory

The community inventory covers three sectors: Transportation, Residential and ICI (Industrial, Commercial and Institutional)

To ensure that we respect the privacy of residents and businesses, no individual accounts were identified for the community inventory and data was collected in aggregate for each sector.

Note that community waste emissions are included in the corporate waste sector as the Town is a part-owner of the landfill.

Transportation

Transportation includes private vehicles owned by residents, businesses and institutions in Okotoks. This is mainly a variety of cars and trucks. However, the Okotoks Air Ranch is a small airport that is also included in our inventory. No emissions from rail travel have been included as there are no rail stops within the municipal boundary. GHG emissions from this sector come from gasoline, diesel and aviation gasoline ('avgas').

Residential

In 2018, the municipal census indicated that Okotoks had a population of 29,002. GHG emissions from this sector come from natural gas used for heating and hot water, and from electricity used for lighting and power. Emissions from other sources, such as propane for BBQs or refrigerant leakage from household air-conditioning, were not quantified due to difficulties in gathering data, but these are thought to be small sources of emissions. Future inventories may include these or other sources if appropriate data can be sourced.

Industrial, Commercial and Institutional (ICI)

This sector includes all buildings and

facilities in the community that are not residential, such as schools, healthcare facilities, retail, light industry, etc. Due to data limitations, most of this sector is presented in aggregate. If better data becomes available in the future, it may be possible to separate industrial, commercial and institutional uses. GHG emissions from this sector come from natural gas used for heating and hot water, and from electricity used for lighting and power; as with the residential sector, emissions from sources such as refrigeration were not quantified due to data limitations.

The Baseline Year

The baseline is the first year of the inventory – the "starting line" that future years' inventories will be compared against. The Town has set 2018 as the baseline year to correlate with the publication of the Environmental Master Plan (EMP) which set the target for net zero footprint by 2050.

All data for the baseline is for 2018, with the following exceptions:

- The Okotoks Air Ranch – data was from 2017 as the Air Ranch did not operate in 2018;
- Town commuting data – data was from 2019 as this was the first year the commuting survey was completed.

3 Baseline results: the Okotoks carbon footprint

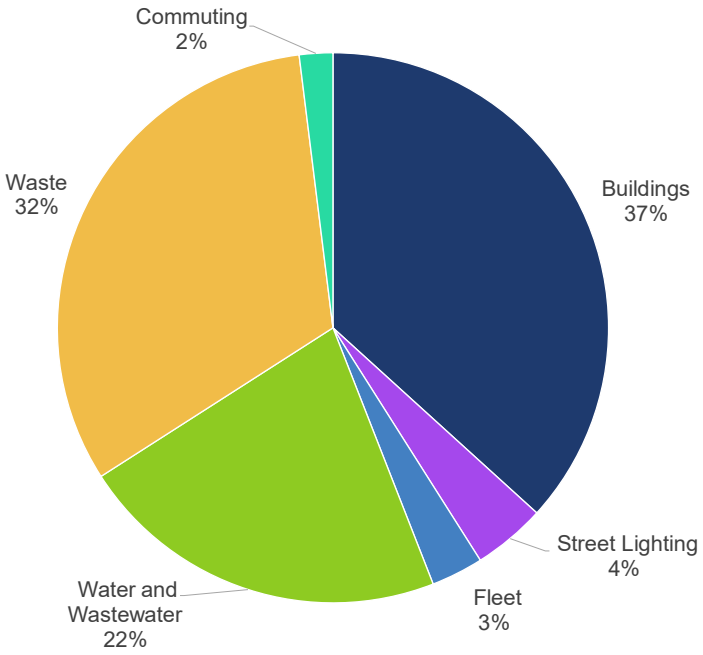
The baseline year carbon footprint is 404,082 tonnes CO_2e. This is composed of 24,335 tonnes CO_2e from the corporate inventory, and 379,747 tonnes CO_2e from the community inventory. The corporate inventory represents approximately 6% of the total inventory, with the remaining 94% coming from community sources. With 29,002 residents, this results in an overall carbon footprint of 13.93 tonnes CO_2e/person.

What is contributing to this carbon footprint? The following sections break down the inventory into more detail, considering emissions by sector, source and gas species, as required by the PCP.

Inventory by sectors

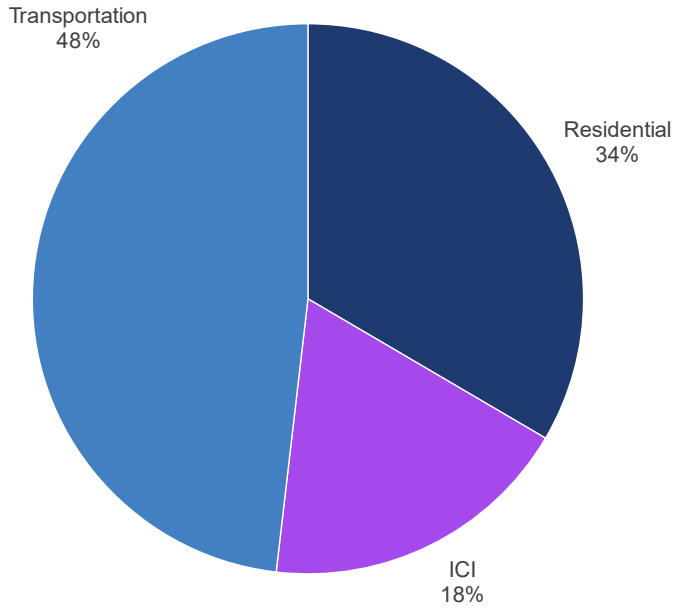
Figure 1 shows the corporate inventory breakdown by sector. Within the corporate inventory, buildings and waste are the two largest emission sources, making up 37% and 32% of its emissions profile. Water accounts for another 22%, so these three sectors are responsible for 91% of corporate emissions.

Figure 2 illustrates the breakdown for the community inventory. Transportation emissions are the largest source, at almost half of the community emissions released. The residential sector comprises another third of the inventory, with the ICI sector making up the remaining fifth.



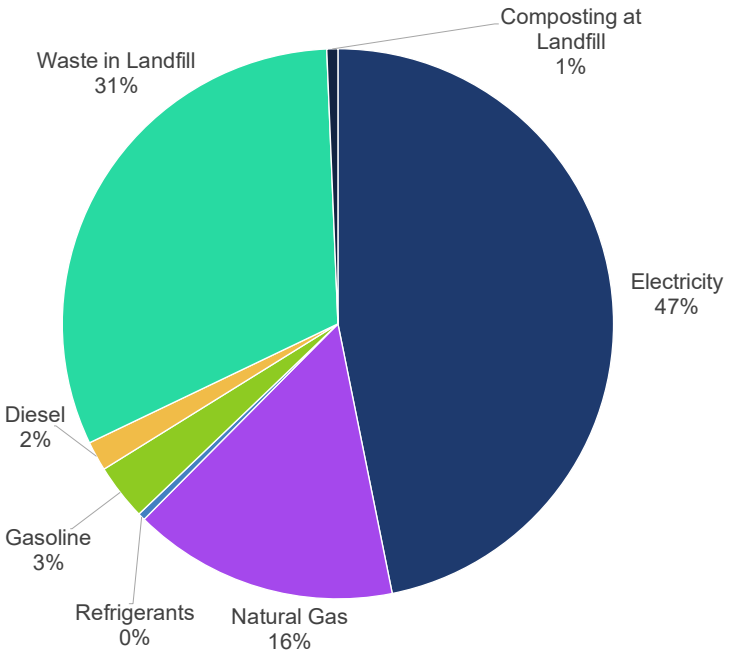
Sector	GHG Emissions (tonnes CO_2e)
Buildings	8,943
Waste	7,816
Water & Wastewater	5,315
Street Lighting	1,040
Fleet	743
Commuting	477
TOTAL	24,335

Figure 1 - Corporate GHG Emissions by Sector (tonnes CO_2e)



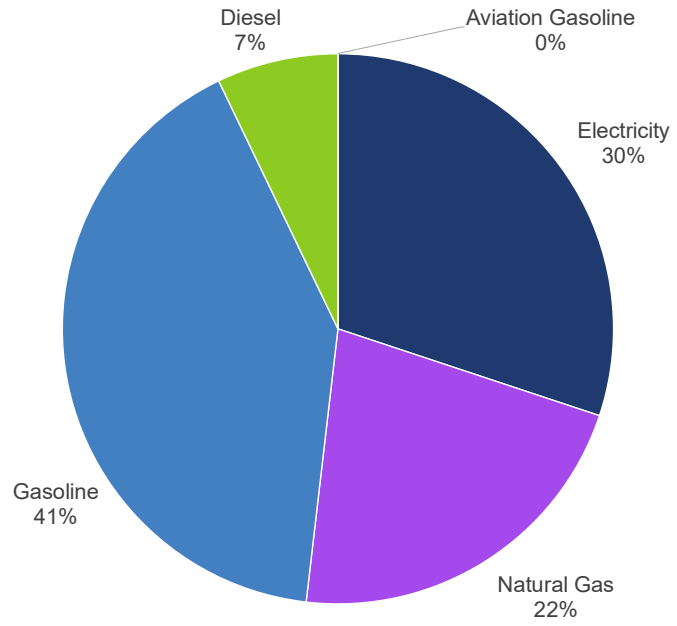
Sector	GHG Emissions (tonnes CO_2e)
Transportation	182,879
Residential	127,046
ICI	69,822
TOTAL	379,747

Figure 2 - Community GHG Emissions by Sector (tonnes CO_2e)



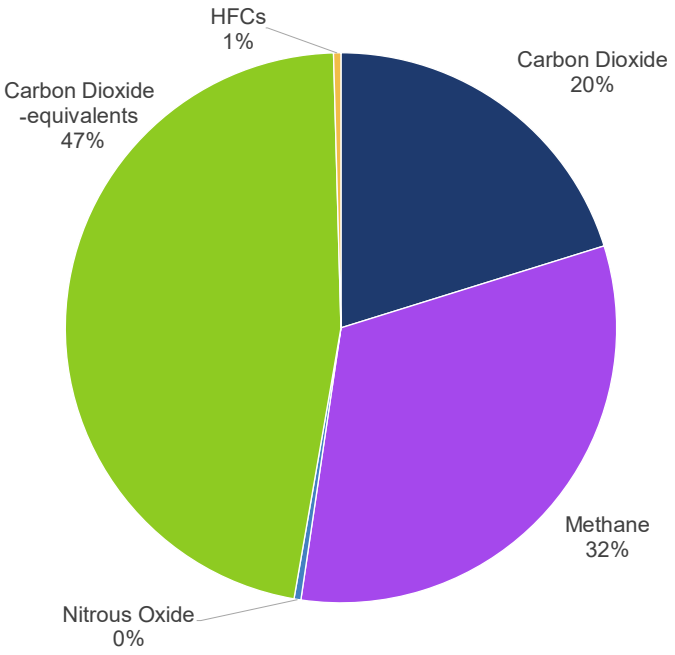
Sector	GHG Emissions (tonnes CO_2e)
Electricity	11,399
Waste in Landfill	7,658
Natural Gas	3,789
Gasoline	802
Diesel	424
Composting at Landfill	158
Refrigerants	105
TOTAL	24,335

Figure 3 - Corporate GHG Emissions by Source (tonnes CO_2e)



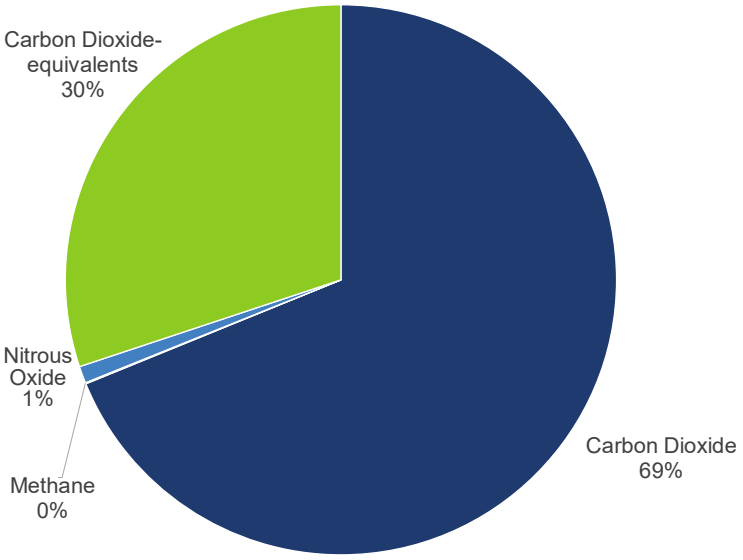
Sector	GHG Emissions (tonnes CO_2e)
Gasoline	155,830
Electricity	114,342
Natural Gas	82,526
Diesel	27,025
Aviation Gasoline	23
TOTAL	379,747

Figure 4 - Community GHG Emissions by Source (tonnes CO_2e)



Sector	GHG Emissions (tonnes CO_2e)
Carbon Dioxide-equivalents	11,399
Methane	7,821
Carbon Dioxide	4,913
HFCs	105
Nitrous Oxide	98
TOTAL	24,335

Figure 5 - Corporate GHG Emissions by GHG Species (tonnes CO_2e)



Sector	GHG Emissions (tonnes CO_2e)
Carbon Dioxide	261,377
Carbon Dioxide-equivalents	114,342
Nitrous Oxide	3,786
Methane	242
TOTAL	379,747

Figure 6 - Community GHG Emissions by GHG Species (tonnes CO_2e)

Inventory by sources

Another way of looking at a GHG inventory is to consider the sources of emissions. For example, consider whether emissions are coming mostly from electricity, natural gas or waste disposal. **Figure 3** and **Figure 4** show the source-by-source breakdown for the corporate and community inventories.

Corporately, three emission sources are significant: electricity (47%), waste decaying at the FRSC landfill (31%) and natural gas use (16%). Combined, these three sources account for 94% of the carbon footprint.

For the community inventory the largest emission source is gasoline (41%), followed by electricity (30%) and natural gas (22%) with diesel comprising another 7% of community emissions.

Inventory by gas species

A third way of looking at the inventory is to consider it by GHG species i.e. the type of gases being emitted. As shown in **Figure 5**, releases calculated directly as CO_2e (which, in this case, come from electricity) are the largest source, corporately. Methane is also a significant release as it is released by waste in the landfill site.

In the community, almost all emissions are in the form of CO_2 (or CO_2e), which is the principal component of fossil fuel (gasoline, natural gas, diesel and aviation gas) combustion. This is shown in **Figure 6**.

Corporate Inventory

Buildings

Operating municipally-owned buildings resulted in 8,943 tonnes of CO_2e being released in 2018 and was the largest emissions source in the corporate inventory. Of this, around two-thirds came from electricity and one-third from natural gas, as shown in **Figure 7**.

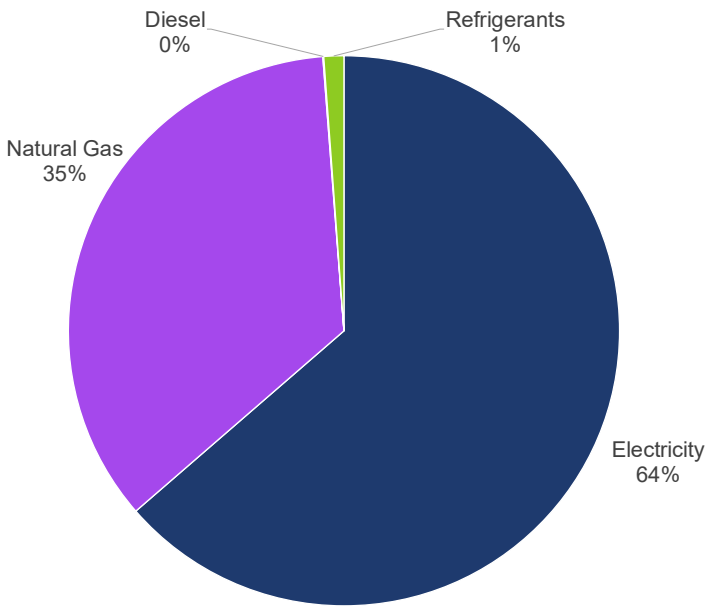
Over three-fifths of these GHG emissions come from just two buildings: the Okotoks Recreation Centre and the Pason Centennial Arena. **Table 1** lists the top five buildings that account for 83% of GHG emissions from this sector.

Waste Management

Despite the Town sharing landfill emissions with five other partners, Okotoks' share of emissions from the waste sector made it the second largest corporate sector, at 7,816 tonnes CO_2e in 2018. Emissions at the LRRC mainly come from decomposing organic matter in the landfill which, in the absence of oxygen, breaks down to produce large volumes of methane, making up 98% of emissions from this sector. A smaller source of emissions at the site is the on-site composting activity. Composting produces a small amount of methane and nitrous oxide as the organic material breaks down. This was responsible for the other 2% of emissions from this sector.

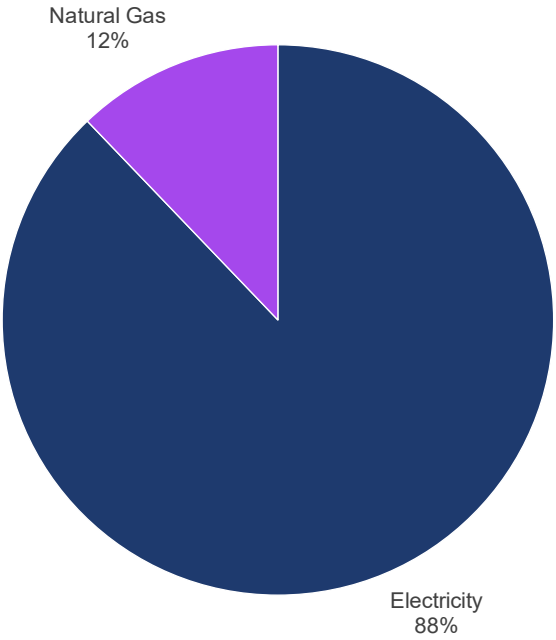
Water and Wastewater Treatment

The water and wastewater infrastructure resulted in 5,315 tonnes of CO_2e in 2018. This is the third



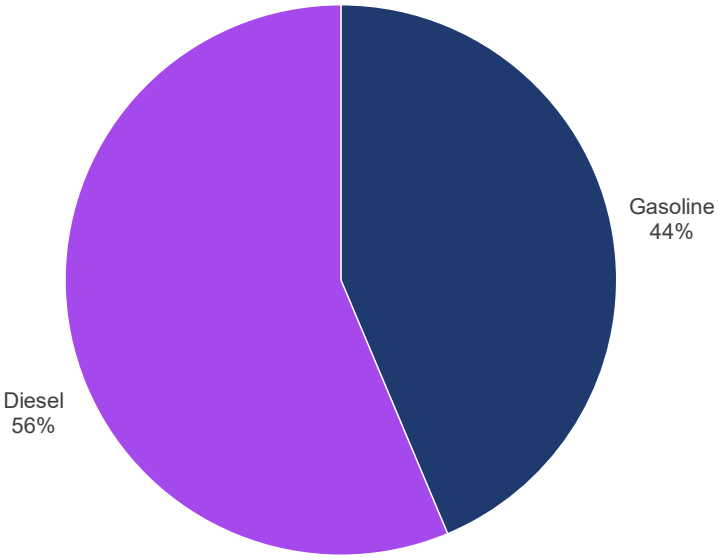
Sector	GHG Emissions (tonnes CO_2e)
Electricity	5,690
Natural Gas	3,144
Refrigerants	105
Diesel	5
TOTAL	8,943

Figure 7 - GHG Emissions by Energy Source, Buildings (tonnes CO_2e)



Source	GHG Emissions (tonnes CO_2e)
Electricity	4,669
Natural Gas	646
TOTAL	5,315

Figure 8 - GHG Emissions by Energy Source, Water & Wastewater (tonnes CO_2e)



Source	GHG Emissions (tonnes CO_2e)
Diesel	419
Gasoline	325
TOTAL	743

Figure 9 - GHG Emissions by Energy Source, Fleet (tonnes CO_2e)

Table 1 - Top 5 GHG Emitters, Buildings

Building	GHG Emissions (tonnes CO_2e)	% Of Sector
Recreation Centre	3,337	37%
Pason Arenas	2,735	31%
Cresent Point Field House	526	6%
South Ridge Emergency Centre	432	5%
Operations Centre	424	5%
TOTAL	7,454	83%

Table 2 - Top 5 GHG Emitters, Water & Wastewater

Facility	GHG Emissions (tonnes CO_2e)	% Of Sector
Wastewater Treatment Plant	2,804	53%
Water Treatment Plant	1,235	23%
West Well Field - Pump Station	462	9%
Zone 2 North Reservoir	285	5%
Zone 3 Reservoir	149	3%
TOTAL	4,935	93%

largest corporate sector. Most of these emissions came from electricity consumption, as shown in **Figure 8**.

As with the Buildings sector, most of these GHG emissions come from just two buildings: the Wastewater Treatment Plant and the Water Treatment Plant. **Table 2** lists the top five buildings that account for 93% of GHG emissions from this sector.

Street Lighting, Traffic Lights & Other Lighting

This Sector released 1,040 tonnes of CO_2e in 2018 and was the fourth largest corporate sector. Although there are 38 individual accounts in this Sector, almost all lighting in Okotoks is included in an account called "All Street Lights". This is responsible for 83%, or 865 tonnes CO_2e, of GHG emissions from this sector. Various traffic lights, park lights and other miscellaneous accounts represent the other 17% of emissions from this sector.

Fleet

This Sector released 743 tonnes of CO_2e in 2018 and was the second smallest corporate sector. **Table 3** shows the largest five fleets that account for 81% of emissions from this sector. Around three-fifths of emissions resulted from diesel combustion and the other two-fifths from gasoline combustion, as shown in **Figure 9**.

Commuting

As of August 2019, the Town employed 265 staff. A voluntary commuting survey was completed by 124 employees. This simple survey asked employees how far they travelled to work, what mode of transport they used and how many days a week they used a particular mode. Employees were also asked to identify if they used a different mode of transport on a seasonal basis.

Table 3 - Top 5 GHG Emitters, Fleet

Fleet	GHG Emissions (tonnes CO_2e)	% Of Sector
Waste Management	186	25%
Parks	141	19%
Transportation	119	16%
FRSC	93	12.5%
Fire	61	8%
TOTAL	601	81%

Adjusting for those employees who did not complete the survey, the Town estimates that 477 tonnes CO_2e was released from this sector, or 1.8 tonnes CO_2e/employee.

As **Table 4** shows, the total annual distance travelled by our employees was almost 1.8 million km, of which 98.5% was travelled by car or motorbike, with only 1.5% being travelled by bicycle or by foot.

Largest Emission Sources

Table 5 lists the ten largest emission sources for the Town of Okotoks. Collectively, these account for 85% of corporate emissions.

Table 4 - Distance Travelled by Mode,

Mode	Annual km travelled	%
Car - solo	1,652,503	92.0%
Car - carpool/shared	103,627	5.8%
Motorcycle	14,120	0.8%
Bicycle	19.022	1.1%
Walking	6,465	0.4%
Bus	0	0%
TOTAL	1,795,737	100%

Just ten sources make up 85% of the corporate emissions inventory

Table 5 - Top 10 GHG Emitters, Corporate Inventory

Source	GHG Emissions (tonnes CO_2e)	% Of Inventory
Methane from Landfill	7,816	32%
Okotoks Recreation Centre	3,337	14%
Wastewater Treatment Plant	2,804	12%
Pason Centennnial Arena	2,735	11%
Water Treatment Plant	1,235	5%
Street Lights	865	4%
Crescent Point Field House	526	2%
Employee Commuting	477	2%
West Well Field - Pump Station	462	2%
Southridge Emergency Services	432	2%
TOTAL	20,691	85%

Community Inventory

Transportation

Community transportation represented the largest sector in the community inventory and included all gasoline and diesel fuel purchased from fueling stations within the Okotoks' borders. On an emissions basis, 155,830 tonnes or 85% of the sector total are from gasoline combustion and 27,025 or 15% are from diesel combustion. This is shown in **Figure 10**.

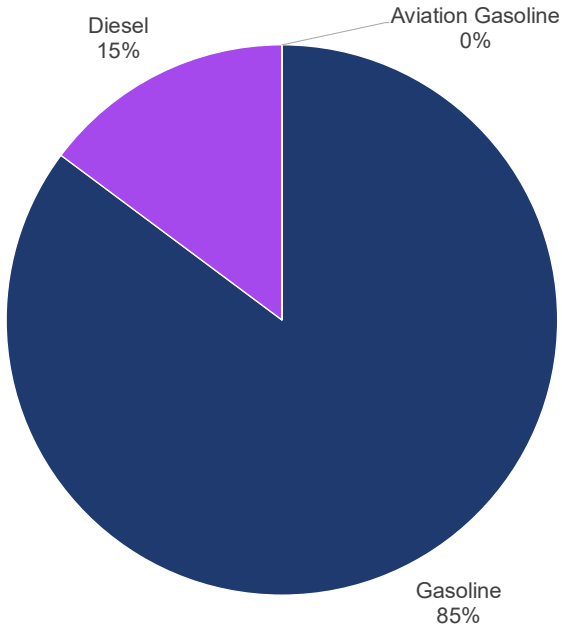
Emissions from air travel within the Towns' borders, exclusively from planes taking off and landing at the Okotoks Air Ranch (i.e. not including commercial airlines), account for less than 0.001% of community transportation emissions.

Residences

Residential GHG emissions from Okotoks arise from both electricity and natural gas consumption in roughly equal proportion, as shown in **Figure 11**. Total emissions from this sector were 127,046 tonnes CO_2e in 2018, making it the second largest sector in the community inventory after transportation.

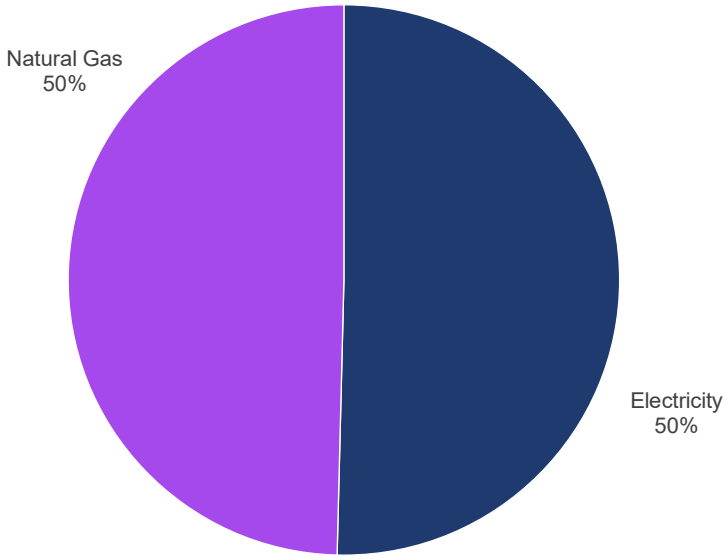
Industrial, Commercial & Institutional Buildings (ICI)

In contrast to the residential sector, GHG emissions from the ICI sector in Okotoks is predominantly from electricity consumption, as shown in **Figure 12**. Total emissions from this sector were 69,822 tonnes CO_2e in 2018, approximately three-quarters of which were due to electricity consumption.



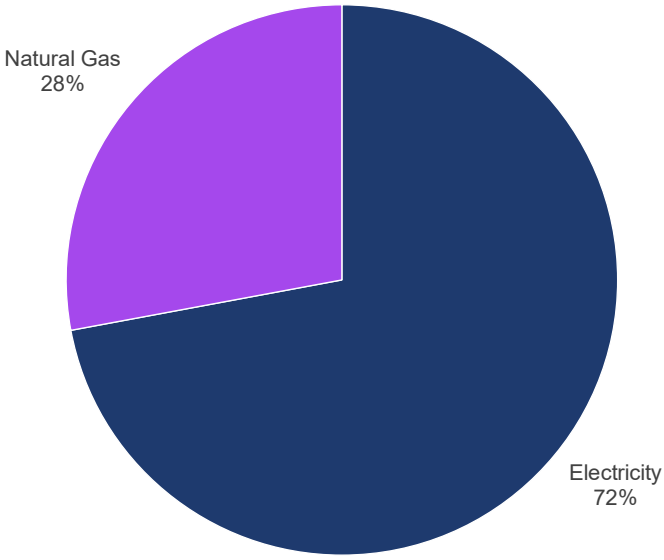
Source	GHG Emissions (tonnes CO_2e)
Gasoline	155,830
Diesel	27,025
Aviation Gasoline	23
TOTAL	182,879

Figure 10 - GHG Emissions by Energy Source, Transportation (tonnes CO_2e)



Source	GHG Emissions (tonnes CO_2e)
Electricity	64,022
Natural Gas	63,024
TOTAL	127,046

Figure 11 - GHG Emissions by Energy Source, Residences (tonnes CO_2e)



Source	GHG Emissions (tonnes CO_2e)
Electricity	50,320
Natural Gas	19,502
TOTAL	69,822

Figure 12 - GHG Emissions by Energy Source, ICI (tonnes CO_2e)

Table 6 - Emission Performance Indicators

Sector	EPI	Baseline Value
Corporate buildings	GHG per floor area	17.35 tonnes $CO_2e/1000ft^2$
Corporate fleet	GHG per vehicle	5.76 tonnes CO_2e/vehicle
Corporate water	GHG per volume processed	0.55 tonnes $CO_2e/1000m^3$
Corporate waste	GHG per resident	0.27 tonnes CO_2e/resident
Community residences	GHG per resident	4.38 tonnes CO_2e/resident
Community transportation	GHG per resident	6.31 tonnes CO_2e/resident
Community transportation	GHG per vehicle	5.85 tonnes CO_2e/vehicle
Corporate commuting	GHG per employee	1.80 tonnes CO_2e/employee
Whole inventory	GHG per resident	13.93 tonnes CO_2e/resident

Emission Performance Indicators

The Town of Okotoks is predicted to grow substantially between now and 2050. Underlying trends in its emissions profile, particularly in the early years of action – such as increasing or decreasing GHG emissions intensity – may be masked by this absolute growth. For example, if the Town adds an additional building to its corporate assets to provide new services to residents, this will increase its corporate GHG footprint in that sector even if that building is built to a particularly high energy efficiency standard. Emissions Performance Indicators (EPIs) are a way of analysing emissions data to try to capture increases (or decreases) in GHG per unit of service. **Table 6** shows a number of EPIs that the Town will use to track performance over time. These will be monitored and may be updated over time according to usefulness.

Avoided Emissions

The Town has already taken actions to reduce its corporate footprint, resulting in some emission savings. Without these actions, baseline GHG emissions would have been higher. These include:

- **Facility LEED® design standards:** the Southridge Emergency Services Building is a Leadership in Energy and Environmental Design (LEED®) Gold certified facility. As a result of following this design standard, it is estimated that the facility design is 41% more energy efficient than it would otherwise have been. The Operations Centre Administative Building and Fleet Building, opened in 2017, has also been constructed to LEED standards.

- **Facility Solar PV:** A small solar photovoltaic (PV) array is mounted on the Okotoks Public Library. This generates electricity from sunlight. In 2018, the array produced 1,161 kWh of solar power, saving **0.93 tonnes CO_2e** of GHG emissions. Other solar PV arrays have been installed at the Municipal Centre and Art Gallery. The Drake Landing Energy Centre, operated jointly by the Town and its partners in the Drake Landing Solar Community, is also powered by solar PV.

- **Facility Solar Thermal**: Both the Fire Station and the Operations Shop have solar thermal domestic hot water systems. Okotoks Recreation Centre also uses solar thermal to heat domestic water in the bathrooms and change roooms.

- **Green Cart Program:** The Town has implemented a comprehensive composting program through its Green Organic Carts. These are provided to private householders and in 2018 Green For Life, the Town's contractor collected 2,174 tonnes of organic waste from this source, and an additional 32 tonnes from corporate green bins. This material was all diverted from landfill and sent to Strathmore for

composting. If it had remained in landfill, it would have decomposed and produced methane emissions. Accounting for the small amount of methane and nitrous oxide emissions produced by composting this material, this program nevertheless prevented **1,888 tonnes CO_2e** of GHG emissions in 2018;

- **Town Hybrid Fleet Car:** The Town has a plug-in hybrid electric (PHEV) fleet car – a 2017 Ford Fusion – that staff use for Town business (e.g. travelling between Town buildings or to out-of-town meetings). As a PHEV this vehicle can run in purely electric mode to a range of around 35km. In 2018 this vehicle travelled 11,023km but only consumed 44L of gasoline (all other energy coming from electricity). The PHEV therefore released 1.40 tonnes CO_2e. A comparable internal-combustion engine model of Ford Fusion (2017, FWD, 2.0L) would have released 2.89 tonnes CO_2e. Thus, by using a PHEV fleet car, the Town avoided **1.49 tonnes CO_2e** in 2018, or slightly over half of the emissions of a regular car.

- **Town Public Charging Station for EVs:** Infrastructure that enables private citizens to charge up electric vehicles (EVs) outside of their homes is essential to encourage more widespread adoption of this new transportation technology. Such infrastructure enables EV owners to take longer journeys, making it possible to completely replace their traditional, internal combustion engine vehicles. To assist in this, the Town provides an on-street public charging station for EVs outside the municipal building. In 2018, this charging station provided 1,617 kWh of charging to publicly owned electric vehicles – the energy equivalent to 182 litres of gasoline. This small volume is to be expected as EV ownership in Okotoks is currently minimal. However, this infrastructure will help to support ownership and the Town expects that use will

increase over time. It is not possible to calculate the exact emissions avoided through the station without knowing both the type of vehicles being charged and the type of vehicles that are being displaced.

Town actions have reduced GHG emissions by at least 1890 tonnes CO_2e/yr.

- In total, at least 1890 tonnes CO_2e of GHG emissions were avoided in 2018.

How does Okotoks compare?

Comparing GHG inventories from one municipality to another is difficult. Each municipality is a different size, has a different population, different climate, historic development patterns, demographics, growth trajectories, local industrial base etc. Different municipalities may also use alternate inventory boundaries, appropriate to their own circumstances and data collection challenges, and many municipalities have only calculated their own corporate inventory and not their community inventory.

Corporate Inventory

The scope of services provided by municipalities is generally similar, so some comparison of the corporate GHG inventory is possible. This is helpful in identifying how efficiently municipal services are provided in regards to emissions. Despite this, differences between municipalities remain significant. When comparing one municipal inventory to another the following are of particular interest:

- Whether or not a municipality owns/operates a landfill. Many do not, so landfill emissions are not included in their corporate inventories.
- Whether or not a municipality owns/operates a public transit service. Those that do are likely to have larger fleet emissions in their corporate inventories.
- The GHG emissions intensity of the provincial or local electricity grid. For example, Alberta, Saskatchewan and Nova Scotia still rely heavily on coal for power generation, and Nunavut uses heavy fuel oil. In these provinces, electricity is more carbon-intensive than natural gas consumption. By contrast, Quebec, British Columbia and Manitoba receive almost all of their electricity from hydropower, which means electricity has far fewer associated GHG emissions in these jurisdictions. **Figure 13** shows the emissions intensity of electricity consumption in each province in Canada.

As such, the corporate inventory is only compared against other jurisdictions from Alberta, which:

- Are participating in the PCP framework, and
- Have publicly available GHG inventories (these inventories vary

in publishing date from 2006 – 2018), and

- Are similarly sized and therefore provide a reasonably comparable breadth of services.

To ensure a fair comparison, the emissions from landfill and commuting have been excluded in this comparison, as most of these municipalities have **not** included these in their corporate inventories. This is shown in **Figure 14.**

The average GHG per resident for the five comparison municipalities is 0.49 tonnes CO_2e per person for corporate GHG emissions only, which is comparable to the average GHG per resident for Okotoks, which was 0.55 tonnes CO_2e per person in 2018. This indicates that Okotoks' emissions efficiency for municipal services is comparable to that of other similar municipalities.

Total Emissions

As with corporate emissions, comparing total emissions between municipalities must be done carefully as each municipality has a different built form, contains different levels of industry, and so on.

Figure 15 compares total emissions – both corporate and community – against the same municipalities as in **Figure 14**. The exception is the City of Calgary replaces Lethbridge (data for Lethbridge's community emissions were not included in their GHG report for 2011).

As shown in **Figure 15**, the 13.93 tonnes CO_2e per person emissions for Okotoks is comparable to that of the other municipalities, which range from 10.44 (Town of Stony Plain) to 22.9 (Town of Canmore). The average for the five other municipalities is 15.04 tonnes CO_2e per person.

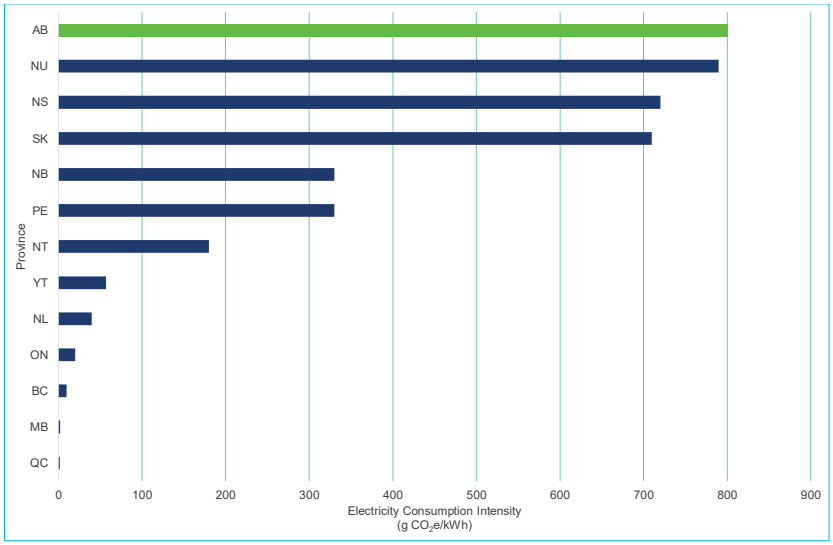


Figure 13 - GHG Emissions Intensity of Provincial Electricity Grids in Canada

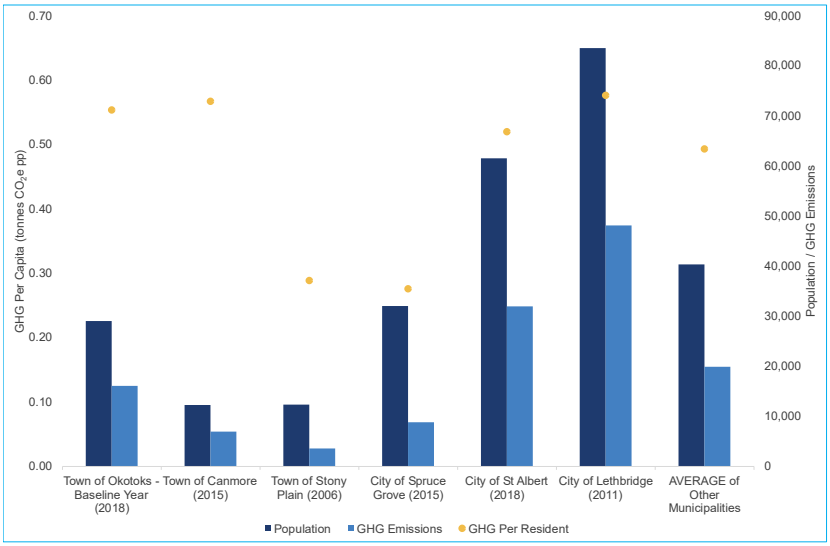


Figure 14 - Okotoks Corporate GHG Inventory vs Other Municipalities (Excluding Landfill and Commuting)

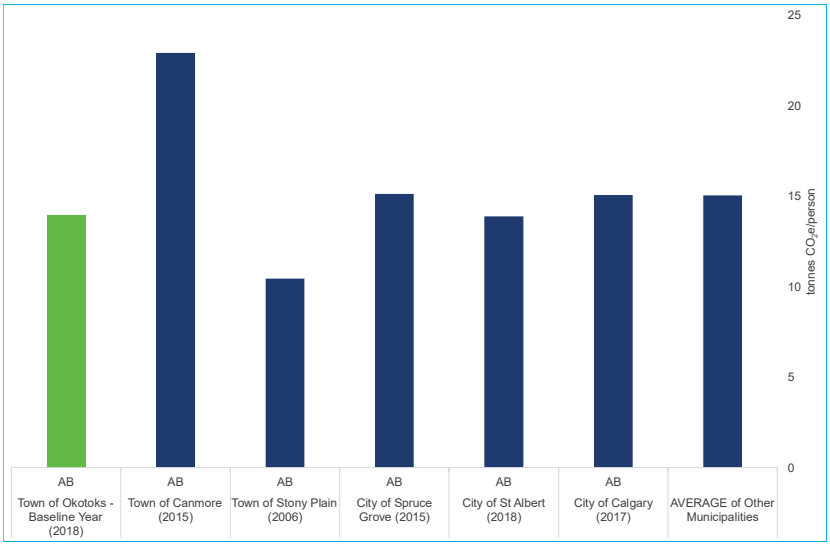


Figure 15 - Okotoks Total (Corporate + Community) GHG Inventory vs Other Municipalities

4 What does the future look like?

Forecasting Okotoks' most likely future emissions profile is a challenge. Although we can anticipate certain structural changes to the economy and society, the speed and range of these changes will be influenced by Federal and Provincial government policy, macro-economic factors and environmental changes.

For example, it is widely anticipated that our transportation infrastructure is going to change as electrified and autonomous vehicles increasingly displace traditional, internal-combustion engines. The impact of these changes is hard to predict. For example, whether autonomous vehicles decrease or increase emissions relative to manually-operated vehicles will depend on how they are designed to work and whether or not they remain in private ownership or operate more like a carpool. The speed at which national charging infrastructure develops, the existence of government subsidies to encourage ownership of these vehicles, changes to road safety rules, societal acceptance, legal and labour challenges to these new forms of transport and other factors which the Town cannot control, will impact how quickly and to what extent this change happens.

As such, forecasting the likely shape of our future GHG emissions – under a Business-As-Usual (BAU) scenario – is based on changes to only a few key factors, which produces a forecast that is easy to understand while remaining reasonably robust.

What is "Business As Usual"?

"Business-As-Usual" (BAU) scenario planning is required by the PCP framework. A BAU scenario imagines what would happen in the absence of any actions by the Town.

- **Population is expected to rise:** the Town anticipates that, by 2050, the population will have grown from its current level of 29,000 to ~54,500. This has been modelled as a linear rise between now and 2050.

- **Emissions are expected to rise:** Emissions from corporate services such as water and wastewater provision, and emissions from community sources such as private residences, are expected to increase in line with a growing population. A constant emissions intensity (GHG emissions per capita) has been modelled for all emissions sources except electricity.

- **The electricity grid is expected to become cleaner:** the electricity grid in Alberta has been slowly decarbonizing as natural gas, wind and solar have begun to displace coal generation. Federal regulations on the coal sector are intended to lead to a phasing out of coal generation by 2030 and the Alberta Electricity System Operator (AESO) predicts renewables will contribute 19% of Alberta's generation by 2030. Emissions intensity for electricity in the future has therefore been modified by the expectation that grid emissions intensity for Alberta will decline by around 47% by 2030 as coal plants are replaced by natural gas generation and renewable energy sources.

- **Electric vehicles are expected to become more common:** although electric vehicles are still relatively uncommon in Alberta, they are expected to become increasingly widespread over the coming decades as costs decrease, performance increases and the range of vehicle selection expands. Under Transport Canada's Zero Emission Vehicle strategy, targets for zero emission vehicles (ZEVs) project that 10% of new light-duty vehicle sales will be ZEV by 2025, 30% by 2030 and 100% by 2040; with ZEVs acconting for 3%, 10% and 48% of the on-road vehicle stock by those dates. Adoption of ZEVs in line has been modelled in line with these federal targets.

As illustrated in **Figure 16**, the BAU forecast shows that in 10 years time, emissions in Okotoks would reach 443,176 tonnes CO_2e. By 2050 this would be 540,174 tonnes CO_2e, which is an increase of 34% compared to our baseline year.

This shows the true scale of the challenge – as a growing municipality, its demand for energy, water, waste disposal and other environmental services is also growing, and without a significant intervention this means its environmental footprint, including its

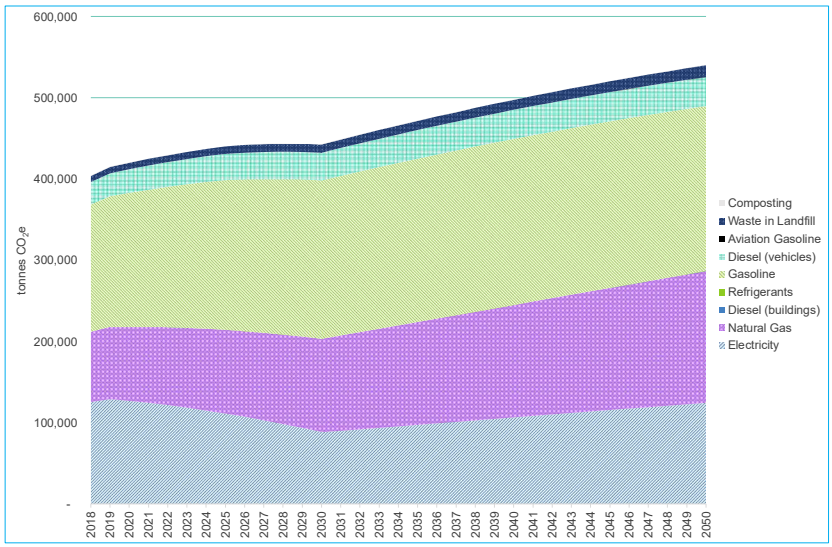


Figure 16 - Business-As-Usual (BAU) Emissions Forecast

impact on GHG emissions, will grow.

Tackling the problem: the impact of existing policies

Our 2050 target is to reduce GHG emissions to “net zero”.

The Town has already identified a number of energy efficiency, sustainable transportation and waste disposal policies and targets in its Environmental Master Plan 2018 and its Municipal Development Plan which will lead to a reduction in GHG emissions. These are outlined in **Table 7**.

Modelling of the impact of these targets has been completed, and as **Figure 17** shows, these have the potential to reduce emissions to 386,036 tonnes CO_2e by 2050. This would be 71% of Business-As-Usual emissions by 2050, and a reduction of 4% from 2018 emission levels.

While this would be a major achievement, it still falls short. However, it should be noted that this does not take into account any sequestration activities – these will be explored in more detail as we prepare the Municipal Climate Change Action Plan.

By 2050, the Town’s existing commitments are anticipated to reduce GHGs to 71% of BAU emissions, and to 4% below current levels.

Table 7 - Existing GHG Reduction Targets from the Municipal Development Plan

Target	Target Year	Inventory Sector(s) Impacted
100% renewable energy generation for corporate facilities (from the EMP 2018)	2050	Buildings, Water
100% of new construction is built to a green building standard	2033	Buildings, Residential, ICI
20% of all new construction is built and certified to Passivhaus (or equivalent) standard	2033	
Increase % of trips made using public transit from 3% in 2016 to 5% in 2021	2021	Transportation, Commuting
Increase % of trips made using Okotoks Public Transit System from 0% to 2% by 2020*	2020	
Reduce the distance driven by residents (vehicle km travelled) by 25%	2033	
Increase % of trips made using transit or active transportation by 25% (from 9.5% in 2016 to 12% in 2033)	2033	
80% waste diversion	2020	Waste
Recycle, reuse, or compost 95% of waste	2050	

*Despite Okotoks not having a transit system at the time of writing, 3% of Okotoks residents reported using public transit for their commute. This may include a portion of the commute journey made in Calgary or use of the Southland Transportation regional bus system.

Interim target setting: what we've heard

On August 22nd, 2019,the Town undertook a preliminary engagement session with key stakeholders from primary emissions sectors in the community. Attendees included key institutional stakeholders such as Alberta Health and Foothills School Division, transportation representatives from Southland Transportation Ltd., local business representatives from the Okotoks Chamber of Commerce and RioCan REIT and utilities representatives from Fortis Alberta. The session included a survey of participant's organizational knowledge and readiness for climate change planning. While half of the participants have in place a GHG reduction plan or expect to have one ready in the next 12 months, the other half have nothing in place.

At the preliminary engagement session the Town introduced the draft inventory, and solicited feedback from the stakeholders on what 2025 GHG reduction targets they felt were realistic, as well as the opportunities and challenges each sector faces.

As shown in **Figure 18**, opinions diverged considerably on appropriate reduction targets in each sector for 2025:

- **Water:** no clear consensus was obtained, but 58% of responses recommended a range between 6 to 15%.
- **Buildings:** no clear consensus was obtained, but recommendations ranged from 6 to 10% to 26% or greater; most recommendations (almost 40%) were for a 6 to 10% target.

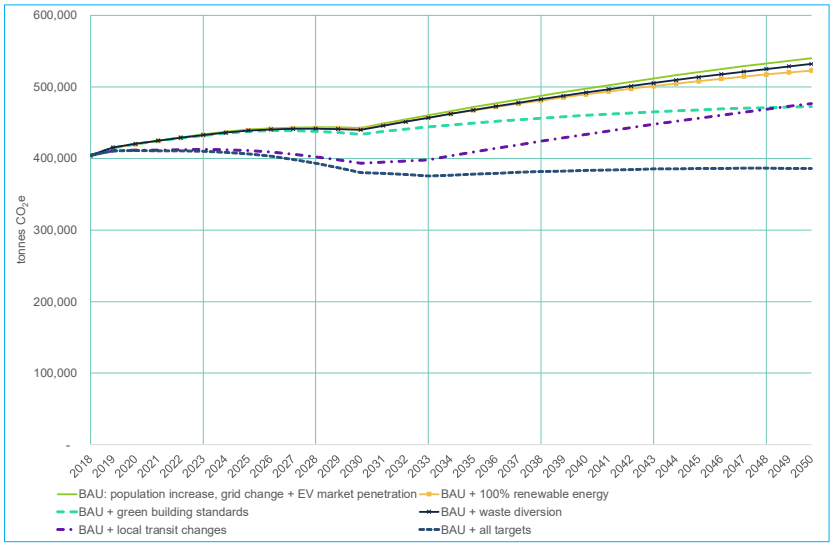


Figure 17 - Impact of Existing Targets on GHG Emission Forecasts

- **Transportation:** this generated the most consensus; over 70% of respondents felt that a 6 to 10% target would be realistic, with the other 30% recommending a target of 16 to 20%.

- **Waste**: the largest reduction recommended in this area was 16 to 20%; however, three-quarters of respondents recommended a reduction in the range of 6 to 15%.

This will be explored in further detail as the Municipal Climate Change Action Plan is developed.

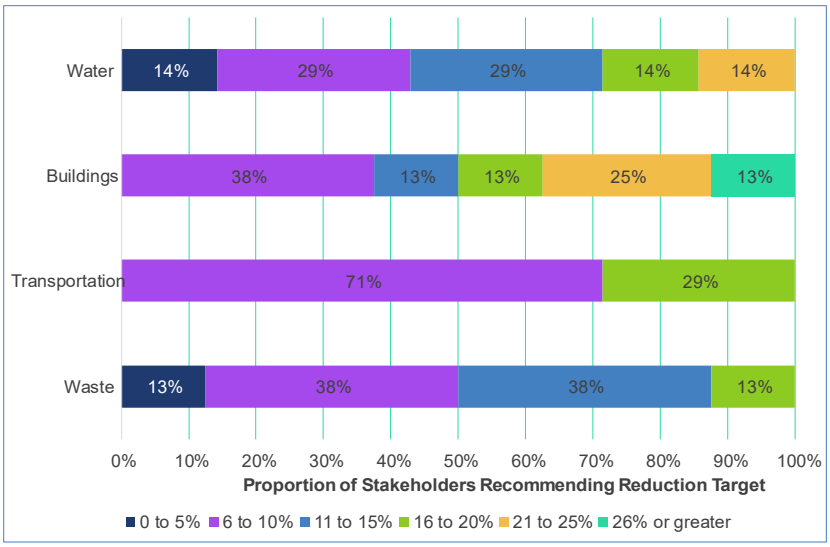


Figure 18 - Stakeholder Opinions on Realistic 2025 Reduction Targets, by Sector

5 Where do we go from here? Next steps.

Now that our corporate and community carbon footprint is understood, next steps for the Town include completing Milestones 3, 4 and 5 of the PCP process. This includes developing a local Municipal Climate Change Action Plan, implementing that plan, monitoring its successes and challenges, and continually modifying and updating it to ensure it is effective and relevant.

Responding to the challenge of climate change presents the opportunity to design cost-effective policies and practices for Okotoks, particularly given that it is a growing community. There is an opportunity to design policies and practices for a carbon-constrained future. For example, geoexchange for heating and cooling – similar to what is being used at the pioneering Drake Landing Solar Community – offers huge potential to reduce GHG emissions in the residential sector by providing a renewable alternative to natural gas heating. For optimal cost-effectiveness, these types of practices should be planned for, and installed, as part of new neighbourhood planning and development.

Access to funding is also increasingly being tied to consideration for climate mitigation and adaptation. For example, the Federal Government's Investing in Canada's Infrastructure Program (ICIP) requires a 'Climate Lens' assessment to be completed as part of a funding application for infrastructure projects.

Detailed sector-by-sector and interim targets for the corporate and community inventories for 2025 and

2030 will be set in consultation with internal and external stakeholders as part of the Municipal Climate Change Action Plan process. This process will occur during 2020 with a view to publishing the first Municipal Climate Change Action Plan in 2020.

Following the development of the Municipal Climate Change Action Plan, the Town will work proactively to reduce its own impact and to support the community in reducing its carbon footprint (Milestone 4). The GHG inventory will be updated on an annual basis to monitor progress, reporting on successful projects and upcoming activities, as well as providing updates to the GHG emissions forecast (Milestone 5).

6 Summary and conclusions

The Town is proud to have compiled this first corporate and community greenhouse gas inventory for Okotoks, which has been completed following the Partners for Climate Protection (PCP) Protocol. This completes Milestones 1 and 2 of the PCP's 5-Milestone Framework.

These are critical first steps on the journey to achieving carbon neutrality by 2050, a goal that places Okotoks at the forefront of global action to tackle climate change.

The Town has identified that the 2018 GHG baseline is 24,335 tonnes CO_2e from corporate activities, and 379,747 tonnes CO_2e from community activities. Under a Business-As-Usual scenario, these values will rise to 35,372 and 504,802 tonnes CO_2e, respectively, by 2050.

The Town has identified Okotoks' top emissions sources for the 2018 baseline year, for the inventory as a whole and, where the data allows it, on a sector-by-sector basis. This will allow efforts and resources to be focused on the most significant emission sources, where they can have the biggest impact.

The next step is to work with stakeholders to establish interim emission reduction targets and actions needed to meet these targets. This will culminate in the Municipal Climate Change Action Plan, expected to be published in 2020.


CANADIAN PACIFIC