Greenhouse gas emissions in Yukon: 2019

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Climate Change Secretariat
Department of Environment
Government of Yukon

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Introduction

Through *Our Clean Future: a Yukon strategy for climate change, energy and a green economy*, the Government of Yukon is committed to taking ambitious climate action. In order measure our progress, accurate and transparent greenhouse gas (GHG) tracking and reporting is vital. This report begins with an explanation of how Yukon's GHG emissions are calculated including an overview of key data sources and explanation of recent methodological updates. Secondly, it presents annual GHG emission totals with an examination of how they have changed between 2009 and 2019. Lastly, it analyzes the impact of key factors such as Yukon's population and gross domestic product on emissions.

Methodology

Greenhouse gases

The most well-known GHG, carbon dioxide (CO_2), accounts for the majority of human-caused emissions. In addition to CO_2, several other GHGs contribute to climate change. Many of these are significantly more potent than CO_2. The Government of Yukon reports Yukon's emissions in terms of carbon dioxide equivalent (CO_2e). This metric includes the six greenhouse gasses that are regulated under the Kyoto Protocol (Table 1), and how they compare to CO_2 in terms of potency. To convert non-CO_2 GHGs into a carbon dioxide equivalent, a conversion factor called the global warming potential (GWP) is used (Table 1).

Table 1: Global warming potential of greenhouse gasses emitted in Yukon.

Greenhouse gas	Global warming potential[1]
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28

[1] Intergovernmental Panel on Climate Change, Fifth Assessment Report.

Greenhouse gas	Global warming potential[1]
Nitrous Oxide (N_20)	265
Hydrofluorocarbon (HFC)	4 – 12,400
Perfluorocarbon (PFC)	7,190 – 11,100
Sulfur Hexafluoride (SF6)	23,500

Data sources

The Government of Yukon uses two main data sources to measure Yukon's emissions in order to use the best available data for all sectors. The first source is the National Inventory Report (NIR), which is produced annually by the Government of Canada and reports the greenhouse gas emissions of all provinces and territories. The NIR is released with a two-year lag due to the length of time required to compile and analyze data across the country. For example, the report on 2019 emissions was released in April 2021. As a result, the Government of Yukon's emissions reporting also operates on a two-year lag.

The second data source is Yukon's fuel tax databases, which track the total volume of fuel purchased in Yukon based on the amount of tax paid. The Yukon Bureau of Statistics uses this information to calculate greenhouse gas emissions from different types of fuel.

Table 2 lists the fuel types included in Yukon's GHG inventory and which of the two main data sources we use to calculate emissions from each fuel.

Table 2: Fuel types included in Yukon's GHG inventory.

Fuel type	Description	Data source	Methodology
Aviation fuel	Aviation gas, jet fuel, and any other aviation fuels sold within Yukon.	Yukon Bureau of Statistics: Fuel tax databases	Emissions calculated based on the total amount of aviation fuel purchased in Yukon.
Heating	Diesel and propane used to heat buildings.	Yukon Bureau of Statistics: Fuel tax databases	Emissions calculated based on the total amount of heating fuel purchased in Yukon.
Electricity generation	Diesel and liquid natural gas used to generate electricity.	Yukon Bureau of Statistics: Fuel tax databases Yukon Bureau of Statistics: Calculations based on Yukon Energy Corporation and ATCO Electric Yukon annual public reporting	Emissions calculated based on total volume of diesel and liquid natural gas combusted by Yukon's public utilities as well as total amount of tax exempt fuel purchased by private entities for electricity generation purposes under the Fuel Tax Exempt Program.
Mining	Diesel purchased for use at a mine site	Yukon Bureau of Statistics: Fuel tax databases	Emissions calculated based on total amount of tax exempt fuel purchased for mining

Fuel type	Description	Data source	Methodology
			purposes under the Fuel Tax Exempt Program.
Off-road diesel	Diesel purchased for non-mining off-road uses. This includes diesel used for farming, hunting/outfitting, trapping, logging, sawmills and tourism.	Yukon Bureau of Statistics: Fuel tax databases	Emissions calculated based on total amount of tax exempt fuel purchased for non-mining activities under the Fuel Tax Exempt Program.
On-road diesel	Diesel used in registered vehicles intended to be used on official roadways only.	National Inventory Report	Emission simulation model calculates road transportation emissions based on factors including number and type of registered vehicles, average annual kilometres driven per vehicle type, and uptake of emission control technology.
On-road gasoline	Includes gasoline used in registered vehicles intended to be used on official roadways only.	National Inventory Report	

Fuel type	Description	Data source	Methodology
All other sources	This captures emission sources not included in the above categories. In Yukon, emissions in this category come from waste management and industrial processes and product use (IPPU).	National Inventory Report	Methane emitted from waste management sites is calculated based on a rate of decay model and the population serviced by each site. IPPU emission methodologies vary significantly based on the specific process/product. 91 per cent of Yukon's IPPU emissions come from the use of hydrofluorocarbons (refrigerants), which are measured based on bulk import data.

Methodological updates

The methods used to measure greenhouse gases are constantly being improved. When there is an update to the methods used to calculate emissions, the new method is also applied retroactively to previous years. This is referred to as "backcasting." This is done so that we can directly compare emissions from one year to the next and accurately track our progress. This means that emissions reported for previous years are revised if an improved methodology is adopted.

Key updates

Several improved methodologies have been adopted in this 2019 emissions report and backcasted to previous years. These updates include:

- **Municipal Solid Waste** – The most significant revision between this and the previous report is to the "All Other Sources" fuel type. This change comes from an update in how Environment and Climate Change Canada calculates emissions for municipal solid waste landfilling. This is due to the decay model being updated with new decay rates, and inclusion of waste type-specific parameters.
- **Mining –** Previously, mining and non-mining uses of tax exempt fuel were distinguished from one another based on company names submitting the permits. Beginning in this reporting year, tax exemption permits include the "category" of fuel use for all tax exempt fuel purchases. This explicitly states which off-road fuel is used for mining purposes. This new classification method resulted in mining emissions being revised consistently downwards.
- **Non-mining off-road fuel –** Due to the category field on tax exemption permits discussed above, off-road fuel for other purposes can be more accurately identified, resulting in a consistent downward revision.
- **Electricity generation –**The category field on tax exemption permits enabled the Yukon Bureau of Statistics to identify additional thermal generation reported on these permits outside of thermal generation from the Yukon Energy Corporation and ATCO Electric Yukon. This resulted in emissions from electricity generation consistently increasing by a small amount in nearly all previous years.

Implications of methodological updates

Given that Yukon's 2030 greenhouse gas reduction target is based on 2010 emissions, revisions to 2010 emissions due to methodological updates affect the baseline from which we are aiming to reduce emissions. As a result of the updates described above, 2010 non-mining emissions are four per cent higher than they were reported as last year, meaning that our 2030 target emissions level has also increased. However, total emissions from 2011 to 2018 also increased by one to four per cent[2] as a result of the methodological improvements, meaning that our ability to meet the 2030 greenhouse

[2] The range of percentages is because each year's emissions inventory was revised upwards by a slightly different amount.

gas reduction target has not been significantly impacted by the methodological changes. Updated historical emission data will be incorporated into our third-party GHG model to ensure our projected emissions scenarios out to 2030 are as accurate as possible.

Table 3. Revisions to Yukon's historical GHG emissions due to methodological updates. Revisions highlighted in yellow.

	2009		2010		2011		2012		2013	
	Old	New	Old	New	Old	New	Old	New	Old	New
Aviation	33.9	33.9	43.5	43.5	56.5	56.5	44.5	44.5	39.1	39.1
Heating	128	128	118.6	118.6	137.2	137.2	136.8	136.8	126.1	126.1
Electricity Generation	16.6	16.6	18	19.2	25.6	26.9	18.1	18.9	17.4	18.8
Mining	76.4	76.4	78.7	73.1	105	96.9	114.6	104.8	104.3	99.1
Non-mining off-road fuel	4	4	3.3	0.3	3.6	0.2	2.3	0.3	6.9	0.2
On-road gasoline	153.6	153.6	157.8	157.8	160.2	160.2	154.2	154.2	139.9	139.9
On-road diesel	169.7	169.6	219.3	219.3	238.3	238.3	239.3	239.3	217.5	217.4
All other	28.6	41.3	30.4	52.7	33.4	55.3	34.1	55.7	23.5	44.9
Total	610.8	633.3	669.6	684.4	759.9	771.5	743.9	754.6	674.6	685.5

	2014		2015		2016		2017		2018	
	Old	New	Old	New	Old	New	Old	New	Old	New
Aviation	42.8	42.8	49.4	49.4	44.8	44.8	46.5	46.5	50.4	50.4
Heating	123.5	123.5	103.8	103.8	108.2	108.2	146.6	146.6	135.7	135.7
Electricity Generation	16.9	18	19.3	20.6	19.5	20.6	24.1	25.2	33.9	34.8
Mining	91.2	84.5	59.5	55.2	66	60.9	69	64	81.9	75.9
Non-mining off-road fuel	3.5	0.3	3.1	0.3	3.3	0.9	4.5	1.5	3.3	0.4
On-road gasoline	141.8	141.8	150.1	150.1	169.1	169.1	171.5	171.5	195.0	195.0
On-road diesel	172.5	172.5	193.2	193.2	177.1	177.0	203.3	203.3	228.8	227.2
All other	24.9	46.2	25	46	26.1	48.1	28.8	51.5	31.9	55.2
Total	617.1	629.6	603.5	618.7	614	629.6	694.3	710.1	761	774.6

Results

In 2019, Yukon's total greenhouse gas emissions were 783 kilotonnes (kt) of CO_2e. This is a slight (1.5 per cent) increase from Yukon's previous emissions peak in 2011, and a 14 per cent increase from 2010 levels.

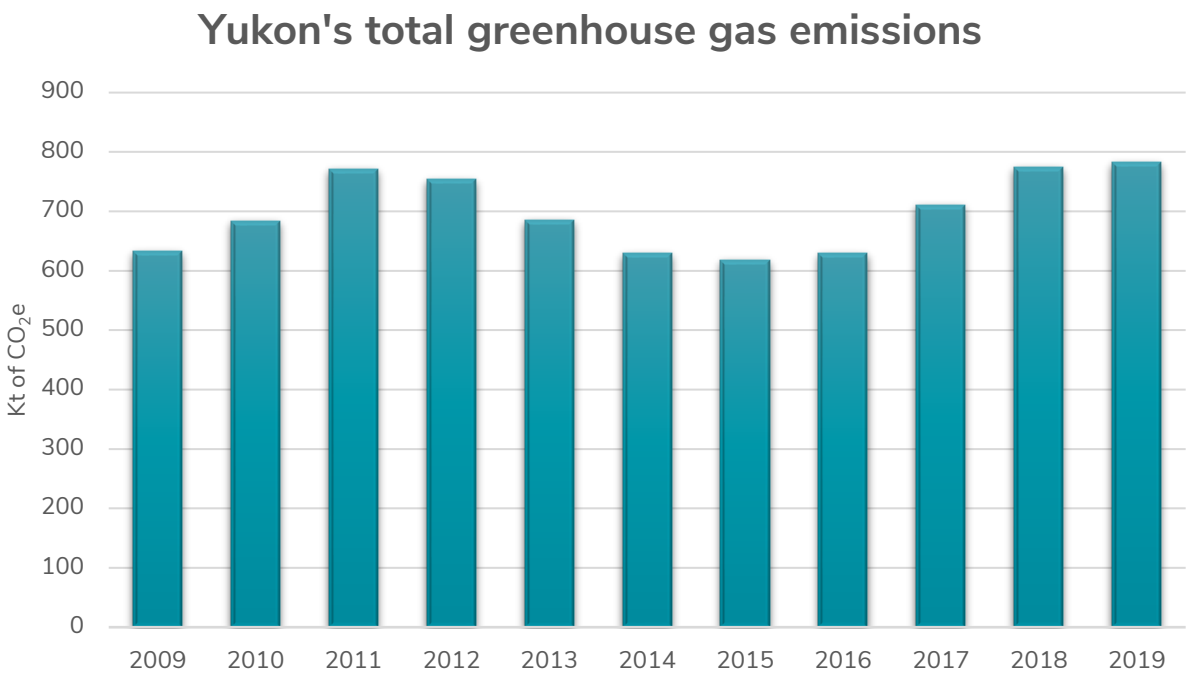

Figure 1. Yukon's total greenhouse gas emissions from 2009 to 2019.

The dominant sources of emissions in Yukon have remained relatively consistent between 2010 and 2019 (Figure 2). Road transportation continues to make up slightly over half of all emissions, accounting for 55 per cent in 2010 and 56 per cent in 2019. It is notable, however, that within this category, the proportion of diesel has decreased while the proportion of gasoline has increased. While emissions from on-road diesel remained relatively consistent over this period, emissions from on-road gasoline increased by 64 kilotonnes, or 41 per cent, from 2010 to 2019.

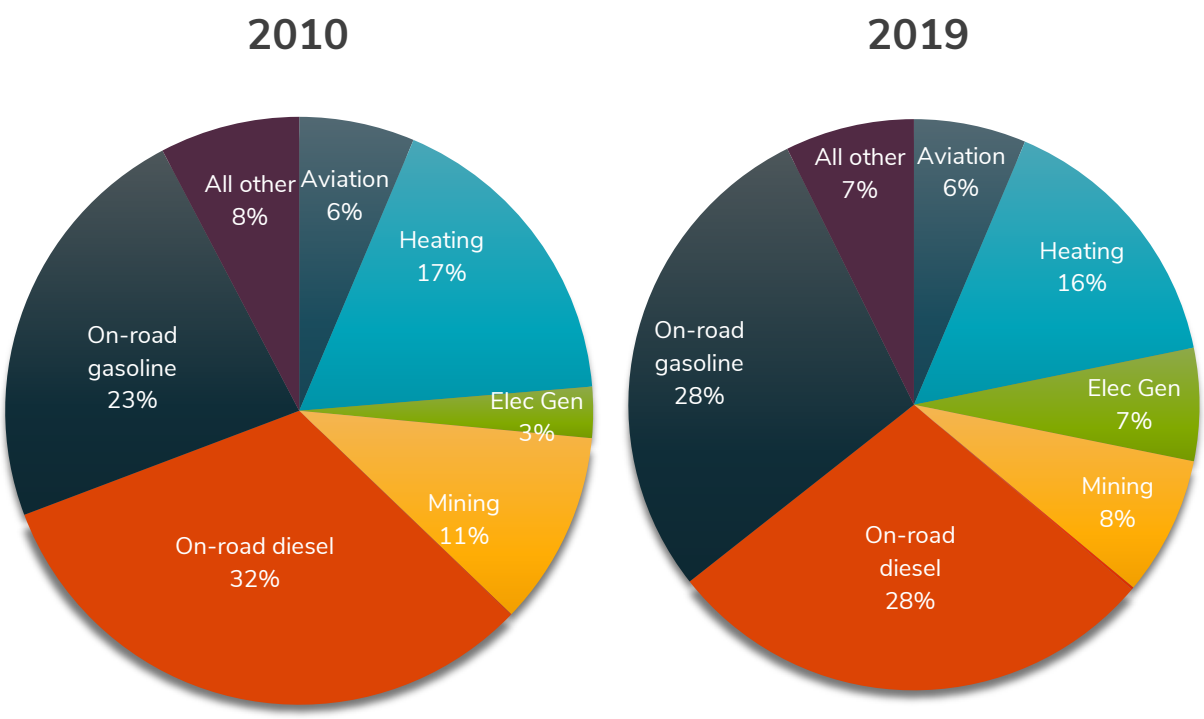

Figure 2. Yukon's emissions by fuel type in 2010 and 2019.

Emissions from electricity generation have steadily increased over this period, and made up seven per cent of overall emissions in 2019 as compared to three per cent in 2010. The proportion of emissions from aviation, heating and all other sources remained relatively consistent over this period. The percentage of emissions from mining is variable year-to-year, and made up a slightly lower proportion of total emissions in 2019 (8 per cent) as compared to 2010 (11 per cent).

Emissions for all categories in the interim years remained relatively consistent over time as well (Figure 3 and Table 4). However, in years where Yukon's emissions were particularly high, such as 2011 and 2018, emissions from mining, aviation and/or on-road diesel are visibly higher as compared to other years. This points to these three fuel types as potential drivers of inter-annual variation.

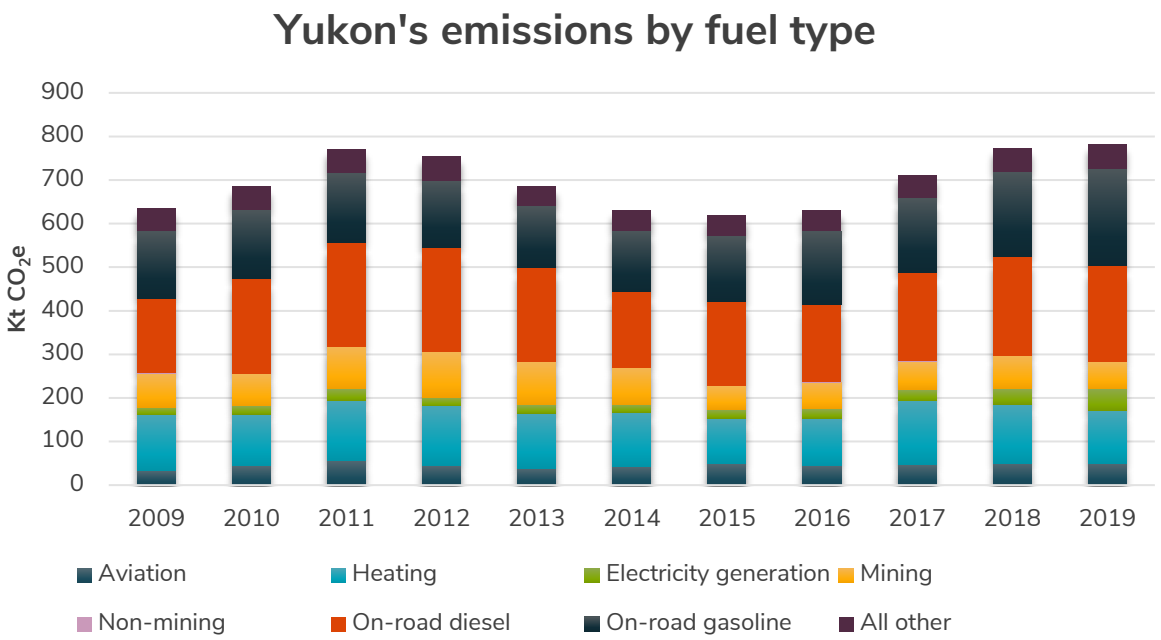

Figure 3. Yukon's emissions by fuel type from 2009 to 2019.

Table 4. Yukon's total greenhouse gas emissions by fuel type from 2010 to 2019.

Fuel Type Group	2009	2010 (base year)	2011	2012	2013	2014	2015	2016	2017	2018	2019	% Change[3] 2010 - 2019
Heating diesel/propane	128	119	137	137	126	124	104	109	147	136	121	2
LNG/diesel for electrical generation	17	19	27	19	19	18	21	21	25	35	50	160
Mining off-road fuel	76	73	97	105	99	85	55	61	64	76	62	-16
On-road diesel	170	219	238	239	217	173	193	177	203	227	221	1
On-road gasoline	154	158	160	154	140	142	150	169	172	195	222	41
Aviation gas/jet fuel	34	44	57	45	39	43	49	45	47	50	50	15
Off-road diesel	4	0.3	0.2	0.3	0.2	0.3	0.3	0.9	1.5	0.4	1	233
All other	51	53	55	56	45	46	46	48	52	55	57	9
Total	633	684	772	755	686	630	619	630	710	775	783	14

[3] Percentage change is compared against a 2010 base year, as this is the base year for Yukon's emission reduction targets.

Analysis

Territory-wide demographic and economic factors such as population and gross domestic product (GDP) impact Yukon's emissions significantly. Between 2009 and 2019, a growing population and growing economy appear to be tied to the observed increase in GHG emissions.

Between 2009 and 2019, Yukon's GDP increased by 23 per cent. This is similar to the 24 per cent increase in GHG emissions over this same time period (Figure 4).

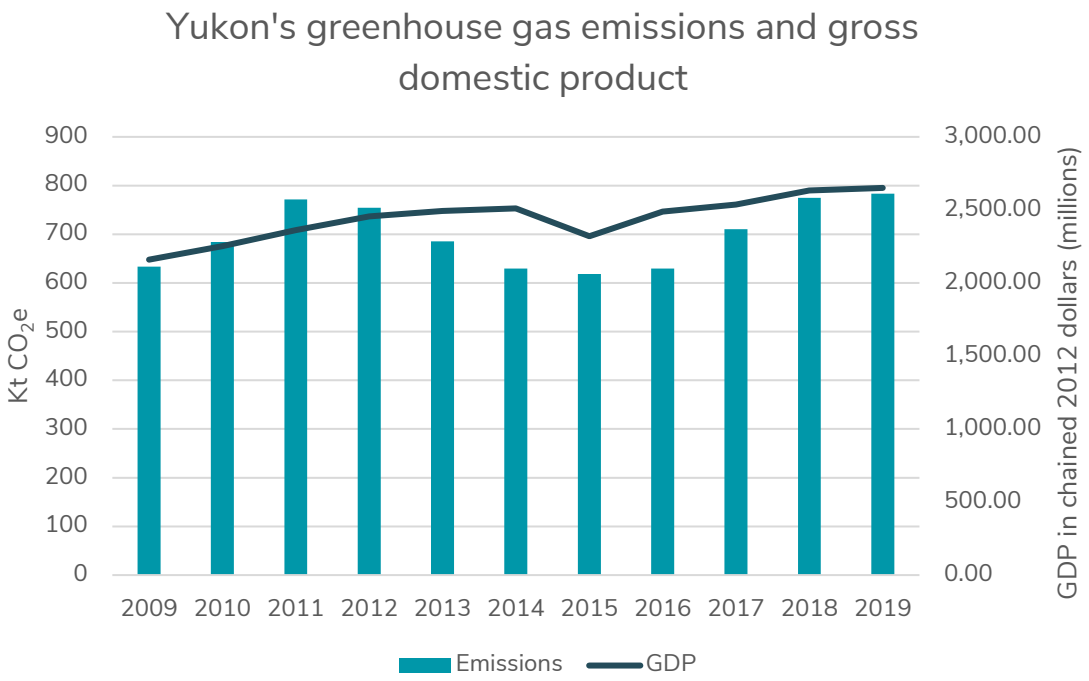

Figure 4. Yukon's greenhouse gas emissions and gross domestic product[4] from 2009 to 2019.

Consequently, Yukon's emissions per unit of GDP (measured in tonnes of CO_2e per million chained 2012 dollars) were approximately the same in 2009 and 2019 (Figure 5), demonstrating that the emissions intensity of the economy remained fairly consistent. When we compare between 2010 and 2019, there was a slight decrease in the emissions intensity of the economy. The emissions intensity of the economy peaked

[4] Source: Statistics Canada table 36-10-0402-01.

in 2011 at 327 kt CO_2e per million chained 2012 dollars, then decreased to the lowest levels from 2014 to 2016 and increased again from 2017 to 2019.

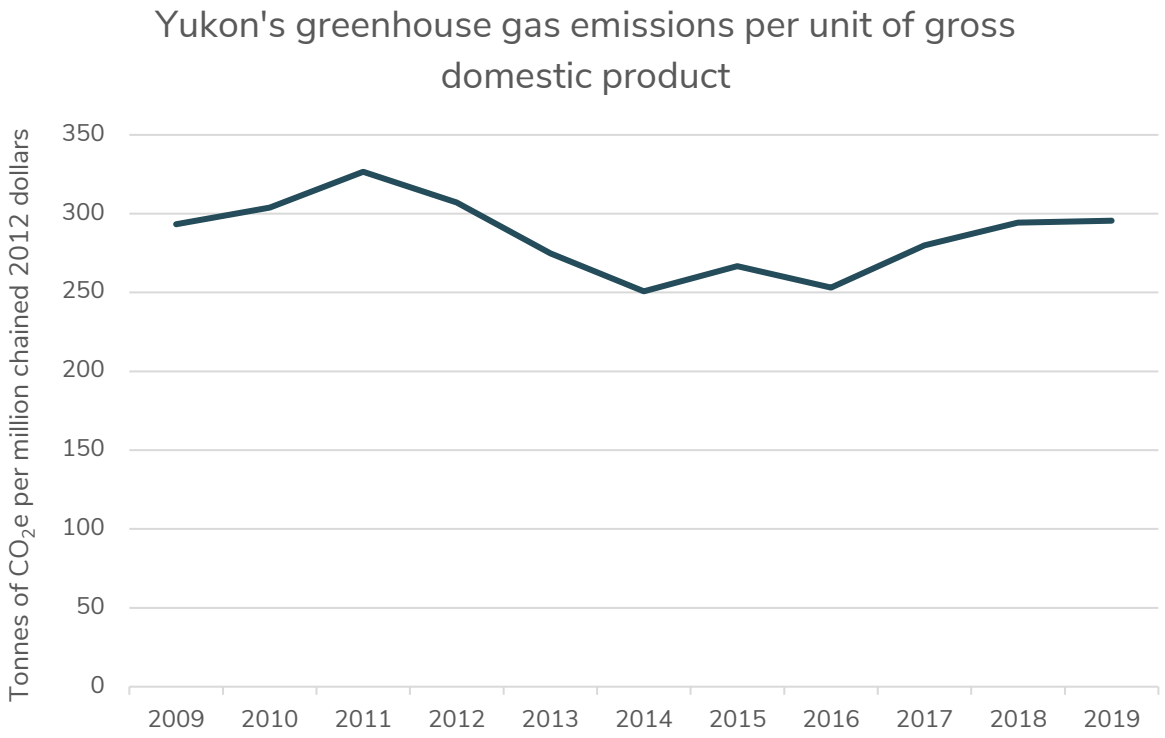

Figure 5. Yukon's greenhouse gas emissions per unit of gross domestic product from 2009 to 2019.

Similar to GDP, Yukon's population increased 22 per cent between 2009 and 2019 (Figure 6). This increase has been consistent from year to year, growing from approximately 34,000 people in 2009 to 41,000 people in 2019. While Yukon's GHG emissions also increased during this period, emissions and population appear to be less correlated than emissions and GDP. For example, population steadily rose from 2013 to 2016 while emissions dipped during this period.

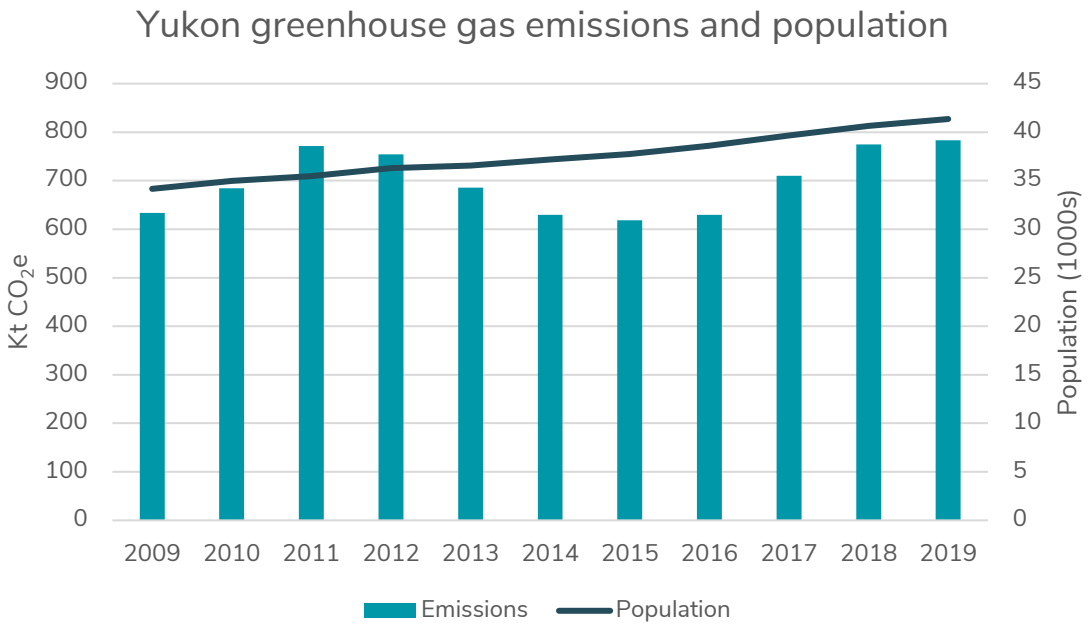

Figure 6. Yukon greenhouse gas emissions and population[5] from 2009 to 2019.

Yukon's per capita emissions in 2019 were 18.9 tonnes per person, which is a two per cent increase from 2009 levels of 18.5 tonnes per person (Figure 7). Similar to the emissions intensity of the economy, Yukon's per capita emissions peaked in 2011, decreased to 2016 and then increased again out to 2018 and 2019. When we compare to 2010 levels, per capita emissions in 2019 were slightly lower.

[5] Source: Yukon Bureau of Statistics, Population as of June 31st of each year.

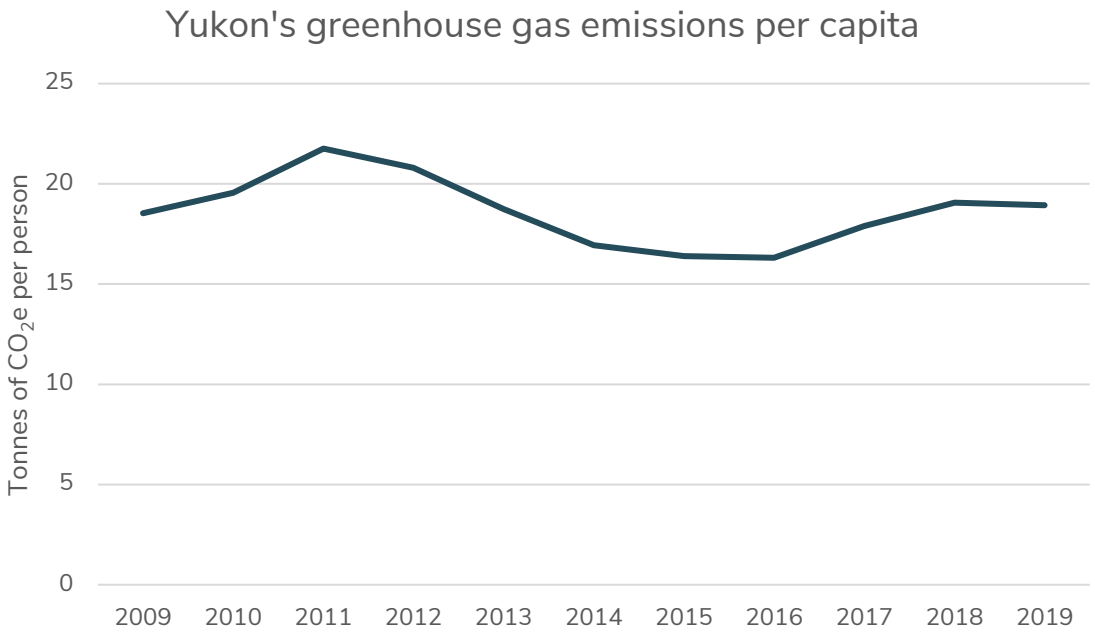

Figure 7. Yukon's greenhouse gas emissions per capita from 2009 to 2019.

While economic growth, and to a lesser degree population growth, appear to be strong drivers of Yukon's greenhouse gas emissions historically, we plan to decouple[6] Yukon's emissions from these factors through the actions in *Our Clean Future: a Yukon strategy for climate change, energy and a green economy*.

Conclusions

Yukon's emissions increased 14 per cent between 2010 and 2019. This increase appears to be linked to larger trends such as Yukon's economic and population growth. In particular, emissions from the transportation sector increased significantly (17 per cent) over this period. More information on the actions that Government of Yukon is taking to significantly reduce Yukon's emissions can be found in the *Our Clean Future 2020 Progress Report*.

[6] Decoupling refers to having continued economic growth without a corresponding increase in GHG emissions.

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