Yukon

Greenhouse gas emissions in the Yukon: 2021

December 2023

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Yukon-wide: 2021 greenhouse gas emissions

2021 total emissions:

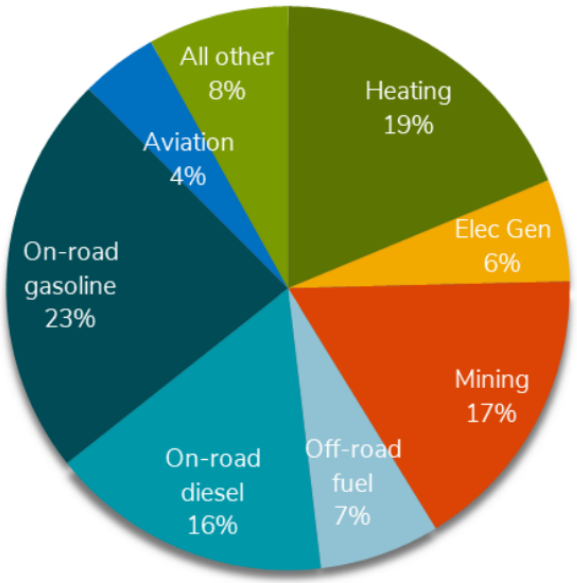
705 kilotonnes of CO_2e

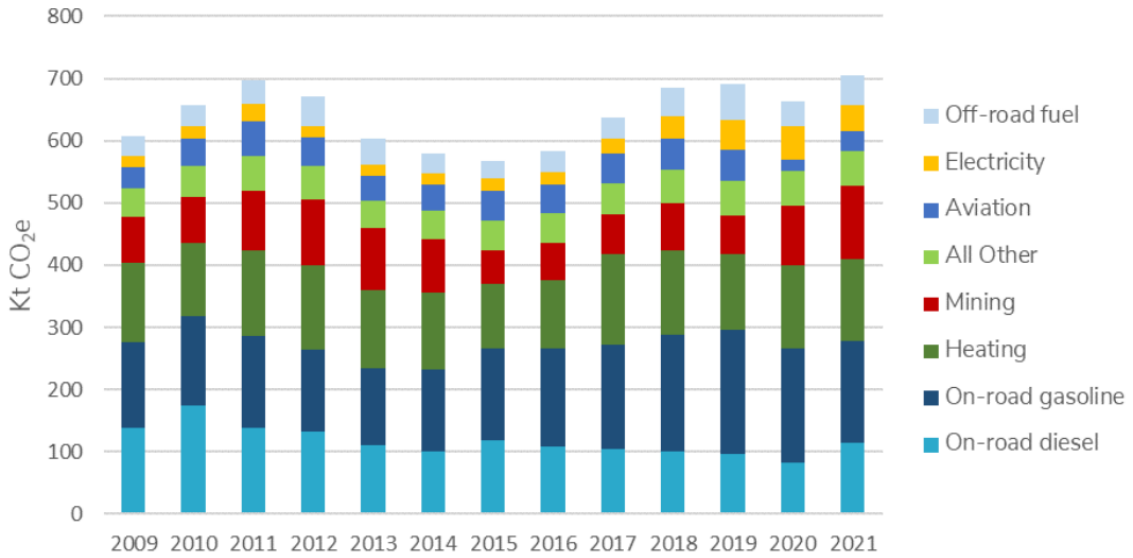
Compared to 2010 levels: ↑ 7% increase

Compared to 2020 levels: ↑ 6% increase

Emissions increased somewhat in 2021, mainly due to increases in on-road diesel, mining and aviation compared to 2020.

Key emission sources:





Connection to *Our Clean Future* goals:

Our Clean Future Goal 1 is to reduce the Yukon's greenhouse gas emissions, with targets of reducing non-mining emissions to 45 per cent below 2010 levels by 2030, and overall emissions to net-zero by 2050. This report shares information on the Yukon's **total** (mining and non-mining) emissions.

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. To measure our progress, accurate and transparent greenhouse gas tracking and reporting is vital. Emissions are reported with a two-year lag (meaning 2021 emissions are being reported in 2023) due to the length of time required for key data sources to be compiled and analyzed.

This report presents the Yukon's most recent greenhouse gas emissions data, explains how they are calculated including an overview of recent methodological updates, and analyses the impact of key factors such as the Yukon's population and gross domestic product on emissions.

Methodology

Greenhouse gases

Greenhouse gases absorb heat and trap it in the Earth's atmosphere. Their concentration in the atmosphere has increased significantly over the past several decades, raising the planet's overall temperature. Carbon dioxide (CO_2) accounts for the majority of human-caused emissions. Several other greenhouse gases are released due to human activity, and are significantly more potent than CO_2. The Government of Yukon reports the Yukon's emissions in terms of carbon dioxide equivalent (CO_2e). This metric includes the six greenhouse gases 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 greenhouse gases 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 gases emitted in the Yukon. These values are used to calculate carbon dioxide equivalent (CO_2e) values for all non-CO_2 greenhouse gases.

Greenhouse gas	Global warming potential[1]
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
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 the Yukon's emissions in order to source the best available data for all sectors. The first source is the National Inventory Report, which is produced annually by the Government of Canada and reports the greenhouse gas emissions of all provinces and territories.

The second data source is the Yukon's fuel tax databases, which track the total volume of fuel purchased in the 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.

For more information on how emissions are calculated for each fuel type, see Table 4 in Appendix A.

Methodological updates

The methods used to measure greenhouse gases are being improved on a regular basis. When there is an update to the methods used to calculate emissions, the new

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

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 emissions report and applied to previous years. These updates include:

- **On-road gasoline; on-road diesel; off-road fuel (gasoline and diesel):** Revisions to how diesel and gasoline are classified into 'on-road' and 'off-road' categories in Canada's National Inventory Report led to a decrease in on-road fuel and a corresponding increase in off-road fuel, which includes mining. Since data from the Yukon Fuel Tax Database were used to calculate the Yukon's mining emissions, this means some mining emissions were previously being double-counted. These double-counted emissions have now been removed, resulting in a consistent decrease in the Yukon's historical emissions.
- **All Other:** Small changes (0.1 – 4.2 kilotonnes (kt) CO_2e) to solid waste disposal emissions due to improved carbon content assumptions.
- **Aviation; mining**: Small changes (>1 kt CO_2e) due to minor revisions to Yukon's fuel tax databases.

Table 2. Revisions to Yukon's historical greenhouse gas emissions due to methodological updates. Revisions highlighted in yellow.

		Aviation	Heating	Electricity Generation	Mining	Non-mining off-road fuel	On-road gasoline	On-road diesel	All other	**Total**
2009	Old	33.9	128	17.6	72.5	11.9	153.6	169.6	51.5	638.6
	New	33.8	128	17.6	72.5	31.1	138.6	137.6	47.3	606.4
2010	Old	43.5	118.6	19.7	73.1	13.1	157.8	219.2	53.1	698.1
	New	43.4	118.6	19.7	73.1	33.5	143.8	174.4	50.7	656.8
2011	Old	56.5	137.2	29.1	96.9	10.3	160.2	238.3	55.9	784.4
	New	56.4	137.2	29.1	96.8	38.1	148.8	137.5	54.1	698.1
2012	Old	44.5	136.8	19.2	104.8	9.3	154.2	239.3	56.3	764.5
	New	44.5	136.8	19.2	104.8	47.8	132.1	131.3	55.2	671.7
2013	Old	39.1	126.1	18.7	99.1	8.6	139.9	217.4	45.4	694.3
	New	39.0	126.1	18.7	99.1	41.3	124.8	109.8	44.1	602.9
2014	Old	42.8	123.5	18.1	84.5	8.7	141.8	172.5	46.8	638.7
	New	42.8	123.5	18.1	84.4	31.7	131.9	100.8	46.1	579.5
2015	Old	49.4	103.8	20.1	55.2	9.6	150.1	193.2	46.6	628.0
	New	49.3	103.8	20.1	55.2	27.3	147.1	118	46.8	567.7
2016	Old	44.8	108.2	20.3	60.9	9	169.1	177	48.6	637.9
	New	44.7	108.2	20.3	61.2	33.7	157.4	109.3	48.1	582.9
2017	Old	46.5	146.6	25.7	64	8.2	171.5	203.3	51.1	716.9
	New	46.5	146.6	25.7	63.9	33.8	165.9	105.2	50.4	638.0
2018	Old	50.4	135.7	36.7	75.9	10.4	195	227.2	55	786.3
	New	50.3	135.7	36.7	75.8	44.2	187.5	99.8	54.2	684.2
2019	Old	49.8	120.9	49.5	61.8	12.7	221.7	220.8	57.4	794.7
	New	49.8	120.9	49.5	61.7	57.7	199.9	96.5	55.9	691.9
2020	Old	17.4	134	54.7	95.5	17.1	187.5	172.3	58.8	737.4
	New	17.4	134	54.7	95.5	39.7	183.1	82.2	56.4	663.0
2021	Old	-	-	-	-	-	-	-	-	-
	New	31.1	132.2	41.4	117.1	48.8	163.2	114.4	57.1	705.3

Results

Our Clean Future and the new *Clean Energy Act* commit to:

A. Reaching a greenhouse gas reduction target of 45 per cent, not including mining sector emissions, below 2010 levels by 2030; and,
B. Reaching net-zero total greenhouse gas emissions by 2050.

The text below describes our progress to each of these targets.

In 2021, the Yukon's non-mining greenhouse gas emissions (target A, above) were 588.2 kt of CO_2e. This is a one per cent increase above the 2010 baseline, and a four per cent increase from 2020 levels.

In 2021, the Yukon's total greenhouse gas emissions (target B, above) for all categories, including mining, were 705 kt of CO_2e. This is a seven per cent increase above the 2010 baseline, and a six per cent increase from 2020 levels.

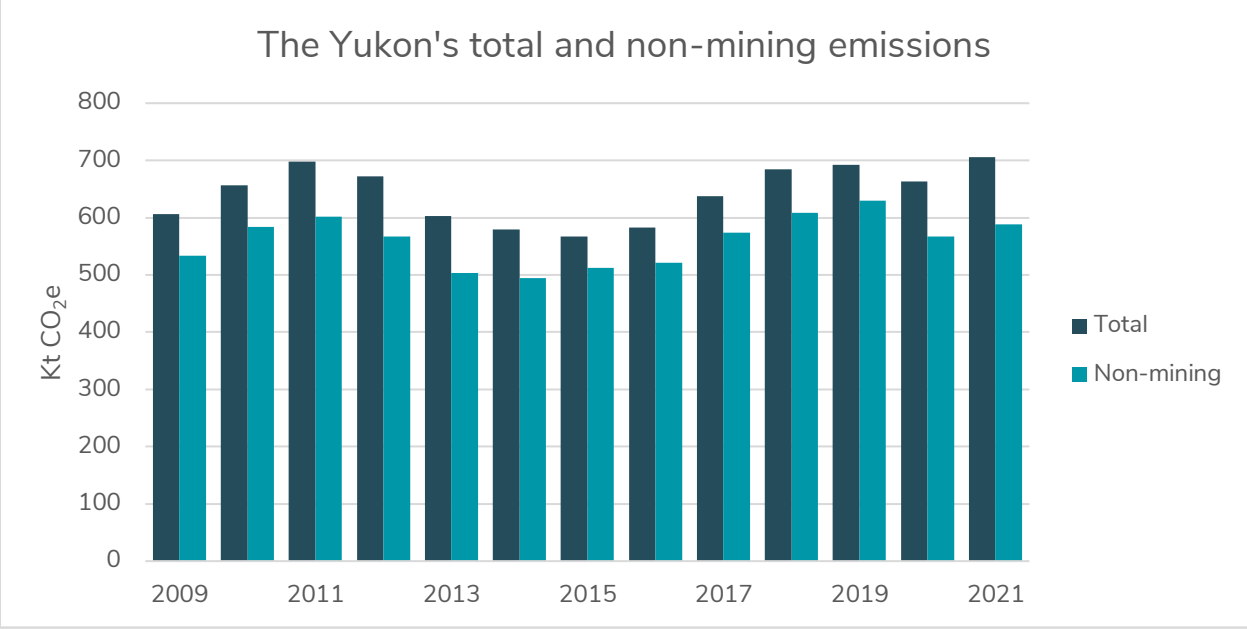


Figure 1. The Yukon's total and non-mining greenhouse gas emissions from 2009 to 2021.

Road transportation continues to be the Yukon's main emission source, making up 48 per cent of 2010 emissions and 39 per cent of 2021 emissions (Figure 2). The lower

share of emissions from road transportation indicates a decrease in on-road diesel emissions over time.

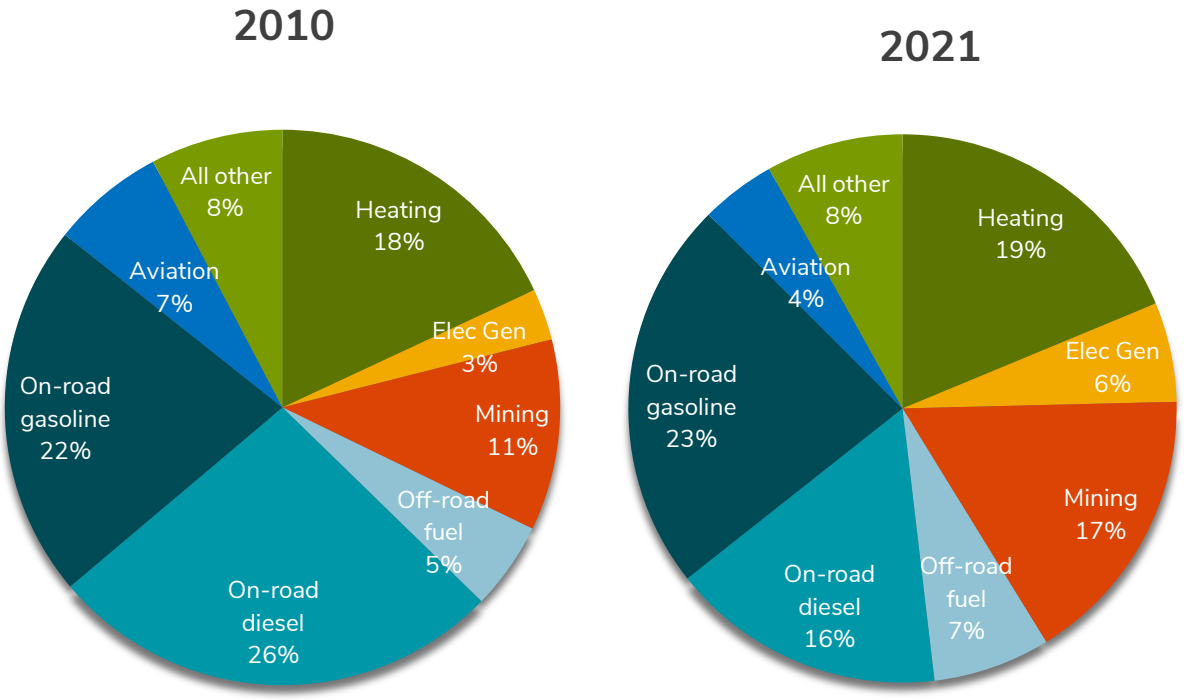


Figure 2. The Yukon's emissions by fuel type in 2010 and 2021. Transportation sector emissions (which include on-road, off-road and aviation fuel) are indicated in blue and make up 55 and 43 per cent of Yukon's emissions in 2010 and 2021, respectively.

Some key changes to emissions were:

- Emissions from electricity generation have increased overall since 2010 despite a significant drop between 2020 and 2021. Current electricity generation emissions are approximately double those in 2010.
- Aviation emissions remained low in 2021, making up a lower proportion of emissions in 2021 compared to 2010.
- Mining emissions made up approximately one sixth of the Yukon's 2021 emissions, which is a higher proportion than in previous years.

Figure 3 demonstrates the changes to emissions in each category between 2010 and 2021. Some categories (mining, heating) show high inter-annual variation, while others (off-road fuel, aviation, other sources) remain relatively consistent. Some notable preliminary trends are the overall increase in on-road gasoline and electricity generation emissions and the overall decrease of on-road diesel emissions.

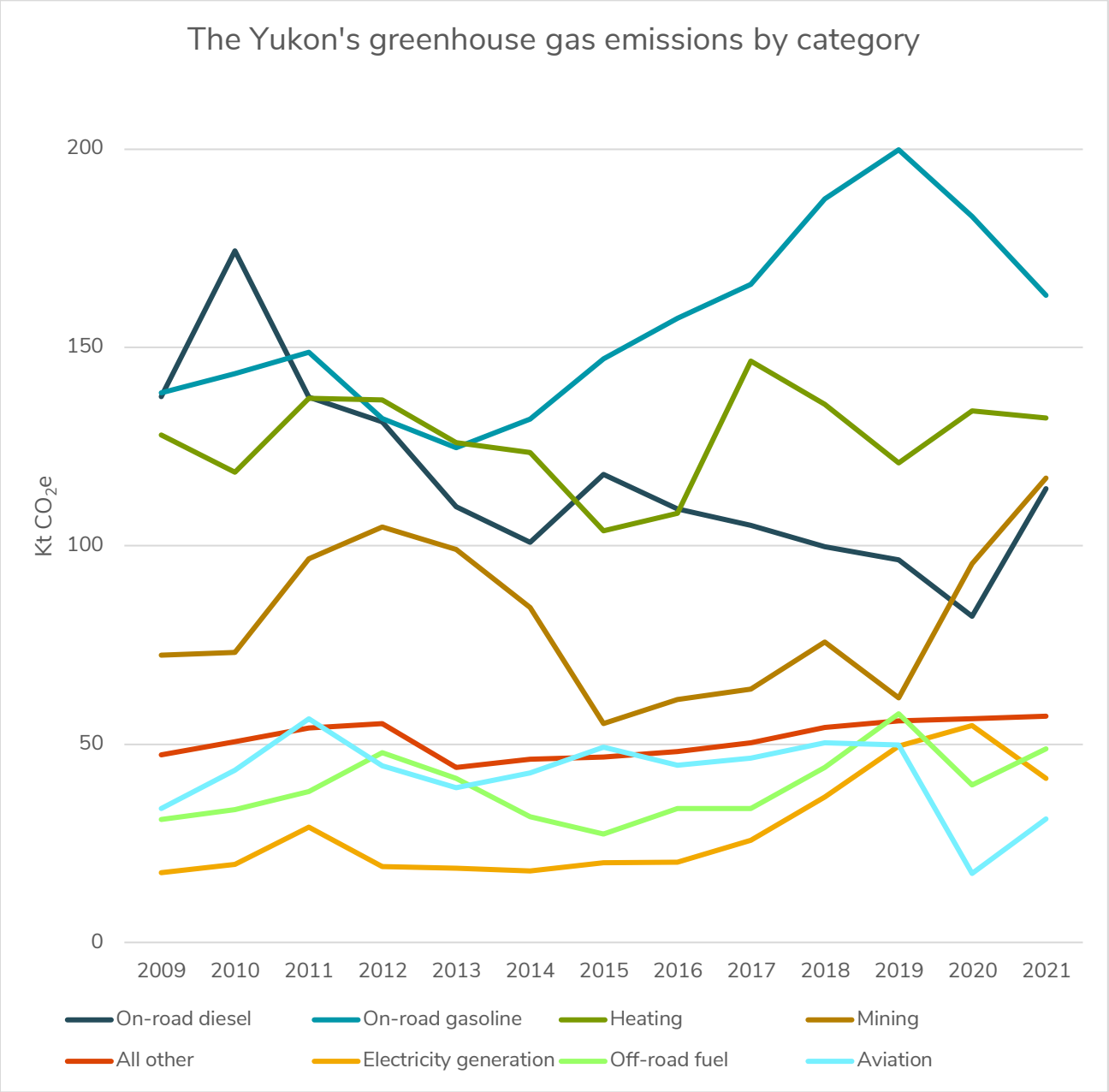


Figure 3. The Yukon's emissions by category from 2009 to 2021.

Emissions Category	2009	2010 (base year)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	% Change[2] 2010-2021
Heating diesel/propane	128	119	137	137	126	124	104	109	147	136	121	134	132	+11
LNG/diesel for electrical generation	18	20	29	19	19	18	20	20	26	37	50	55	41	+110
Mining off-road fuel	76	73	97	105	99	85	55	61	64	76	62	96	117	+60
On-road diesel	138	174	138	131	110	101	118	109	105	100	97	82	114	-34
On-road gasoline	139	143	149	132	125	132	147	157	166	188	200	183	163	+14
Aviation gas/jet fuel	34	45	56	45	39	43	49	45	47	50	50	17	31	-28
Off-road fuel	31	34	38	48	41	32	27	34	34	44	58	40	49	+45
All other	47	51	54	55	44	46	47	48	50	54	56	56	57	+13
Non-mining total	534	584	601	567	504	495	513	522	574	608	630	568	588	+1
Total	606	657	698	672	603	579	568	583	638	684	692	663	705	+7

Table 3. The Yukon's total greenhouse gas emissions by fuel type from 2010 to 2021.

Analysis

COVID-19

The Yukon's 2021 emissions are comparable to levels seen prior to the COVID-19 pandemic. However, transportation emission patterns over this period appear to still be linked to the impact of the COVID-19 pandemic on Yukoners' transportation choices (Figure 4). For example:

- On-road gasoline emissions continued to decrease, with 2021 emissions being 11 per cent lower than those in 2020.
- Aviation emissions increased by 79 per cent in 2021 relative to 2020 levels but remained well below pre-COVID levels.

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

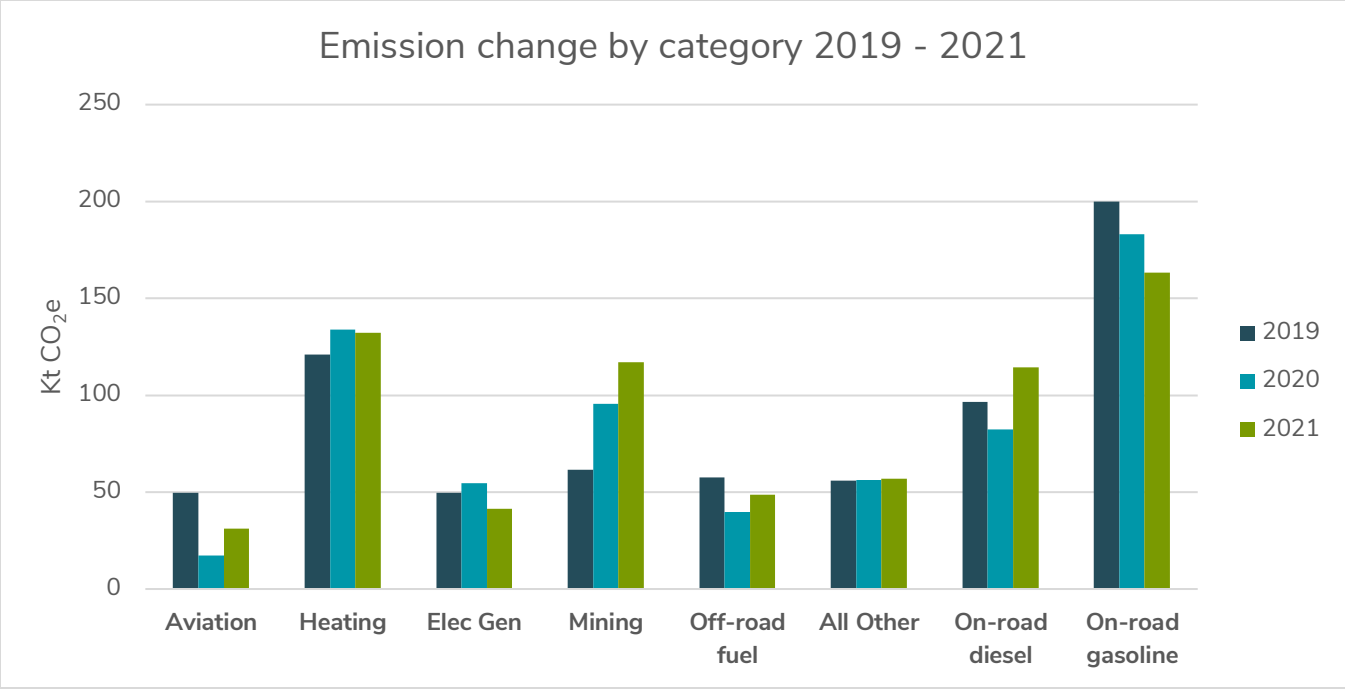


Figure 4. Change in greenhouse gas emissions by category between 2019 and 2021. Categories reflecting personal transportation choices (aviation, on-road gasoline) remain well below 2019 levels, which may be due in part to the COVID-19 pandemic.

Gross Domestic Product

Territory-wide demographic and economic factors such as population change, and gross domestic product (GDP) impact the Yukon's emissions. A growing economy appears to be correlated to the increase in greenhouse gas emissions.

Since 2010, the Yukon's greenhouse gas emissions have increased seven per cent, while its GDP has increased by 30 per cent (Figure 5).

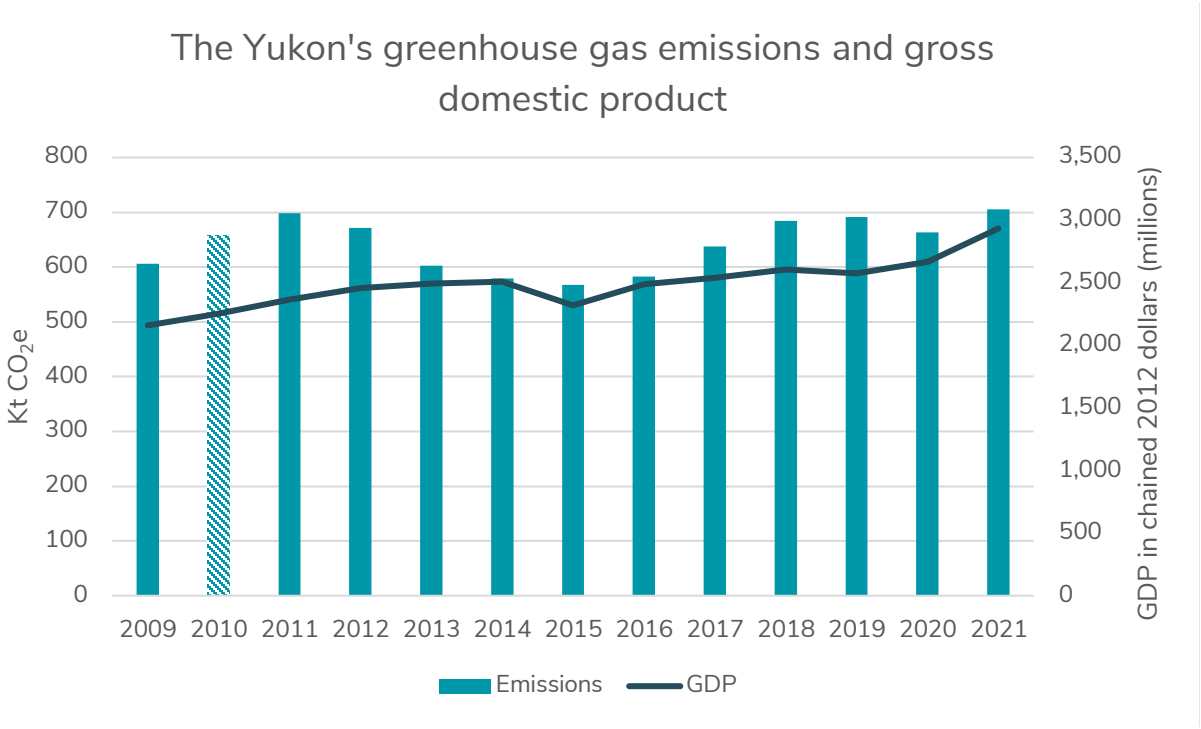


Figure 5. The Yukon's greenhouse gas emissions and gross domestic product[3] from 2009 to 2021. 2010 (represented by the patterned bar) is used as a baseline for all comparisons in order to align with Our Clean Future targets.

The Yukon's GDP increased ten per cent between 2020 and 2021, mainly due to increases in the mining and construction sectors. In past years in which emissions were particularly high, such as 2011 and 2018, mining emissions have been visibly higher compared to other years. This points to this category as being a potential driver of inter-annual variation.

The emissions intensity of the Yukon's economy (measured in tonnes of CO_2e per million chained 2012 dollars[4]) have gradually declined somewhat over time, and is currently three per cent lower than in 2010 (Figure 6).

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

[4] Chained 2012 dollars is a measure used to correct for inflation over time to allow for the comparison of values from different years with 2012 as a base year.

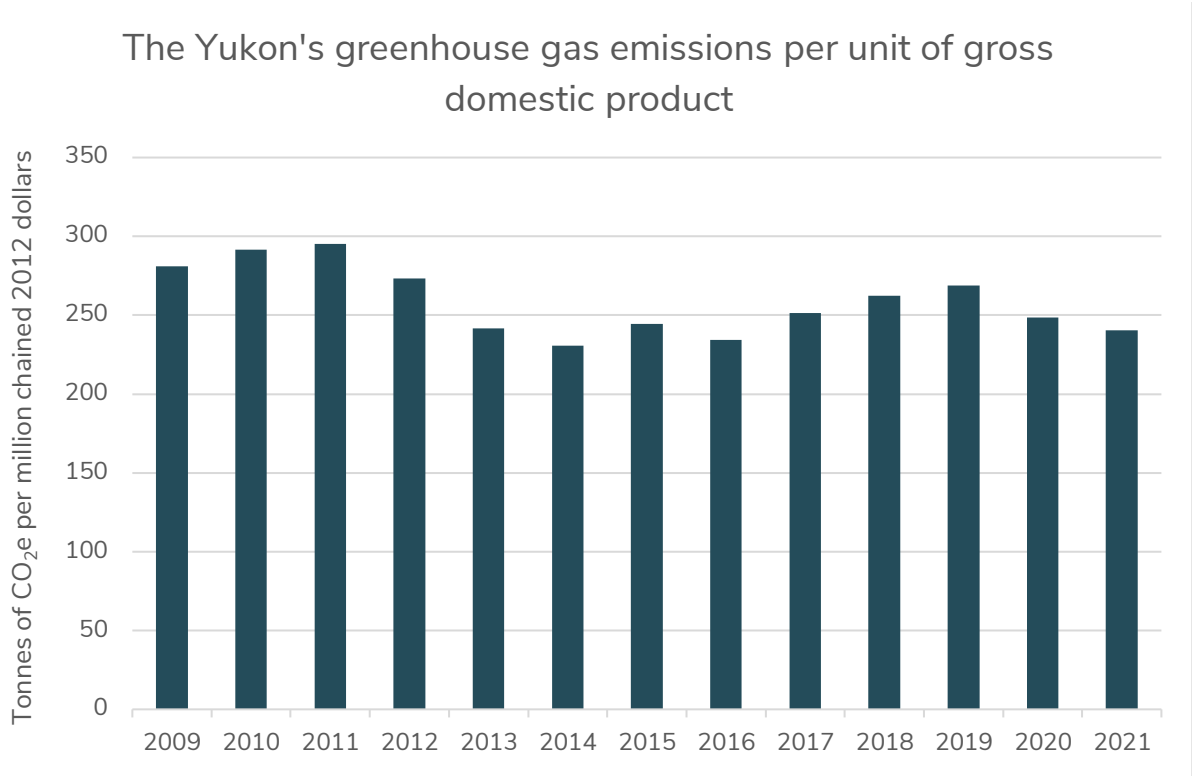


Figure 6. The Yukon's greenhouse gas emissions per unit of gross domestic product from 2009 to 2021.

Population

Similar to GDP, the Yukon's population increased 24 per cent between 2009 and 2021 (Figure 7). This increase has been consistent from year to year, growing from approximately 34,000 people in 2009 to 43,000 people in 2021. While the Yukon's greenhouse gas 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.

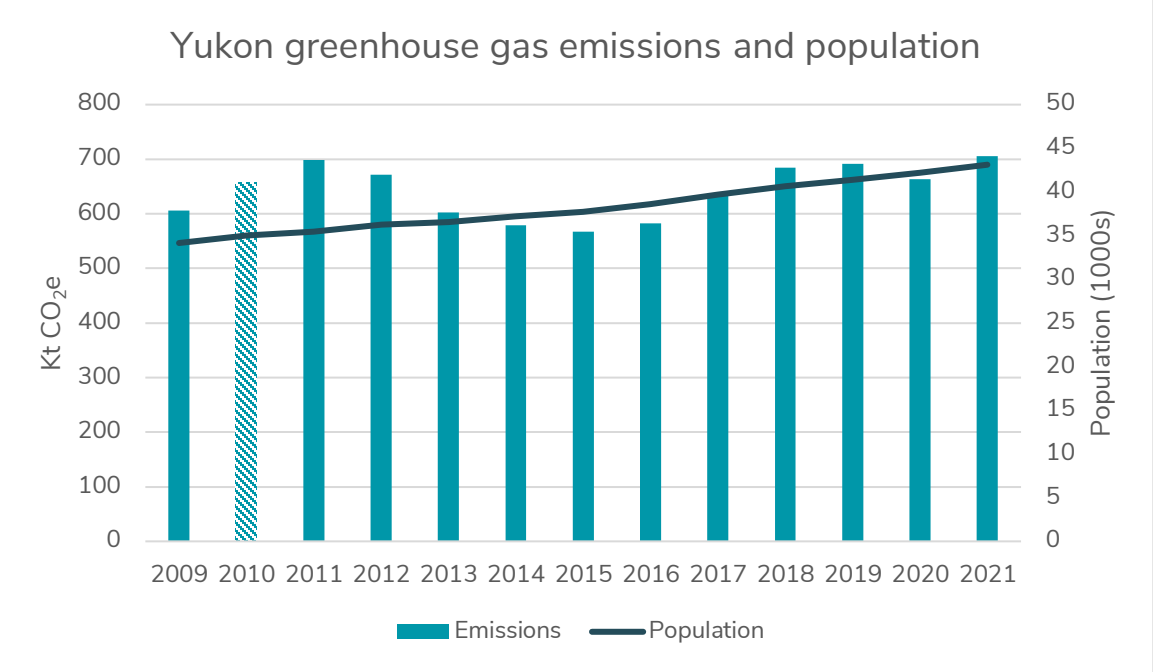


Figure 7. The Yukon greenhouse gas emissions and population[5] from 2009 to 2021. 2010 (represented by the patterned bar) is used as a baseline for all comparisons in order to align with Our Clean Future targets.

The Yukon's per capita emissions in 2021 were 16.4 tonnes per person, which is a 13 per cent decrease from 2010 levels of 18.8 tonnes per person (Figure 8). The Yukon has the 5th highest per capita emissions of Canada's 13 provinces and territories.

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

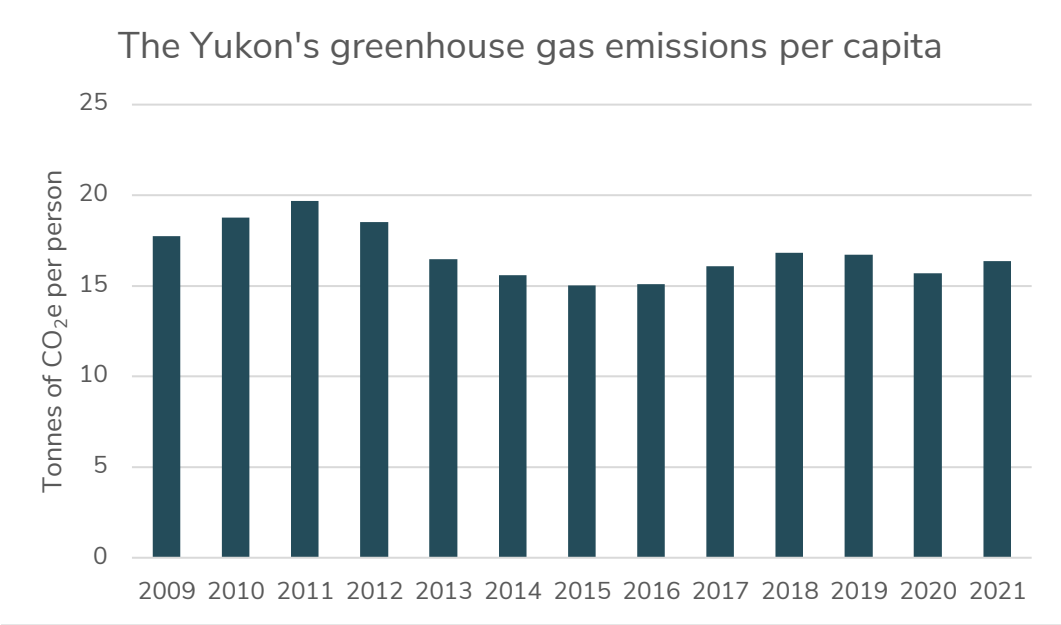


Figure 8. The Yukon's greenhouse gas emissions per capita from 2009 to 2021.

While economic growth, and to a lesser degree population growth, appear to be strong drivers of the Yukon's greenhouse gas emissions historically, we plan to decouple[6] the 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

The Yukon's total emissions in 2021 were seven per cent higher than those in 2010. The increase over the past decade appears to be linked to larger trends, such as the Yukon's economic and population growth. It is promising to see that emissions per capita and per unit of GDP remain well below 2010 levels.

The Yukon is at the start of a long journey towards decarbonisation, guided by the Our Clean Future strategy. Progress is difficult to measure in early years due to the wide

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

range of factors that impact greenhouse gas emissions but is expected to become more and more pronounced as we move towards 2030. Updates on the progress that Government of Yukon has made towards the targets established in Our Clean Future can be found in the 2022 Our Clean Future Annual Report.

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Appendix A – Detailed Methodology

Table 4: Fuel types included in Yukon's greenhouse gas emission inventory.

Fuel type	Description	Data source	Methodology
Aviation fuel	Aviation gas, jet fuel, and any other aviation fuels sold within the 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 the Yukon.
Electricity generation	Diesel and liquified 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 the 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 purposes under the Fuel Tax Exempt Program.
Off-road fuel	Diesel and gasoline not intended for use on official roadways. This includes fuel	National Inventory Report	Emissions calculated based on outputs of simulation model which estimates off-road fuel consumption using factors including number and type of off-

Fuel type	Description	Data source	Methodology
	used for snowmobiles and all-terrain vehicles.		road vehicles, hours of annual run-time and average cargo weight.
On-road diesel	Diesel used in registered vehicles intended to be used on official roadways only.	National Inventory Report	Emissions calculated based on outputs of simulation model which estimates on-road fuel consumption using factors including number and type of registered vehicles, average annual kilometres driven per vehicle type, and uptake of emission control technology.
On-road gasoline	Gasoline used in registered vehicles intended to be used on official roadways only.	National Inventory Report	
All other sources	Emission sources not included in the above categories. This mainly includes direct emissions 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.