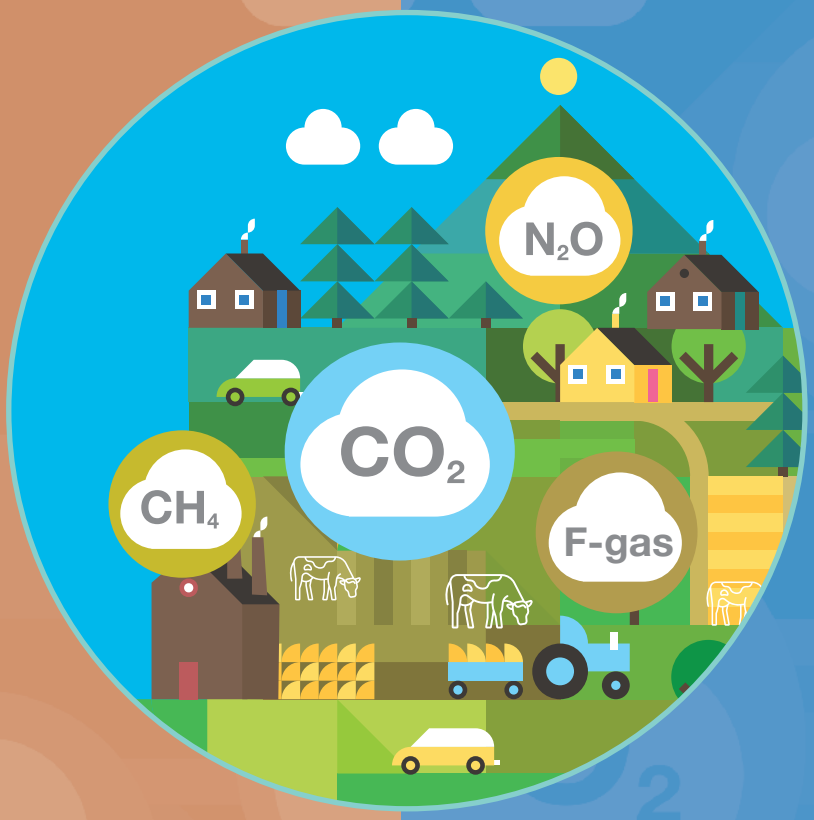
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Quarterly Greenhouse Gas Emissions Indicator Report

2024 Quarter 4

May 2025

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1. Key Findings

Please note that all quoted figures in Key Findings are comparing emissions at the end of Quarter 4 2024 with emissions at the end of Quarter 4 2023 unless otherwise indicated. Emissions are broken down by Climate Action Plan-aligned sectors, excluding LULUCF (Land Use, Land Use Change and Forestry).

Quarterly figures are more susceptible to volatility and seasonality, particularly in the case of comparison to the previous quarter. In addition, these data have been seasonally adjusted to provide a clearer picture of underlying trends by eliminating the noise caused by seasonal fluctuations.

An increase or decrease in quarterly emissions does not indicate an overall yearly change in the same direction.

Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Overall greenhouse gas emissions increased by +2.5% (+311.1 kt CO_2 eq) compared to Quarter 4 2023.
- The largest increase in emissions occurred in the Electricity (+185.8 kt CO_2 eq) sector, followed by the Agriculture (+183.1 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Industry (-98.7 kt CO_2 eq) sector.

Looking at 2024 compared to Full Year 2023:

- Overall greenhouse gas emissions decreased by -0.6% (-311.9 kt CO_2 eq) compared to Full Year 2023.
- The largest decrease in emissions occurred in the Electricity (-459.7 kt CO_2 eq) sector, followed by the Industry (-304.5 kt CO_2 eq) sector.
- The largest increase in emissions occurred in the Buildings (+455.8 kt CO_2 eq) sector, followed by the Agriculture (+159.0 kt CO_2 eq) sector.

There were 6.3% more heating degree days (HDD, days below 15.5 degrees Celsius where heating would be needed) in 2024 compared to 2023, resulting in increased demand for heating in the Building sector. In particular, there was a marked increase of HDDs in the Summer/Autumn months (June (+153%), July (+28%), August (+45%), September (+54%)).

The share of the energy supply from renewables for electricity generation reduced from 40.5% in 2023 to 38.6% in 2024, as did the share of energy from fossil fuels (49.4% in 2023 reduced to 46.4% in 2024). The reduction in generation was met by the share of the energy from Interconnectors increasing from 10.1% in 2023 to 15.0% in 2024.

Table 1: Key Findings

Sector	Key Finding
Q4 2023 vs. Q4 2024	GHG emissions increased by +2.5% (+311.1 kt CO_2 eq) driven mainly by increases in both the Electricity sector (+185.8 kt CO_2 eq) due to a 19% increase in electricity generated from fossil fuels, and the Agriculture sector (+183.1 kt CO_2 eq) due to increased methane emissions from enteric fermentation.
Agriculture	There was a +3.8% (+183.1 kt CO_2 eq) increase in emissions compared to the same quarter last year. This was due to increased methane emissions from enteric fermentation from dairy cows, driven by increased milk production (+23.6%) in comparison to Q4 2023.
Transport	The primary drivers of the +0.7% (+21.0 kt CO_2 eq) change in emissions this quarter were increased sales of petrol (+7.6%) and decreased sales of diesel (-0.7%) compared to the same quarter last year, offset somewhat by increased biofuel blending rates for petrol (9.8% versus 7.2% by volume) compared to diesel (6.4% versus 6.6% by volume).
Electricity	Emissions increased by +11.3% (+185.8 kt CO_2 eq) due to an increase in fossil fuel use (19.3% increase), and a decrease in electricity generated from renewable sources (-9.9% decrease). In this quarter, the share of the energy supply from imports remained similar: 12.3% in Q4 2024 versus 11.8% in Q4 2023.
Buildings – Commercial & Public	Emissions increased in the Commercial & Public Services (+16.3 kt CO_2 eq) sector due to increased fossil fuel use driven by reduced commercial gas prices.
Buildings – Residential	Emissions increased by +0.8% (+10.3 kt CO_2 eq) driven by reduced gas prices. There were 3.3% fewer heating degree days in Q4 (HDD, days with average temperature below 15.5 degrees Celsius where heating would be needed) compared to the same quarter in 2023.
Industry	Emissions were down -9.8% (-98.7 kt CO_2 eq), driven by reductions in both Manufacturing Combustion and the Mineral Industry. The latter was driven by a drop in production of cement clinker (a key component of cement) as the demand for less carbon intensive construction products increased.
GHG Emissions Q3 2024 to Q4 2024	Overall GHG emissions increased by +0.3% (+36.6 kt CO_2 eq) compared to Quarter 3 2024, on a seasonally adjusted basis, driven mainly by decreases in the Buildings sector (-161.7 kt CO_2 eq) due to reduced heating demand driven by milder weather conditions, and decreases in the Industry sector (-49.0 kt CO_2 eq) driven by reduced emissions from the cement sector in line with a reduction in clinker production.
GHG Emissions Full Year 2023 to 2024	Cumulative GHG emissions for the full year 2024 decreased by -0.6% (-311.9 kt CO_2 eq) compared to 2023. This change was driven mainly by decreases in the Electricity sector (-459.7 kt CO_2 eq) due to increased imports of electricity, and the Industry sector (-304.5 kt CO_2 eq) driven by reduced emissions from the cement sector. However, emissions from the Buildings sector rose (+445.8 kt CO_2 eq) due to increased heating demand from cooler weather.

Table 2 shows the year-on-year changes for 2024 Quarter 4 compared to 2023 Quarter 4, quarter-on-quarter changes for 2024 Quarter 4 compared to 2024 Quarter 3, and year-to-date changes for 2024 compared to 2023.

Table 2: Key Findings

Sector	Emissions Q4 2024 (kt CO_2 eq)	Comparison with Q4 2023 (%)	Comparison with Q3 2024 (%)	Full Year 2024 vs. 2023 (%)
Overall	**12663.8**	**2.5**	**0.3**	**-0.6**
Agriculture	4984.0	3.8	0.9	0.8
Buildings	1730.3	1.6	-8.5	6.6
Electricity	1823.0	11.3	10.7	-6.4
Industry	910.4	-9.8	-5.1	-7.4
Other	355.6	-1.9	-4.4	0.1
Transport	2860.6	0.7	1.5	-1.3

2. 2024 Quarter 4 Summary

This section presents the key high-level emissions estimates for Quarter 4 2024, followed by further sectoral analysis in Section 3.

Figure 1 shows that from a high in Q2 2018 overall emissions are on a downward trend with marked drop in emissions during the Covid-19 pandemic lockdown in Q2 2020.

Similarly, Figure 2 summarises emissions per Climate Action Plan-aligned sector, excluding LULUCF (Land Use, Land Use Change and Forestry). Since 2018, the broadly consistent trend in emissions reductions can be seen in the Buildings, Electricity and Industry sectors. The only major change was in Q2 2020 and Q2 2021 during the Covid-19 pandemic lock downs, with marked reductions in transport emissions. Agriculture remains the largest source of emissions throughout this period and the 'Other' sector (waste, petroleum refining and fluorinated gases) the smallest source.

Figure 1: Overall quarterly movement in greenhouse gas emissions for all sectors from Q1 2018 to Q4 2024.

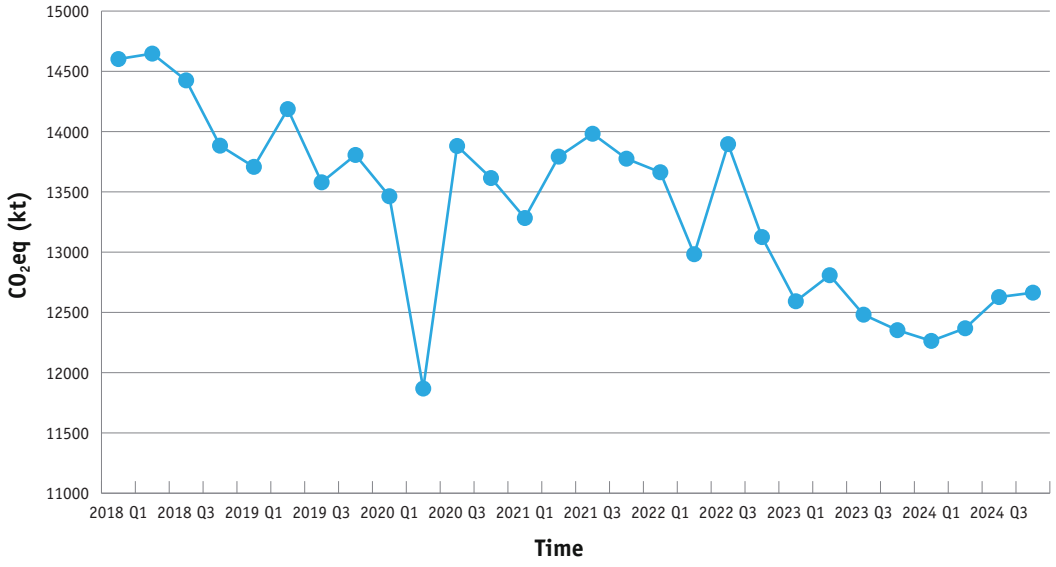
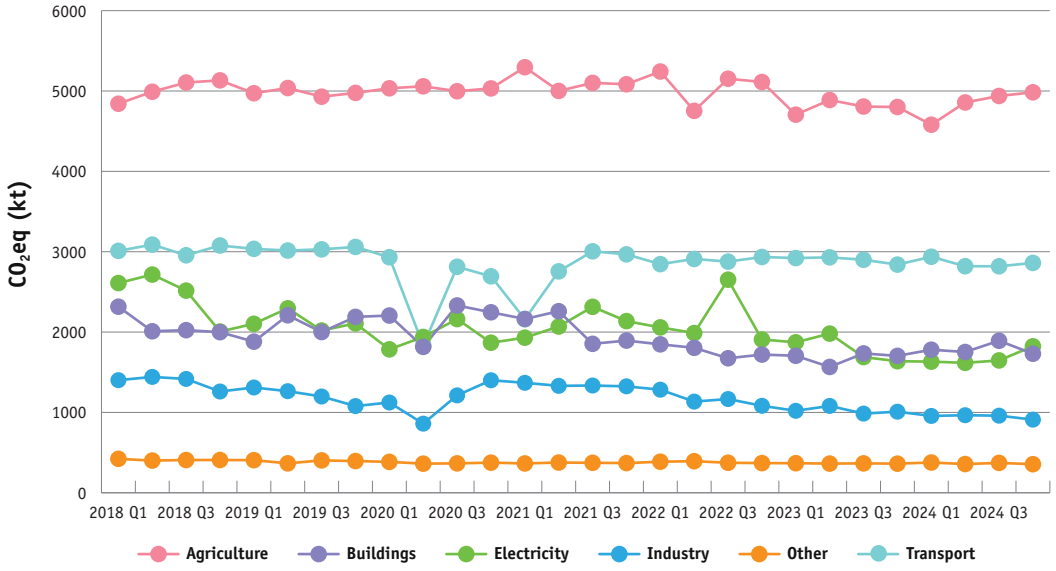


Figure 2: Overall quarterly movement in greenhouse gas emissions for all Sectors from Q1 2018 to Q4 2024.



2.1 Year-on-Year Change

In this section we look at the emissions for Quarter 4 2024 and compare them to Quarter 4 2023. We will also provide cumulative emissions (Year-To-Date) for the four quarters of 2024 in comparison to the four quarters of 2023.

Key finding:

- Overall GHG emissions increased by +2.5% (+311.1 kt CO_2 eq) compared to Quarter 4 2023, driven mainly by increases in the Electricity sector (+185.8 kt CO_2 eq) due to a 19% increase in electricity generated from fossil fuels, and the Agriculture sector (+183.1 kt CO_2 eq) due to increased methane emissions from enteric fermentation from dairy cows, driven by increased milk production (+23.6%) in comparison to Q4 2023.

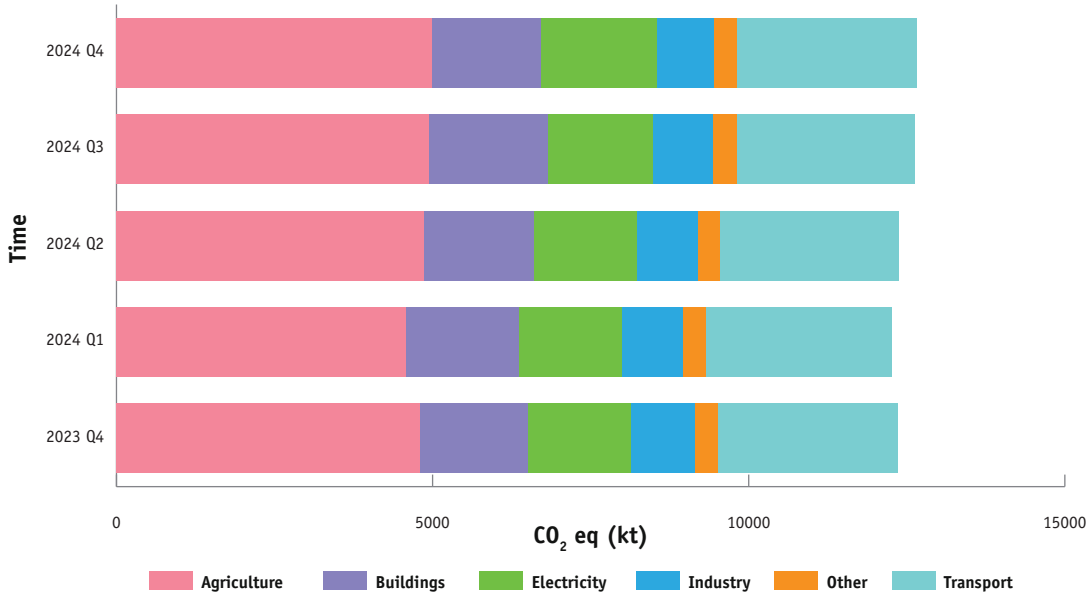
Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Overall greenhouse gas emissions increased by +2.5% (+311.1 kt CO_2 eq) compared to Quarter 4 2023.
- The largest increase in emissions occurred in the Electricity (+185.8 kt CO_2 eq) sector, followed by the Agriculture (+183.1 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Industry (-98.7 kt CO_2 eq) sector.

Table 3: Summary Q4 2024 compared to Q4 2023

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (%)
Overall		**12663.8**	**311.1**	**2.5**
Agriculture	CH_4, CO_2, N_2O	4984.0	183.1	3.8
Buildings	CH_4, CO_2	1730.3	26.7	1.6
Electricity	CO_2	1823.0	185.8	11.3
Industry	CO_2	910.4	-98.7	-9.8
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	355.6	-6.8	-1.9
Transport	CO_2	2860.6	21.0	0.7

Figure 3: Overall quarterly movement in greenhouse gas emissions for all Sectors from Q4 2023 to Q4 2024.



2.2 Year-to-Date Change

Key finding:

- Overall GHG emissions decreased by -0.6% (-311.9 kt CO_2 eq) compared to the same period in 2023, driven mainly by decreases in the Electricity sector (-459.7 kt CO_2 eq) due to a significant increase in imports of electricity (+54.5%), and the Industry sector (-304.5 kt CO_2 eq) driven by reduced emissions from the cement sector in line with a reduction in clinker production.

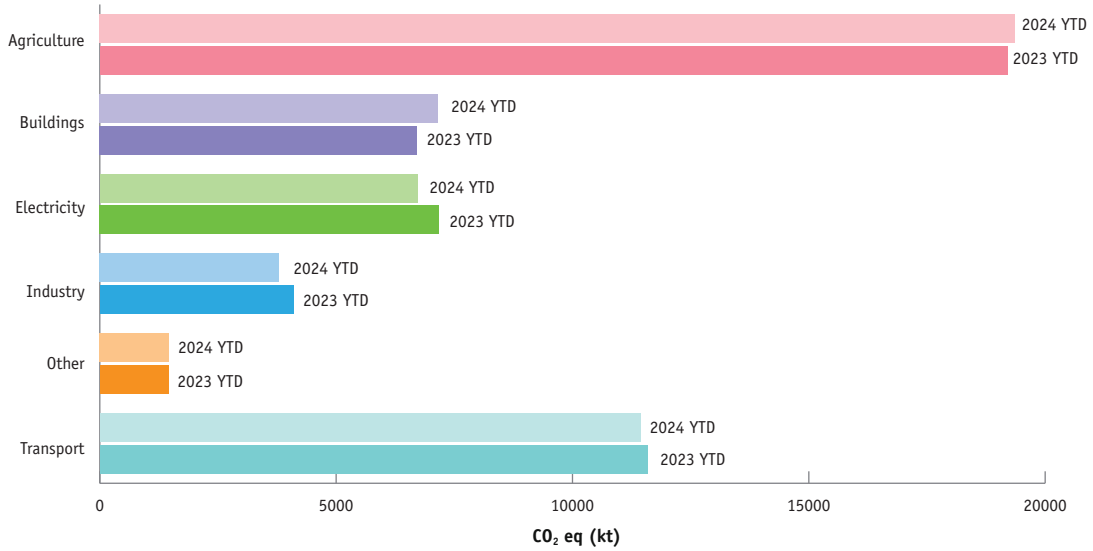
Looking at 2024 compared to Full Year 2023:

- Overall greenhouse gas emissions decreased by -0.2% (-102.6 kt CO_2 eq) compared to Full Year 2023.
- The largest decrease in emissions occurred in the Electricity (-459.7 kt CO_2 eq) sector, followed by the Industry (-304.5 kt CO_2 eq) sector.
- The largest increase in emissions occurred in the Buildings (+445.8 kt CO_2 eq) sector, followed by the Agriculture (+159.0 kt CO_2 eq) sector.

Table 4: Summary YTD 2024 compared to YTD 2023

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Overall		**49922.8**	**-311.9**	**-0.6**
Agriculture	CH_4, CO_2, N_2O	19360.1	159.0	0.8
Buildings	CH_4, CO_2	7154.6	445.8	6.6
Electricity	CO_2	6719.4	-459.7	-6.4
Industry	CO_2	3791.4	-304.5	-7.4
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	1461.4	1.9	0.1
Transport	CO_2	11435.9	-154.5	-1.3

Figure 4: Comparing Year-To-Date 2024 to Year-To-Date 2023 by sector.



2.3 Quarter-on-Quarter Change

Key finding:

- Overall GHG emissions increased by +0.3% (+36.6 kt CO_2 eq) compared to Quarter 3 2024, on a seasonally adjusted basis, driven mainly by decreases in the Buildings sector (-161.7 kt CO_2 eq) due to reduced heating demand driven by milder weather conditions, and decreases in the Industry sector (-49.0 kt CO_2 eq) driven by reduced emissions from the cement sector in line with a reduction in clinker production.

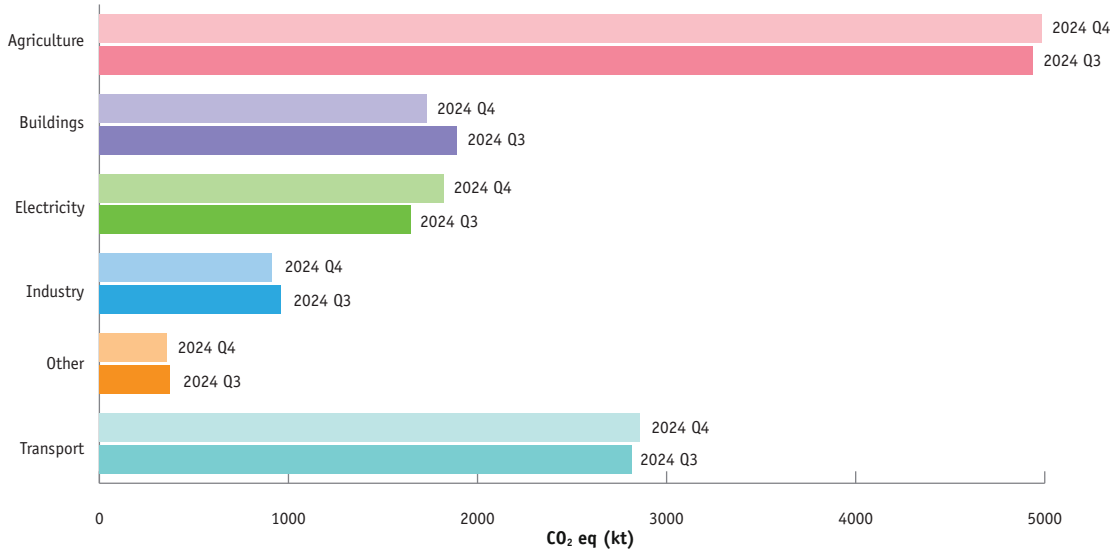
Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Overall greenhouse gas emissions decreased by -0.4% (-48.1 kt CO_2 eq) compared to Quarter 3 2024.
- The largest decrease in emissions occurred in the Buildings (-161.7 kt CO_2 eq) sector, followed by the Industry (-49.0 kt CO_2 eq) sector.
- The largest increase in emissions occurred in the Electricity (+175.8 kt CO_2 eq) sector, followed by the Agriculture (+45.9 kt CO_2 eq) sector.

Table 5: Summary Q4 2024 compared to Q3 2024

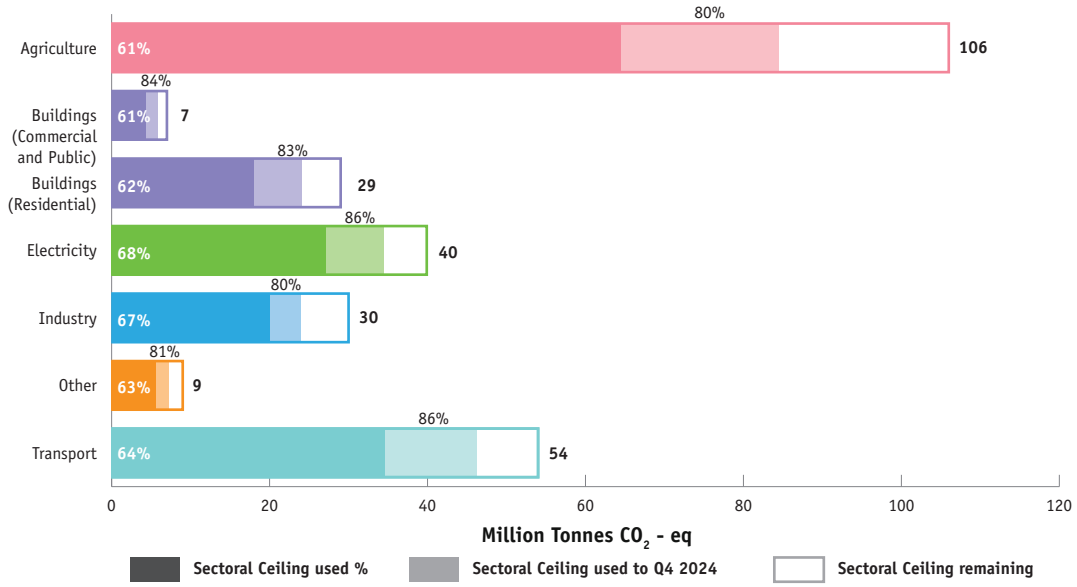
Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2024 Q3 (kt CO_2 eq)	Comparison to 2024 Q3 (%)
Overall		**12663.8**	**36.6**	**0.3**
Agriculture	CH_4, CO_2, N_2O	4984.0	45.9	0.9
Buildings	CH_4, CO_2	1730.3	-161.7	-8.5
Electricity	CO_2	1823.0	175.8	10.7
Industry	CO_2	910.4	-49.0	-5.1
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	355.6	-16.2	-4.4
Transport	CO_2	2860.6	42.0	1.5

Figure 5: Comparing Q4 2024 to Q3 2024 by sector.



With regards to Sectoral Emissions Ceilings, looking specifically at the first Carbon Budget period of 2021-2025, Figure 6 shows the emissions used and the remaining CAP emissions until the ceiling is reached. The amount of sectoral budget used ranges from 80% in the Agriculture Sector to 91% in the Buildings (Residential) sector. The largest percentage increase of emissions of 29% was within Residential buildings; 2024 had 6.3% more days with average temperature below 15.5 degrees Celsius than 2023 (Heating Degree Days).

Figure 6: Summary of Sectoral Ceiling Emissions Used across 2021 and 2022 as reported in the NIR (dark), Emissions Used in Q1 and Q4 2024 (bright) and the Sectoral Ceiling Emissions Remaining (outline).



3. Sectoral Summaries

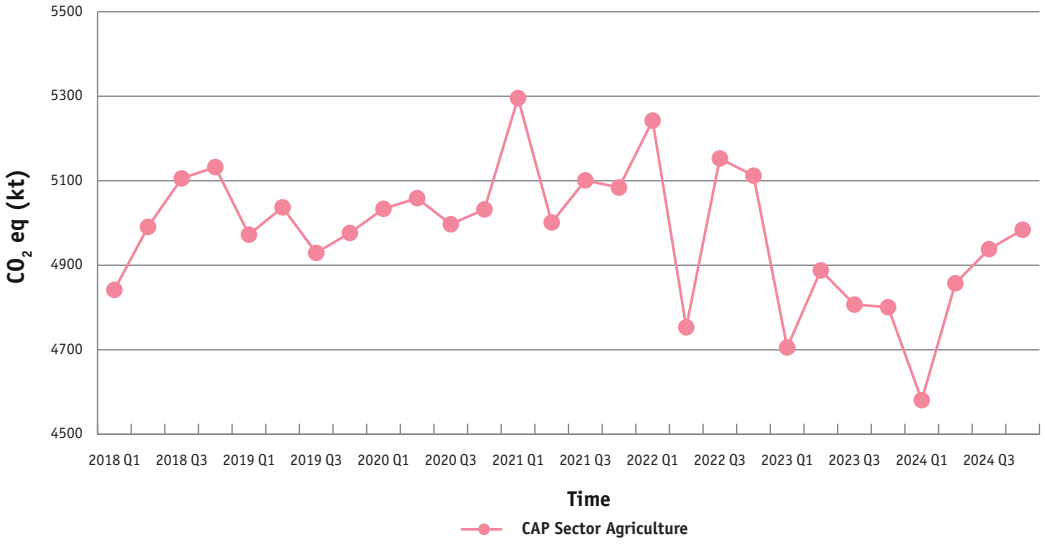
3.1 Agriculture

Subsectors: Agricultural soils; Agriculture/Forestry fuel combustion; Enteric fermentation; Fishing fuel combustion; Liming; Manure management; Urea application

Number of indicator Categories: Eighteen

Estimated total coverage of quarterly indicator categories compared to original annual National Inventory Report: 97.0%

Figure 7: Changes in emissions in the Agriculture Sector from Q1 2018 to Q4 2024, based on seasonally adjusted data.



3.1.1 Agriculture Year-on-Year Change

Key findings:

- There was a +3.8% (+183.1 kt CO_2 eq) increase in emissions compared to the same quarter last year. This was driven by increased milk production (+23.6%) during this period. In additions, there were higher direct CO_2 emissions (+48.6 kt CO_2 eq) associated with lime application. However, as a mitigation measure, liming can positively impact soil fertility and pH status, leading to sustained reductions in fertiliser nitrogen use and a net reduction in greenhouse gas emissions.

Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Agriculture greenhouse gas emissions increased by +3.8% (+183.1 kt CO_2 eq) compared to Quarter 4 2023.
- The largest increase in emissions occurred in the Enteric fermentation (+150.9 kt CO_2 eq) sector, followed by the Liming (+48.6 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Manure management (-19.8 kt CO_2 eq) sector, followed by the Agricultural soils (-14.7 kt CO_2 eq) sector.

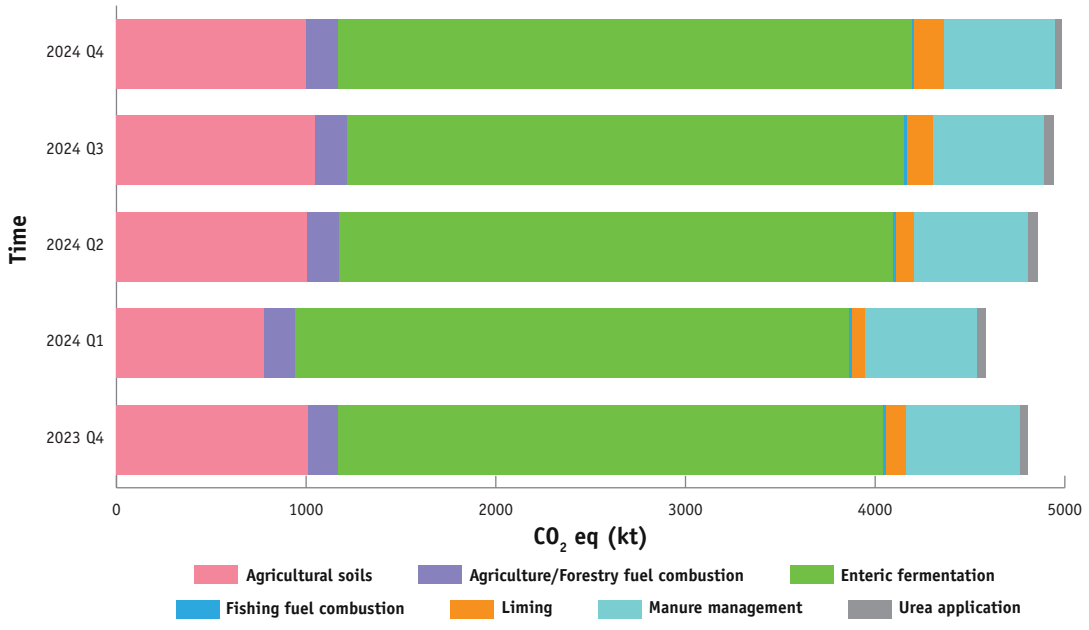
Table 6: Summary Q4 2024 compared to Q4 2023 – Agriculture

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (%)
Agriculture	CH_4, CO_2, N_2O	4984.0	183.1	3.8
Agricultural soils	N_2O	996.7	-14.7	-1.5
Agriculture/Forestry fuel combustion	CO_2	170.4	15.9	10.3
Enteric fermentation	CH_4	3024.4	150.9	5.3
Fishing fuel combustion	CO_2	15.0	-0.5	-3.1
Liming*	CO_2	156.5	48.6	45.0
Manure management	CH_4, N_2O	581.1	-19.8	-3.3
Urea application	CO_2	39.9	2.8	7.5

Note:

* Liming subsector: Direct CO_2 emissions only. Indirect benefits from liming, such as from reduced fertiliser requirements due to increased soil fertility, captured under other subsectors (e.g. Agricultural soils)

Figure 8: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data.



3.1.2 Agriculture Year-to-Date Change

Key findings:

- There was a +0.8% (+159.0 kt CO_2 eq) increase in emissions compared to the previous year, driven by increased fertiliser sales (+15.6%) during this period.

Looking at 2024 compared to Full Year 2023:

- Agriculture greenhouse gas emissions increased by +0.8% (+159.0 kt CO_2 eq) compared to Full Year 2023.
- The largest increase in emissions occurred in the Agricultural soils (+124.6 kt CO_2 eq) sector, followed by the Urea application (+39.1 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Enteric fermentation (-25.7 kt CO_2 eq) sector, followed by the Manure management (-16.7 kt CO_2 eq) sector.

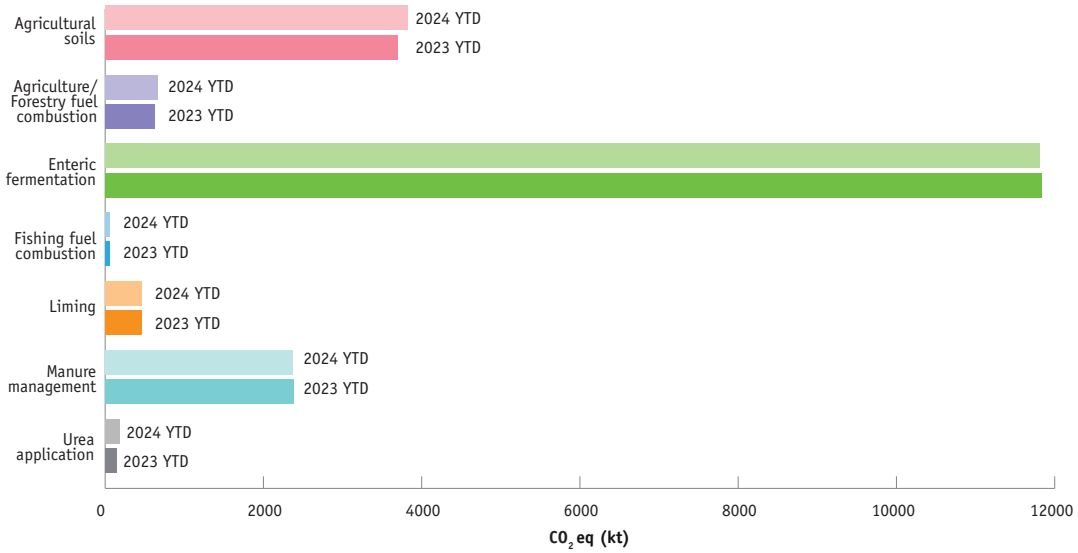
Table 7: Summary YTD 2024 compared to YTD 2023 – Agriculture

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Agriculture	CH_4, CO_2, N_2O	19360.1	159.0	0.8
Agricultural soils	N_2O	3826.1	124.6	3.4
Agriculture/Forestry fuel combustion	CO_2	665.5	37.5	6.0
Enteric fermentation	CH_4	11806.9	-25.7	-0.2
Fishing fuel combustion	CO_2	60.3	0.0	0.0
Liming*	CO_2	456.0	0.3	0.1
Manure management	CH_4, N_2O	2364.2	-16.7	-0.7
Urea application	CO_2	181.0	39.1	27.6

Note:

* Liming subsector: Direct CO_2 emissions only. Indirect benefits from liming, such as from reduced fertiliser requirements due to increased soil fertility, captured under other subsectors (e.g. Agricultural soils)

Figure 9: Comparing Year-To-Date 2024 to Year-To-Date 2023 by sector.



3.1.3 Agriculture Quarter-on-Quarter Change

Key findings:

- There was a +0.9% (+45.9 kt CO_2 eq) increase in emissions compared to the previous quarter. This was driven by seasonally elevated milk production (up +23.6% compared to the same quarter in 2023). There were higher direct CO_2 emissions (+17.2 kt CO_2 eq) associated with lime application. However, as a mitigation measure, liming can positively impact soil fertility and pH status, leading to sustained reductions in fertiliser nitrogen use and a net reduction in greenhouse gas emissions.

Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Agriculture greenhouse gas emissions increased by +0.9% (+45.9 kt CO_2 eq) compared to Quarter 3 2024.
- The largest increase in emissions occurred in the Enteric fermentation (+87.3 kt CO_2 eq) sector, followed by the Liming (+17.2 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Agricultural soils (-48.5 kt CO_2 eq) sector.

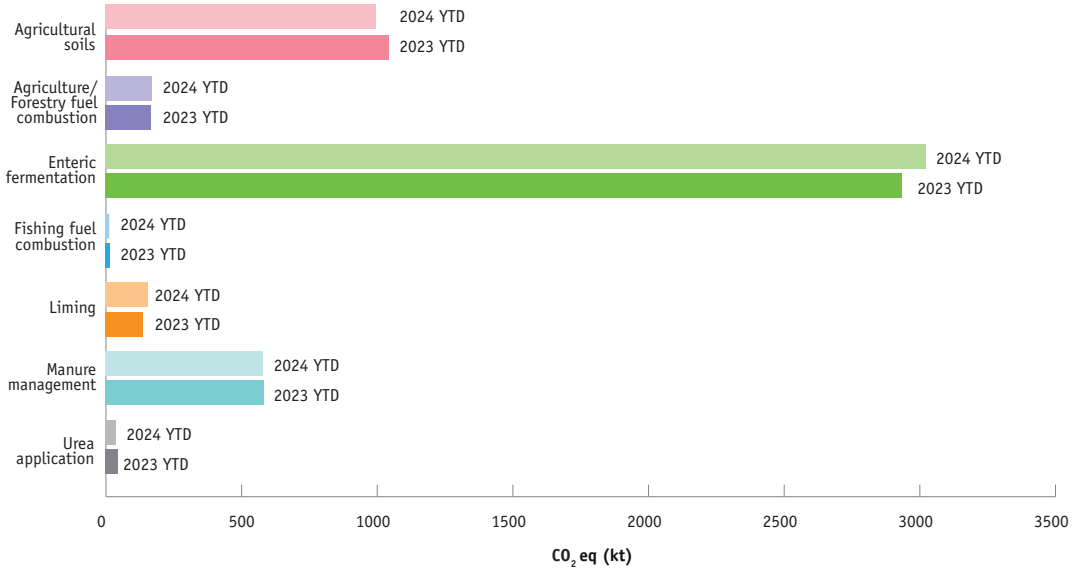
Table 8: Summary Q4 2024 compared to Q3 2024 – Agriculture

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2024 Q3 (kt CO_2 eq)	Comparison to 2024 Q3 (%)
Agriculture	CH_4, CO_2, N_2O	4984.0	45.9	0.9
Agricultural soils	N_2O	996.7	-48.5	-4.6
Agriculture/Forestry fuel combustion	CO_2	170.4	1.6	0.9
Enteric fermentation	CH_4	3024.4	87.3	3.0
Fishing fuel combustion	CO_2	15.0	0.0	-0.3
Liming*	CO_2	156.5	17.2	12.3
Manure management	CH_4, N_2O	581.1	-3.6	-0.6
Urea application	CO_2	39.9	-8.0	-16.8

Note:

* Liming subsector: Direct CO_2 emissions only. Indirect benefits from liming, such as from reduced fertiliser requirements due to increased soil fertility, captured under other subsectors (e.g. Agricultural soils)

Figure 10: Quarter-on-Quarter changes in emissions in the Agriculture Subsectors, based on seasonally adjusted data.



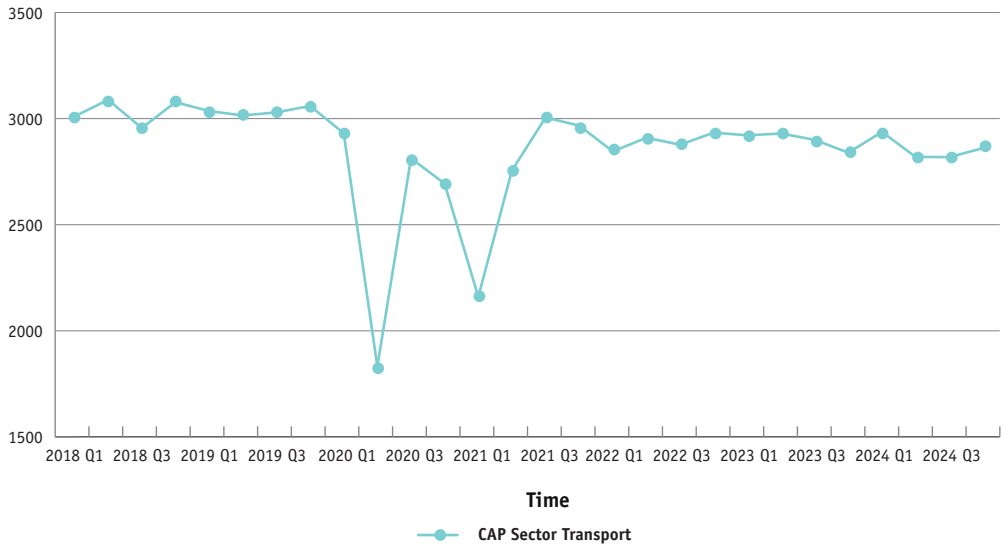
3.2 Transport

Subsectors: Domestic navigation; Other transportation; Railways; Road transportation

Number of indicator Categories: Ten

Estimated total coverage of quarterly indicator categories compared to original annual National Inventory Report: 98.5%

Figure 11: Changes in emissions in the Transport Sector from Q1 2018 to Q4 2024, based on seasonally adjusted data.



3.2.1 Transport Year-on-Year Change

Key finding:

- The primary drivers of the +0.7% (+21.0 kt CO_2 eq) change in emissions this quarter were increased sales of petrol (+7.6%) and decreased sales of diesel (-0.7%) compared to the same quarter last year, offset somewhat by increased biofuel blending rates for petrol (9.8% versus 7.2% by volume) compared to diesel (6.4% versus 6.6% by volume).

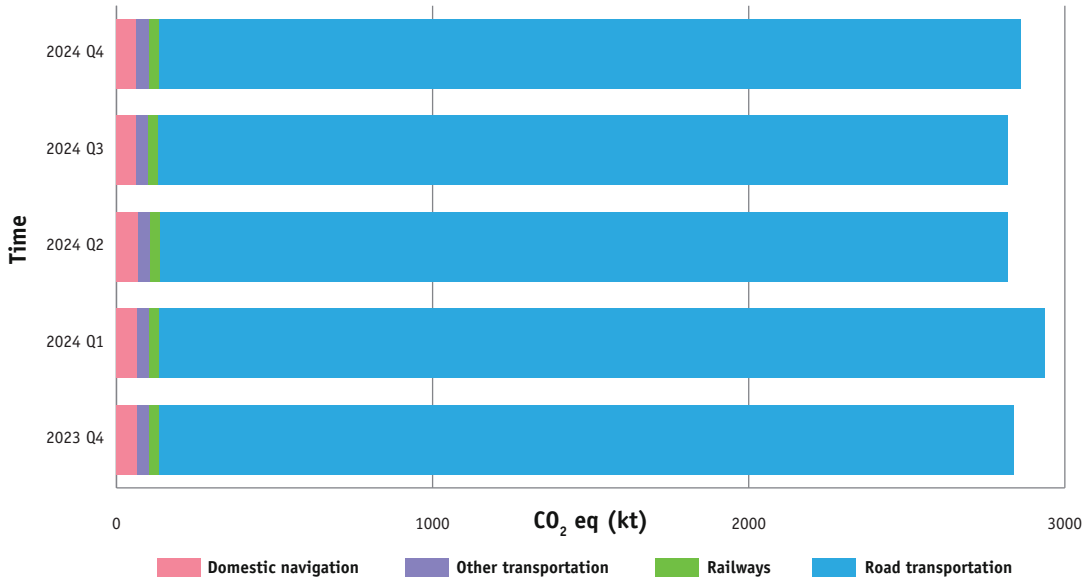
Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Transport greenhouse gas emissions increased by +0.7% (+21.0 kt CO_2 eq) compared to Quarter 4 2023.
- The largest increase in emissions occurred in the Road transportation (+19.6 kt CO_2 eq) sector.

Table 9: Summary Q4 2024 compared to Q4 2023 – Transport

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (%)
Transport	CO_2	2860.6	21.0	0.7
Domestic navigation	CO_2	62.9	-1.7	-2.6
Other transportation	CO_2	39.3	2.1	5.6
Railways	CO_2	32.3	1.0	3.1
Road transportation	CO_2	2726.1	19.6	0.7

Figure 12: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data.



3.2.2 Transport Year-to-Date Change

Key finding:

- The primary driver of the -1.3% (-154.5 kt CO_2 eq) change in emissions this quarter were decreased sales of diesel (-2.5%). In addition, biofuel blending rates increased for petrol (9.8% versus 7.2% by volume) compared to diesel (6.4% versus 6.6% by volume) which offset emissions from the increased sales of petrol (+5.9%).

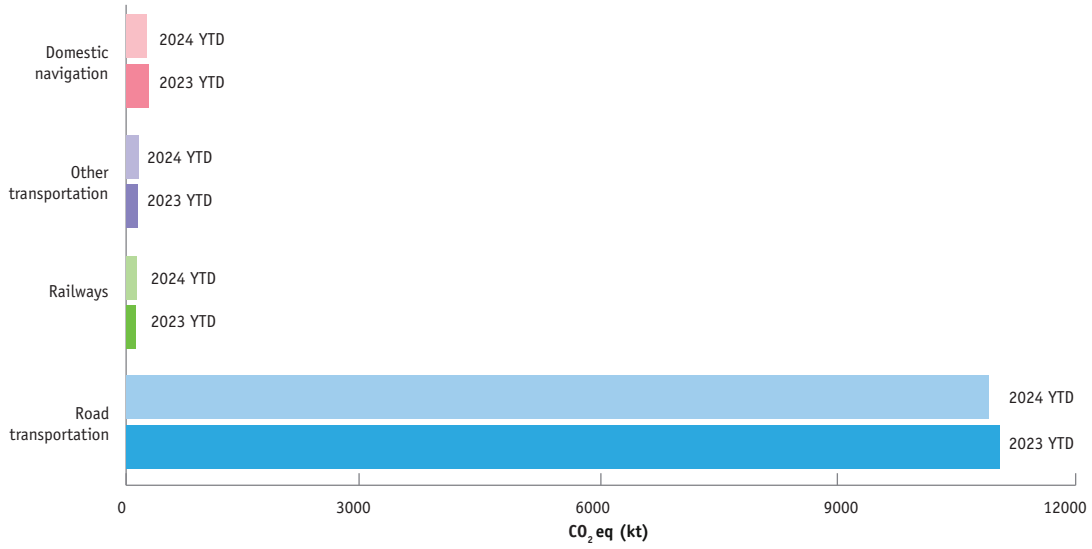
Looking at 2024 compared to Full Year 2023:

- Transport greenhouse gas emissions decreased by -1.3% (-154.5 kt CO_2 eq) compared to Full Year 2023.
- The largest decrease in emissions occurred in the Road transportation (-134.2 kt CO_2 eq) sector, followed by the Domestic navigation (-26.3 kt CO_2 eq) sector.

Table 10: Summary YTD 2024 compared to YTD 2023 – Transport

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Transport	CO_2	11435.9	-154.5	-1.3
Domestic navigation	CO_2	257.5	-26.3	-9.3
Other transportation	CO_2	152.1	2.3	1.5
Railways	CO_2	127.1	3.7	3.0
Road transportation	CO_2	10899.2	-134.2	-1.2

Figure 13: Comparing Year-To-Date 2024 to Year-To-Date 2023 by sector



3.2.3 Transport Quarter-on-Quarter Change

Key finding:

- The primary drivers of the +1.5% (+21.0 kt CO_2 eq) change in emissions this quarter was increased sales of diesel (+1.2%) offset by a reduction in petrol sales (-2.2%) compared to the previous quarter.

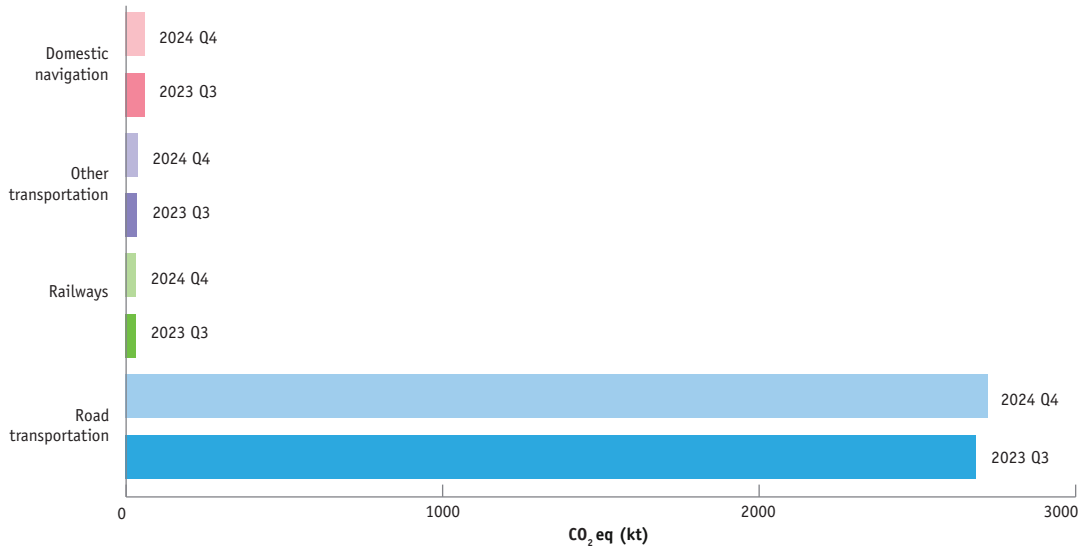
Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Transport greenhouse gas emissions increased by +1.5% (+42.0 kt CO_2 eq) compared to Quarter 3 2024.
- The largest increase in emissions occurred in the Road transportation (+38.6 kt CO_2 eq) sector.

Table 11: Summary Q4 2024 compared to Q3 2024 – Transport

			Comparison to 2024 Q3	
Sector	**Greenhouse Gas**	**Emissions 2024 Q4 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Transport	CO_2	2860.6	42.0	1.5
Domestic navigation	CO_2	62.9	1.3	2.2
Other transportation	CO_2	39.3	1.6	4.2
Railways	CO_2	32.3	0.5	1.4
Road transportation	CO_2	2726.1	38.6	1.4

Figure 14: Changes in emissions in the Transport Subsectors from Q3 2024 to Q4 2024, based on seasonally adjusted data.



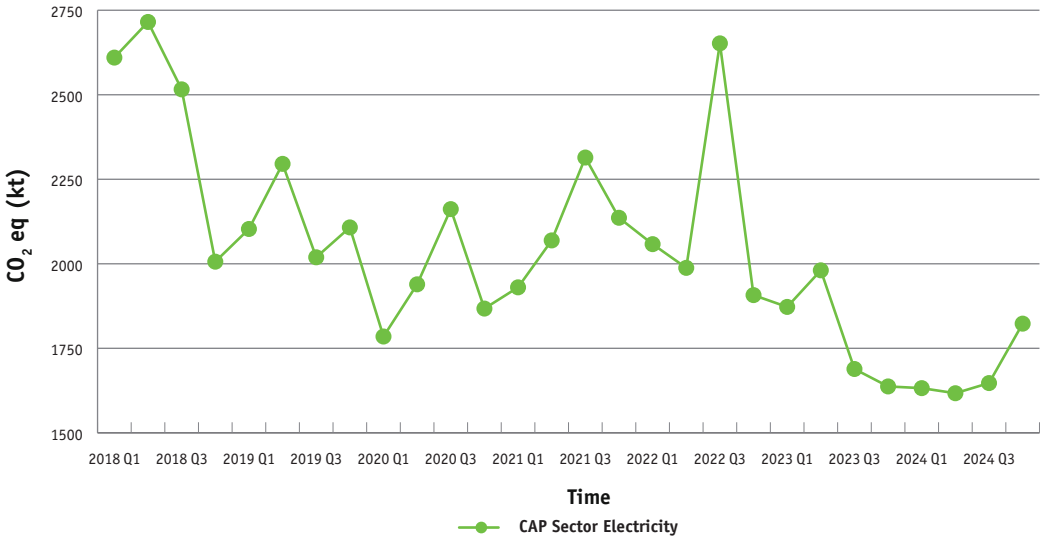
3.3 Electricity

Subsectors: Public electricity and heat production; Solid fuels and other energy industries

Number of indicator Categories: Five

Estimated total coverage of quarterly indicator categories compared to original annual National Inventory Report: 90.6%

Figure 15: Changes in emissions in the Electricity Sector from Q1 2018 to Q4 2024, based on seasonally adjusted data.



3.3.1 Electricity Year-on-Year Change

Key finding:

- Greenhouse gas emissions increased by +11.3% (+185.8 kt CO_2 eq) due to an increase in coal, oil and gas use (19.3% increase), and a decrease in electricity generated from renewable sources (-9.9% decrease). In this quarter, the share of the energy supply from imports remained similar 11.8% in Q4 2023 to 12.3% in Q4 2024.

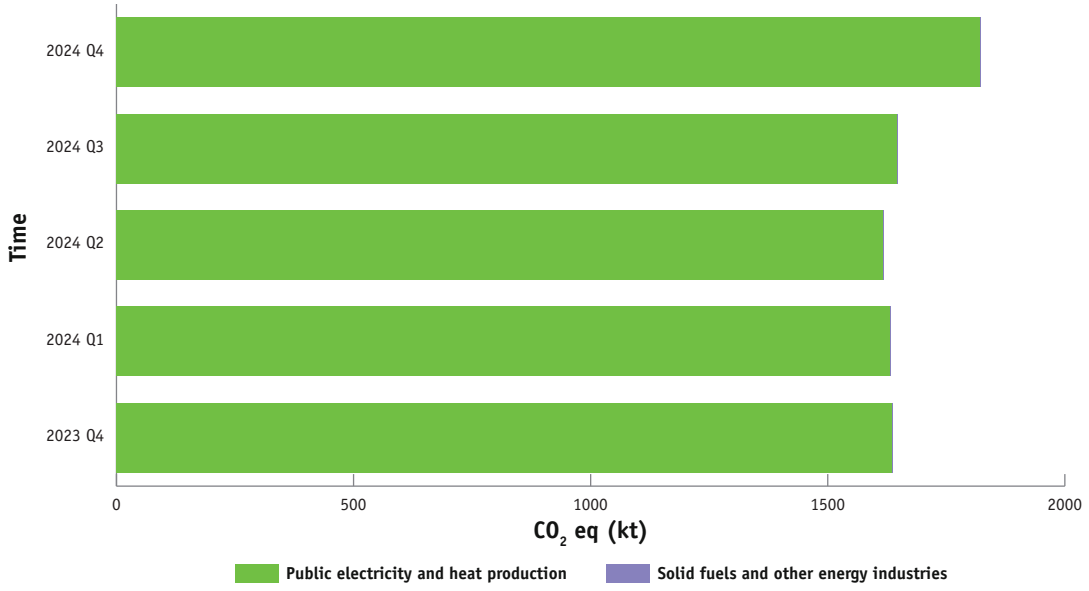
Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Electricity greenhouse gas emissions increased by +11.3% (+185.8 kt CO_2 eq) compared to Quarter 4 2023.
- The largest increase in emissions occurred in the Public electricity and heat production (+185.7 kt CO_2 eq) sector.
- This aligns with a 24.1% increase in electricity generation from natural gas (+765 GWh), and a decrease of -7.8% from wind (-273 GWh) and -43.1% hydro (-146GWh) in this quarter compared to last year.

Table 12: Summary Q4 2024 compared to Q4 2023 – Electricity

			Comparison to 2023 Q4	
Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	(kt CO_2 eq)	(%)
Electricity	CO_2	1823.0	185.8	11.3
Public electricity and heat production	CO_2	1821.9	185.7	11.4
Solid fuels and other energy industries	CO_2	1.1	0.0	3.7

Figure 16: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data.



3.3.2 Electricity Year-to-Date Change

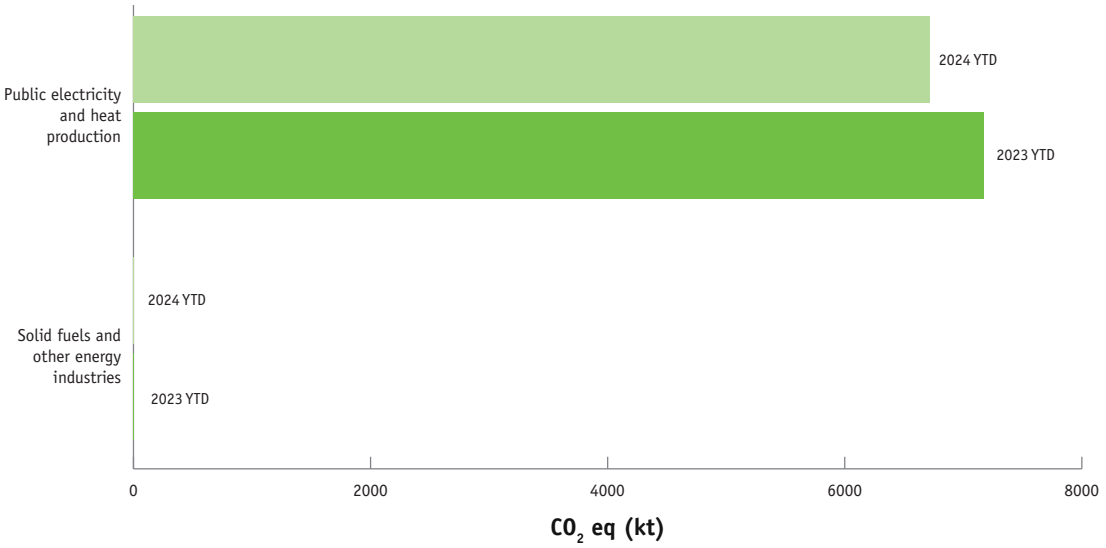
Looking at 2024 compared to Full Year 2023:

- Electricity greenhouse gas emissions decreased by -6.4% (-459.7 kt CO_2 eq) compared to Full Year 2023.
- The largest decrease in emissions occurred in the Public electricity and heat production (-459.7 kt CO_2 eq) sector.

Table 13: Summary YTD 2024 compared to YTD 2023 – Electricity

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Electricity	CO_2	6719.4	-459.7	-6.4
Public electricity and heat production	CO_2	6715.1	-459.7	-6.4
Solid fuels and other energy industries	CO_2	4.3	0.0	0.0

Figure 17: Comparing Year-To-Date 2024 to Year-To-Date 2023 by sector



3.3.3 Electricity Quarter-on-Quarter Change

Key finding:

- Greenhouse gas emissions increased by +10.7% (+175.8 kt CO_2 eq) due to an increase in natural gas and oil use, and minimal change in renewable energy and interconnector imports for electricity generation.

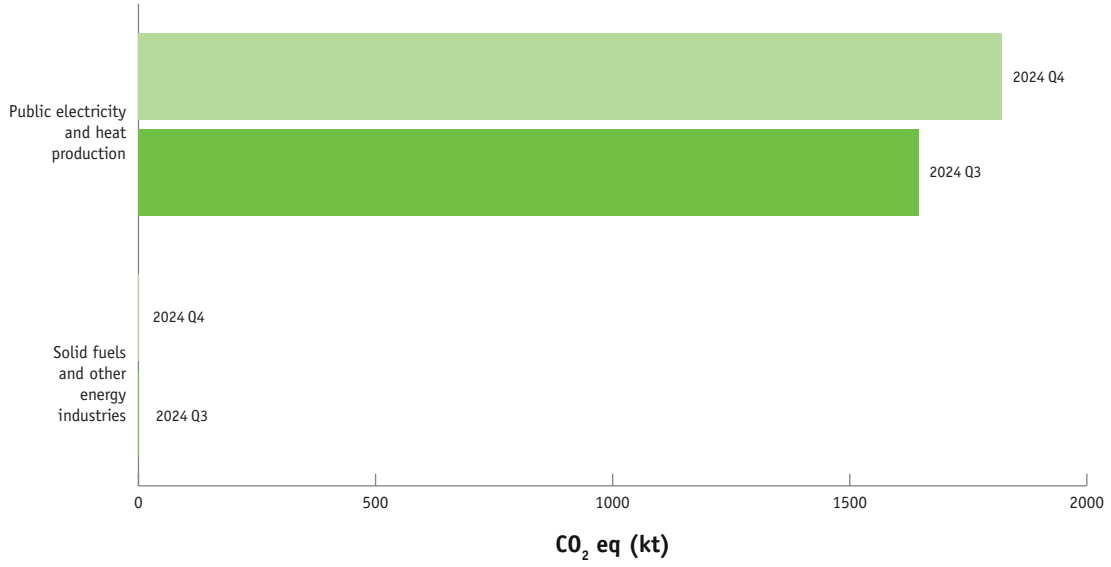
Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Electricity greenhouse gas emissions increased by +10.7% (+175.8 kt CO_2 eq) compared to Quarter 3 2024.
- The largest increase in emissions occurred in the Public electricity and heat production (+175.8 kt CO_2 eq) sector.

Table 14: Summary Q4 2024 compared to Q3 2024 – Electricity

			Comparison to 2024 Q3	
Sector	**Greenhouse Gas**	**Emissions 2024 Q4 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Electricity	CO_2	1823.0	175.8	10.7
Public electricity and heat production	CO_2	1821.9	175.8	10.7
Solid fuels and other energy industries	CO_2	1.1	0.0	0.4

Figure 18: Changes in emissions in the Electricity subsectors from Q4 2024 to Q3 2024, based on seasonally adjusted data.



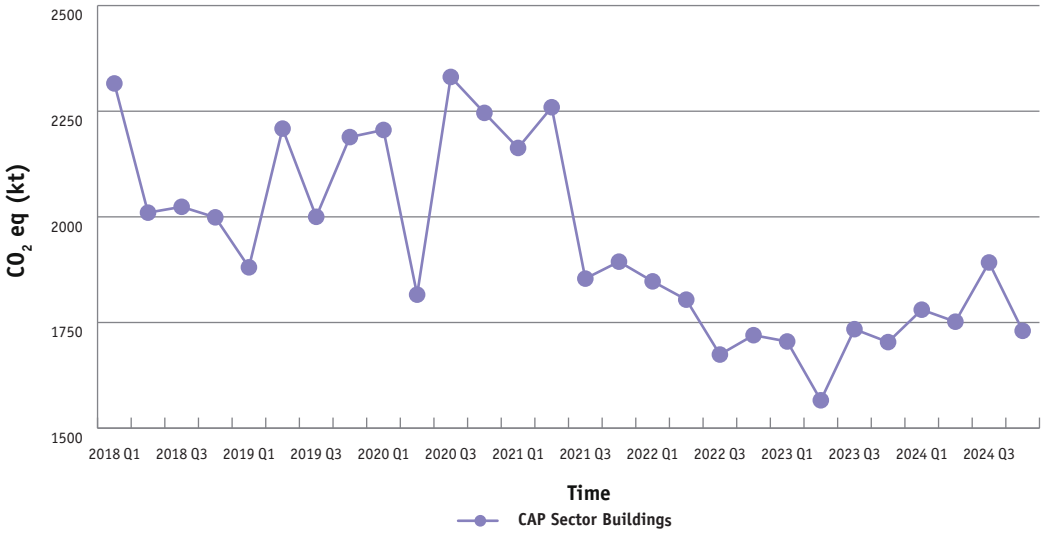
3.4 Buildings

Subsectors: Residential; Commercial & Public Services

Number of indicator Categories: Eight

Estimated total coverage of quarterly indicator categories compared to original annual National Inventory Report: 93.4%

Figure 19: Changes in emissions in the Buildings (Residential) Sector from Q1 2018 to Q4 2024, based on seasonally adjusted data.



3.4.1 Buildings Year-on-Year Change

Key finding:

- Overall GHG emissions from Buildings were up +1.6% (+26.7 kt CO_2 eq) due to increased energy demand in the Commercial & Public Services sector (+4.6%, +16.3 kt CO_2 eq). There was 3.3% fewer heating degree days (HDD, days with average temperature below 15.5 degrees Celsius where heating would be needed) in Quarter 4 2024 compared to Quarter 4 2023 which would indicate reduced demand for residential heating. Commercial gas prices were 15.5% lower in Quarter 2 2024 than Quarter 2 2023 which could also impact gas usage for heating.

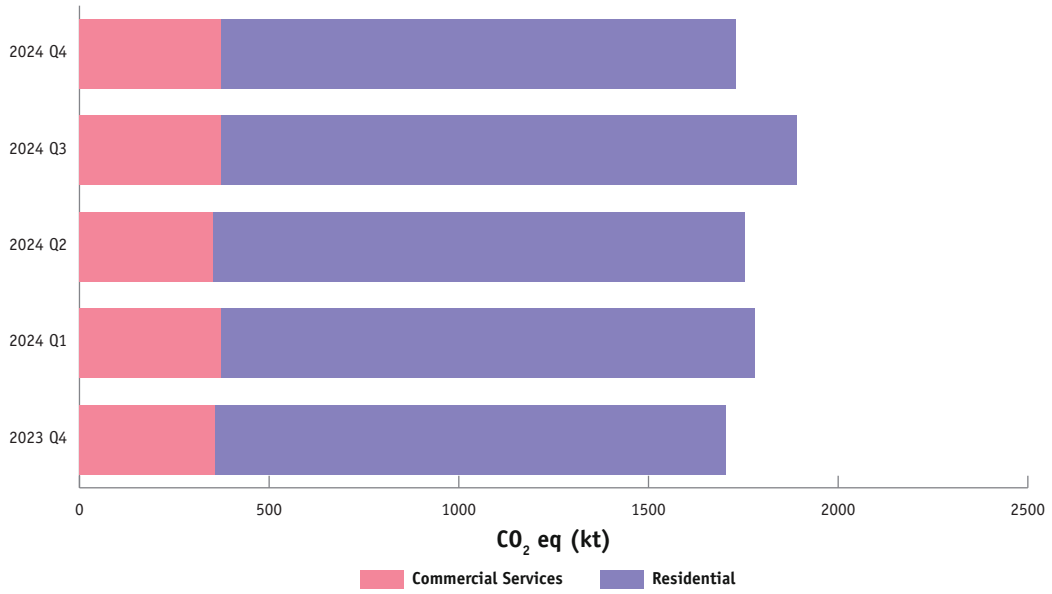
Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Buildings greenhouse gas emissions increased by +1.6% (+26.7 kt CO_2 eq) compared to Quarter 4 2023.
- The largest increase in emissions occurred in the Commercial & Public Services (+16.3 kt CO_2 eq) sector.

Table 15: Summary Q4 2024 compared to Q4 2023 – Buildings

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (%)
Buildings	CH_4, CO_2	1730.3	26.7	1.6
Commercial & Public Services	CO_2	373.4	16.3	4.6
Residential	CH_4, CO_2	1356.9	10.3	0.8

Figure 20: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data.



3.4.2 Buildings Year-to-Date Change

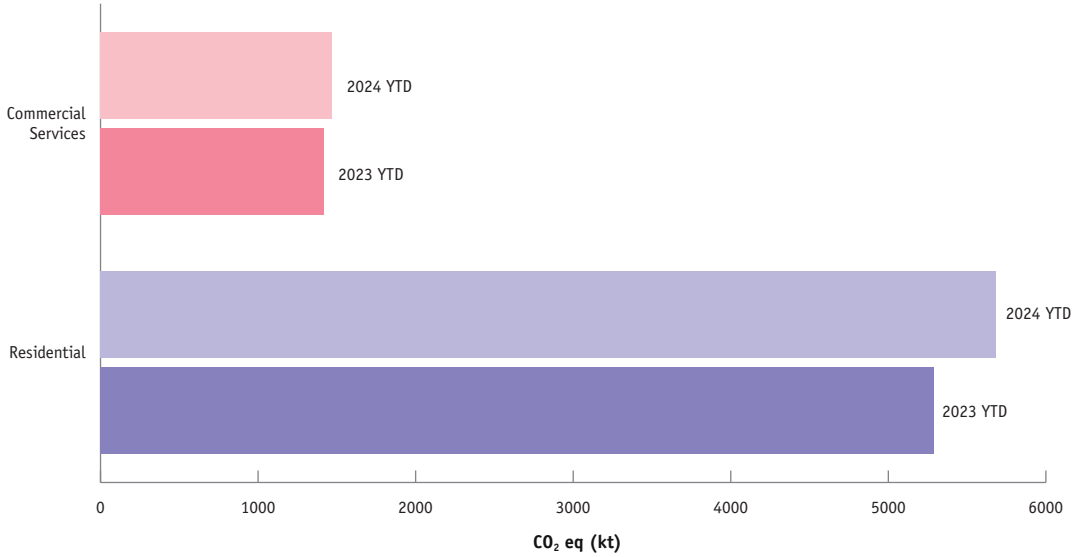
Looking at 2024 compared to Full Year 2023:

- Buildings greenhouse gas emissions increased by +6.6% (+445.8 kt CO_2 eq) compared to Full Year 2023.
- The largest increase in emissions occurred in the Residential (+393.2 kt CO_2 eq) sector. 2024 had 6.3% more days with average temperature below 15.5 degrees Celsius than 2023 (Heating Degree Days) indicating an increased demand for heating in the Building sector.

Table 16: Summary YTD 2024 compared to YTD 2023 – Buildings

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Buildings	CH_4, CO_2	7154.6	445.8	6.6
Commercial & Public Services	CO_2	1471.3	52.6	3.7
Residential	CH_4, CO_2	5683.3	393.2	7.4

Figure 21: Comparing YTD 2024 to YTD 2023 by sector



3.4.3 Buildings Quarter-on-Quarter Change

Key finding:

- GHG emissions from Buildings decreased -8.5% (-161.7 kt CO_2 eq) on a seasonally adjusted basis with the largest subsectoral decrease in emissions in the Residential sector (-163.1 kt CO_2 eq).

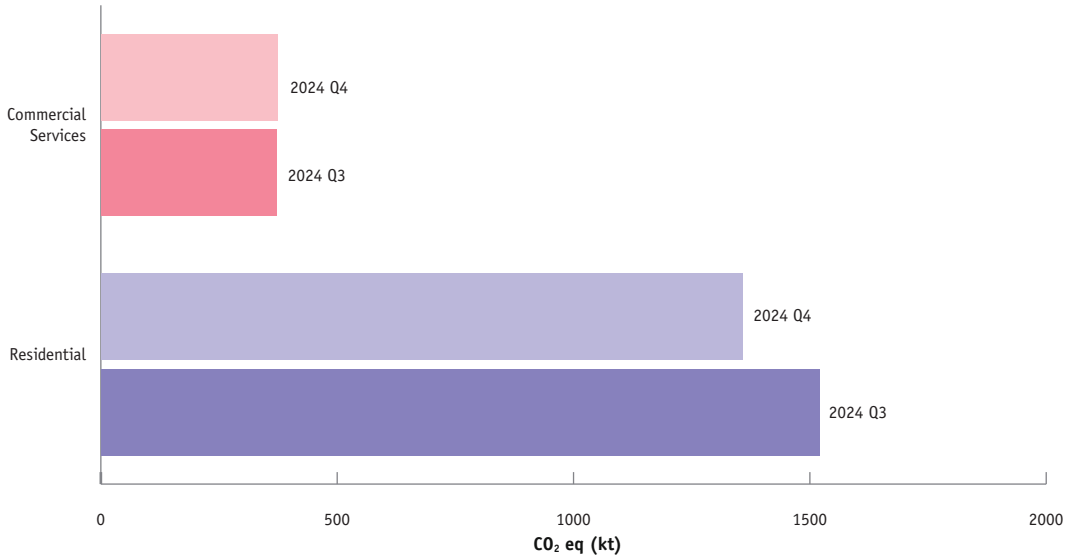
Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Buildings greenhouse gas emissions decreased by -8.5% (-161.7 kt CO_2 eq) compared to Quarter 3 2024.
- The largest decrease in emissions occurred in the Residential (-163.1 kt CO_2 eq) sector.

Table 17: Summary Q4 2024 compared to Q3 2024 – Buildings

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2024 Q3 (kt CO_2 eq)	Comparison to 2024 Q3 (%)
Buildings	CH_4, CO_2	1730.3	-161.7	-8.5
Commercial & Public Services	CO_2	373.4	1.3	0.4
Residential	CH_4, CO_2	1356.9	-163.1	-10.7

Figure 22: Changes in emissions in the Building Subsectors from Q3 2024 to Q4 2024, based on seasonally adjusted data.



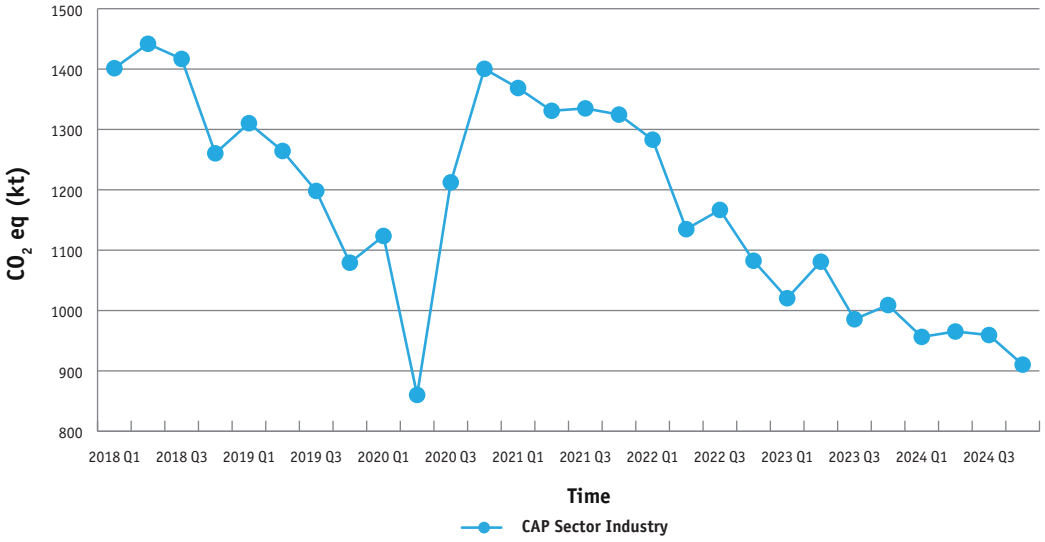
3.5 Industry

Subsectors: Manufacturing Combustion; Mineral Industry

Number of indicator Categories: Ten

Estimated total coverage of quarterly indicator categories compared to original annual National Inventory Report: 93.9%

Figure 23: Changes in emissions in the Industry Sector from Q1 2018 to Q4 2024, based on seasonally adjusted data.



3.5.1 Industry Year-on-Year Change

Key finding:

- Industry emissions were down -9.8% (-98.7 kt CO_2 eq), driven by reductions in both Manufacturing Combustion and the Mineral Industry (largely represented by the cement production sector and includes lime, brick and ceramic sectors). The latter was driven by a drop in production of cement clinker (a key component of cement) as the demand for less carbon intensive construction products increased.

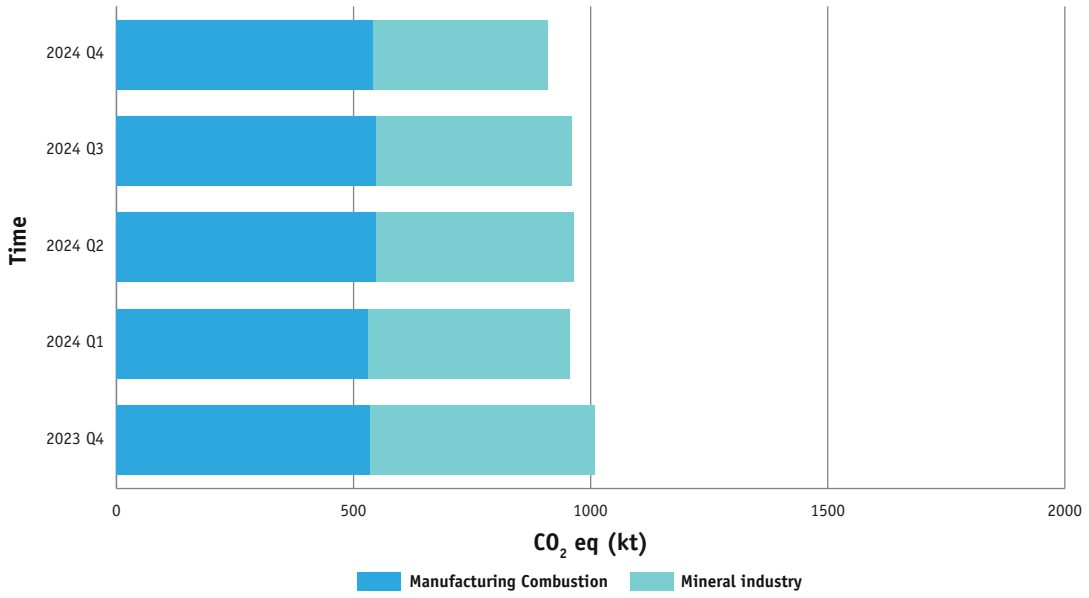
Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Industry greenhouse gas emissions decreased by -9.8% (-98.7 kt CO_2 eq) compared to Quarter 4 2023.
- The largest decrease in emissions occurred in the Mineral industry (-105.9 kt CO_2 eq) sector.

Table 18: Summary Q4 2024 compared to Q4 2023 – Industry

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (%)
Industry	CO_2	910.4	-98.7	-9.8
Manufacturing Combustion	CO_2	541.9	7.3	1.4
Mineral industry	CO_2	368.5	-105.9	-22.3

Figure 24: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data.



3.5.2 Industry Year-to-Date Change

Key finding:

- Industry emissions were down -7.4% (-304.5 kt CO_2 eq), driven by reductions in both Manufacturing Combustion and the Mineral Industry (largely represented by the cement production sector and includes lime, brick and ceramic sectors). The latter was driven by a drop in production of cement clinker (a key component of cement) as the demand for less carbon intensive construction products increased.

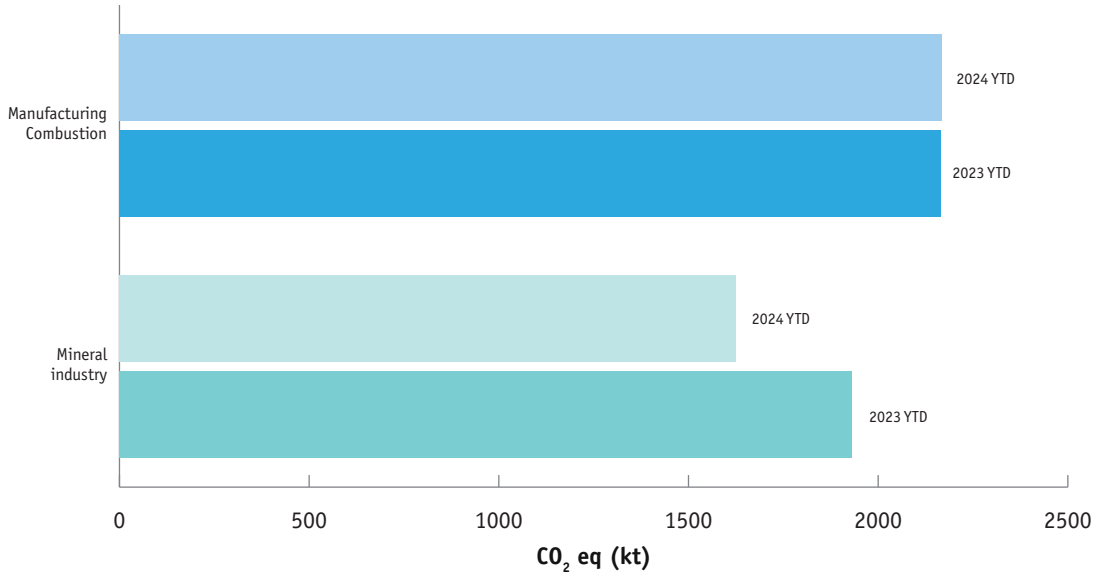
Looking at 2024 compared to Full Year 2023:

- Industry greenhouse gas emissions decreased by -7.4% (-304.5 kt CO_2 eq) compared to Full Year 2023.
- The largest decrease in emissions occurred in the Mineral industry (-306.3 kt CO_2 eq) sector.

Table 19: Summary YTD 2024 compared to YTD 2023 – Industry

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Industry	CO_2	3791.4	-304.5	-7.4
Manufacturing Combustion	CO_2	2167	1.8	0.1
Mineral industry	CO_2	1624.4	-306.3	-15.9

Figure 25: Comparing Year-To-Date 2024 to Year-To-Date 2023 by sector



3.5.3 Industry Quarter-on-Quarter Change

Key finding:

- Industry emissions were down -5.1% (-49.0 kt CO_2 eq), driven by reductions in both process and combustion emissions from the Mineral Industry on a seasonally adjusted basis.

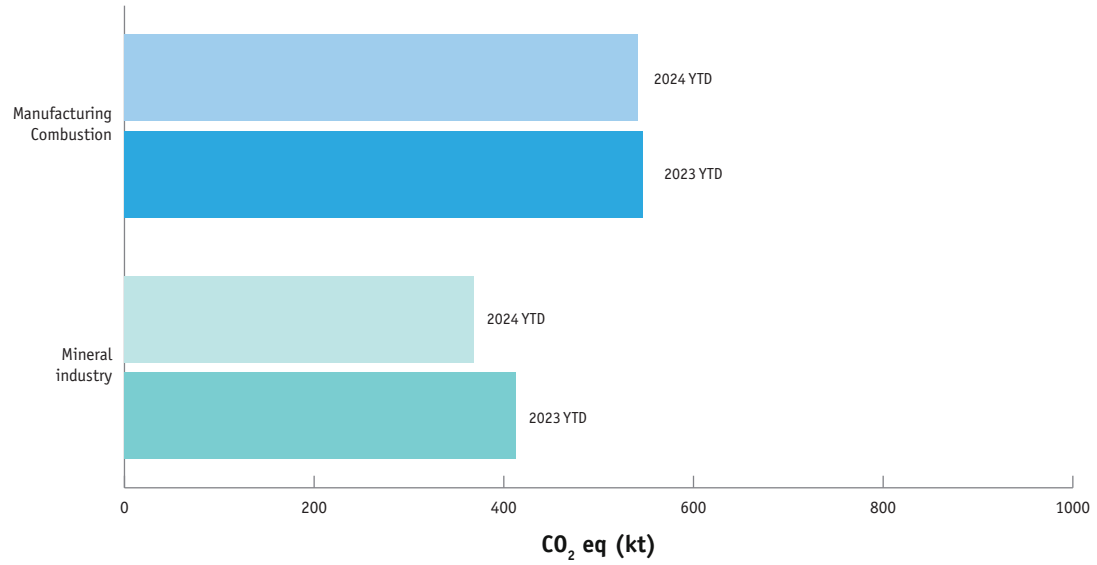
Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Industry greenhouse gas emissions decreased by -5.1% (-49.0 kt CO_2 eq) compared to Quarter 3 2024.
- The largest decrease in emissions occurred in the Mineral industry (-44.2 kt CO_2 eq) sector.

Table 20: Summary Q4 2024 compared to Q3 2024 – Industry

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2024 Q3 (kt CO_2 eq)	Comparison to 2024 Q3 (%)
Industry	CO_2	910.4	-49	-5.1
Manufacturing Combustion	CO_2	541.9	-4.8	-0.9
Mineral industry	CO_2	368.5	-44.2	-10.7

Figure 26: Quarter-on-Quarter Changes in emissions in the Industry Subsectors, based on seasonally adjusted data.



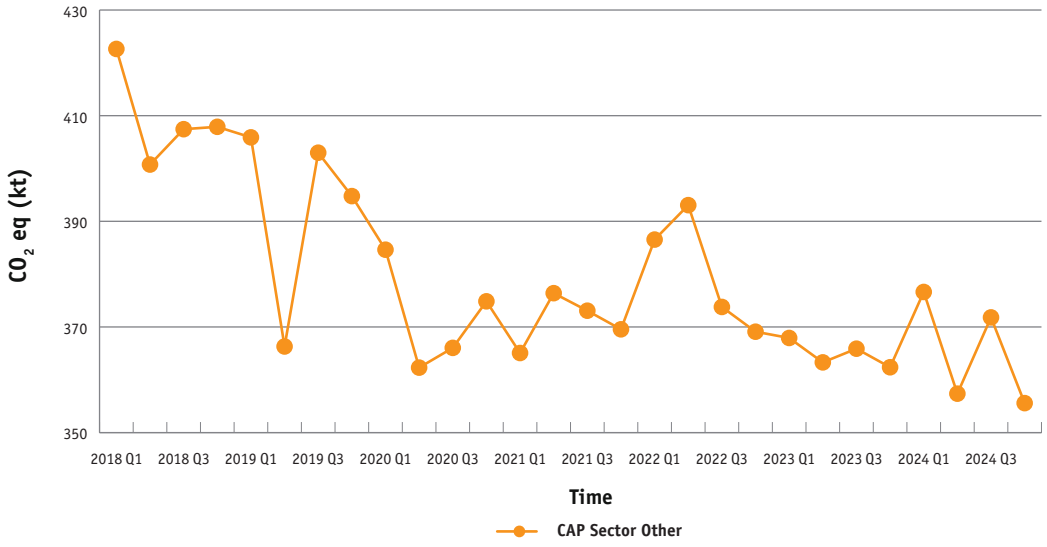
3.6 Other

Subsectors: F-Gases; Petroleum refining; Waste: Landfills; Waste: Wastewater treatment and discharge

Number of indicator Categories: Six

Estimated total coverage of quarterly indicator categories compared to original annual National Inventory Report: 90.3%

Figure 27: Changes in emissions in the Other Sector from Q1 2018 to Q4 2024, based on seasonally adjusted data.



3.6.1 Other Year-on-Year Change

Key finding:

- The primary drivers of the -1.9% (-6.8 kt CO_2 eq) change in emissions this quarter was a decrease in emissions from Petroleum Refining (-26.0%) compared to the year ago quarter due to a refinery being offline for essential maintenance for extended periods.

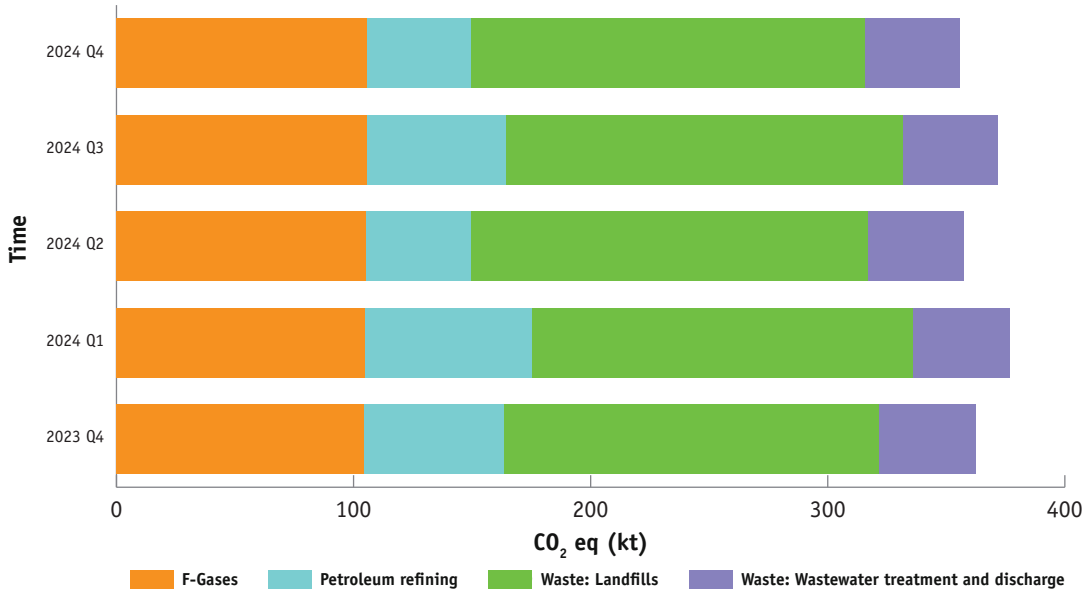
Looking at Quarter 4 2024 compared to Quarter 4 2023:

- Other greenhouse gas emissions decreased by -1.9% (-6.8 kt CO_2 eq) compared to Quarter 4 2023.
- The largest decrease in emissions occurred in the Petroleum refining (-15.3 kt CO_2 eq) sector.

Table 21: Summary Q4 2024 compared to Q4 2023 – Other

Sector	Greenhouse Gas	Emissions 2024 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (kt CO_2 eq)	Comparison to 2023 Q4 (%)
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	355.6	-6.8	-1.9
F-Gases	HFC, PFC, SF_6, NF_3	105.6	1.2	1.2
Petroleum refining	CO_2	43.6	-15.3	-26.0
Waste: Landfills	CH_4	166.4	8.1	5.1
Waste: Wastewater treatment and discharge	CH_4, N_2O	40.0	-0.8	-2.0

Figure 28: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data.



3.6.2 Other Year-to-Date Change

Key finding:

- The primary driver of the +0.1% (+1.9 kt CO_2 eq) change in emissions this quarter was a decrease in emissions from Petroleum Refining (-24.4%) compared to the year ago quarter due to a refinery being offline for essential maintenance for extended periods.

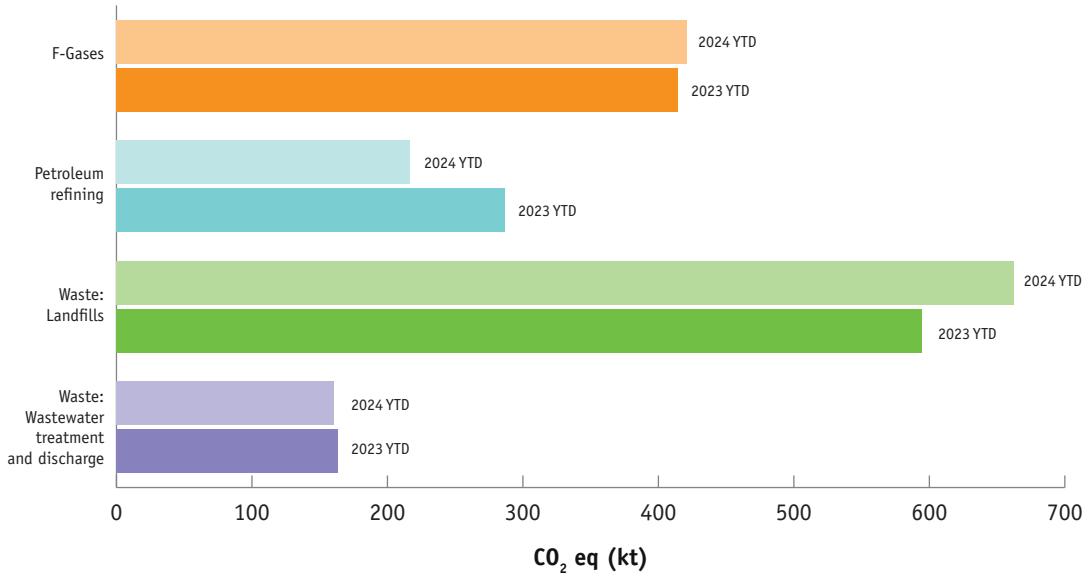
Looking at 2024 compared to Full Year 2023:

- Other greenhouse gas emissions increased by +0.1% (+1.9 kt CO_2 eq) compared to Full Year 2023.
- The largest increase in emissions occurred in the Waste: Landfills (+68.3 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Petroleum refining (-70.0 kt CO_2 eq) sector.

Table 22: Summary YTD 2024 compared to YTD 2023 – Other

			Comparison to YTD 2023	
Sector	**Greenhouse Gas**	**Emissions YTD 2024 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	1461.4	1.9	0.1
F-Gases	HFC, PFC, SF_6, NF_3	421.1	6.5	1.6
Petroleum refining	CO_2	216.8	-70.0	-24.4
Waste: Landfills	CH_4	662.6	68.3	11.5
Waste: Wastewater treatment and discharge	CH_4, N_2O	160.9	-2.9	-1.8

Figure 29: Comparing YTD 2024 to YTD 2023 by sector



3.6.3 Other Quarter-on-Quarter Change

Key finding:

- Emissions from Other sectors decreased -4.4% driven by a quarter-over-quarter decrease in gas and liquid fuel combustion in Petroleum Refining (-26.0%).

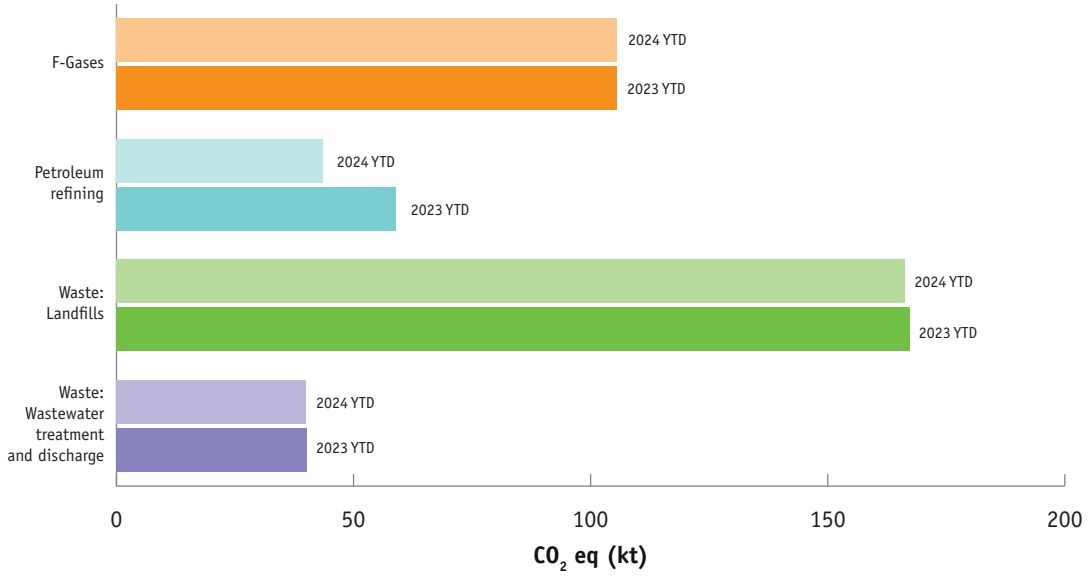
Looking at Quarter 4 2024 compared to Quarter 3 2024:

- Other greenhouse gas emissions decreased by -4.4% (-16.2 kt CO_2 eq) compared to Quarter 3 2024.
- The largest decrease in emissions occurred in the Petroleum refining (-15.4 kt CO_2 eq) sector.

Table 23: Summary Q4 2024 compared to Q3 2024 – Other

			Comparison to 2024 Q3	
Sector	**Greenhouse Gas**	**Emissions 2024 Q4 (kt CO_2 eq)**	**(kt CO_2 eq)**	**(%)**
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	355.6	-16.2	-4.4
F-Gases	HFC, PFC, SF_6, NF_3	105.6	0.1	0.1
Petroleum refining	CO_2	43.6	-15.4	-26.0
Waste: Landfills	CH_4	166.4	-0.9	-0.5
Waste: Wastewater treatment and discharge	CH_4, N_2O	40.0	-0.1	-0.2

Figure 30: Changes in emissions in the Other Subsectors from Q4 2024 to Q3 2024, based on seasonally adjusted data.



4. Data

All source data for this report is provided as a separate downloadable MS Excel file via the EPA website. For access to non-open licensed data, please contact the data provider directly.

5. Methodological Notes

As discussed, a date-versioned summary of the methodology

This section provides an overview of the two key methodologies used to produce quarterly greenhouse gas emissions estimates:

- Temporal disaggregation and benchmarking of the existing EPA National Inventory Report emissions into quarterly values. The method allows for the estimation of quarterly emissions while adhere to the constraint that the sum of all four quarters will equal the reported total annual emissions tonnage. In addition, quarters can be extrapolated by this method beyond current annual data.
- Once quarterly data are available, either primary data or data estimated from temporal disaggregation and benchmarking, the degree of seasonality in the data is assessed and, when present, a robust method of seasonal adjustment is applied.

5.1 Summary Methodology

5.1.1 Temporal Disaggregation with Benchmarking

Temporal disaggregation divides the annual inventory time series into four quarterly values. The benchmarking process ensures that the sum of the four quarters equals the annual reported value for the years. Importantly, the method also extrapolates estimates forward in time to predict quarterly values for which the annual totals are not yet available.

Temporal disaggregation and extrapolation can be employed naively or with information from high frequency time series known as proxy indicators. As a first step, domain experts from each sector produce a list of potential proxy indicators. The indicators should approximate the quarterly behaviour or movement of the greenhouse gases emissions in each IPCC category. Examples of proxy indicator variables include monthly energy statistics, monthly trade data, daily gas meter usage data, quarterly census of animal population.

The appropriate method of temporal disaggregation depends on the length of the high frequency proxy time series available. In the ideal case of ten plus years of high frequency data, the first step is to aggregate the high frequency data into annual data and test for correlation with the annual inventory time series using Kendall's tau. It is important to detrend both series by obtaining the first differences before testing for correlation.

There are two recommended statistical regression methods for the case of ten plus years of high frequency data. The Chow-Lin method is suited for stationary or cointegrated series, and for series with stable growth rates. The alternative Fernandez method is recommended for unstable growth rates or for non-co-integrated data. The appropriate method is selected by comparing the model goodness of fit between Chow-Lin and Fernandez.

The next steps involve checking the quality of the disaggregated quarterly series. The ratio of the quarterly benchmark (the annual values divided by four) to the quarterly indicator over time should be stable. Both the disaggregated quarterly time series and quarterly indicator values are detrended by getting the first difference, and the correlation between the two is calculated using Kendall's tau on the detrended values.

To evaluate the forecast accuracy of the model, out of sample predictive performance for the disaggregated quarterly estimates are calculated. For each full year of available annual inventory data, a comparable annual value is predicted using only the preceding years disaggregated quarterly estimates data. The RMSE, MAE and BIAS between the two estimates as well as the average across years gives a measure of the performance of the disaggregated quarterly series in predicting the annual totals.

Finally, to gauge the volatility in disaggregated quarterly estimates over time, different ratios are calculated between the quarterly estimates and annual totals. The calculated ratios also summarise which quarters, on average, have the most emissions.

It is necessary to apply a slightly altered methodology for high frequency time series covering a period of five to ten years. As before, both Chow-Lin and Fernandez are applied, and the best fitting model chosen. However here we also implement the Denton-Chelotte method, which unlike the regression approaches, retains the movement of the high frequency series regardless of correlation with the annual series. The final model is selected based upon the quality of the disaggregated quarterly series produced from each approach. The Denton-Chelotte method can only accommodate one proxy indicator, and if a more complex model involving multiple indicators is needed, a statistical regression method is used.

If only two to four years of high frequency are available, the implementation of a statistic regression method is not recommended. Here the Denton-Chelotte method is applied to produce disaggregated quarterly estimates. As before, the disaggregated quarterly time series is quality checked, and the predictive performance calculated.

5.1.2 Seasonal Adjustment

The first consideration is the length of the time series, and nine quarters of data is an absolute minimum for seasonal adjustment. If the disaggregated quarterly time series is less than nine quarters, then seasonal adjustment cannot be applied. Preferably, the time series will have at least twenty quarters. If the time series contains more than nine but less than twenty quarters, a domain expert should be consulted to confirm if seasonal adjustment is necessary.

An important first step is to check for the presence of seasonality in the data. Different plots (ACF, PACF, Quarterly sub-series, Lag correlation) are produced to visually inspect for seasonality. In combination with the visual inspection, three formal statistical tests are employed. The first known as the QS-test evaluates the null hypothesis that the first two seasonal lags for quarterly data (4 and 8) are zero. The second Kruskal-Wallis test is non-parametric and tests if the means of each quarter are drawn from different distributions. The final Friedman test is also non-parametric and tests if the medians differ across quarters.12 If at least two out of the three tests find seasonality, seasonal adjustment is implemented. If both the visual inspection, Kruskal-Wallis and Friedman test fail to find any signal of seasonality (no seasonality or highly unstable seasonality), then the series is not adjusted.

All seasonal adjustment is implemented using the RJDemetra interface. According to the CSO methodology, the X-13ARIMA-SEATS pre-treatment, and the 'airline' model ARIMA (0, 1, 1, 0, 1, 1), are chosen as the initial starting point. The software will evaluate whether a log transformation is necessary and will automatically detect clear additive outliers, level shift outliers and temporary change outliers.

It is important to check the quality of the model automatically selected by the RJDemetra interface. The normality, independence and linearity of the model residuals are assessed, and the distribution of model residuals visually inspected. If the model is not a good fit, the fully automated model selection specification is

used to find a suitable model. If this also fails to produce a viable model and both Kruskall Wallis and Friedman tests also fail, then seasonal adjustment is not applied.

Given the conservative threshold of detection in automatic identification of outliers, the irregular component of the initial model is examined and points in the time series where the value is greater than 1.5 times the inter-quartile range are identified. The irregular component is visually inspected, and additional outliers are manually included into the model specification. After applying the new model, if the t-value of the additional outliers is greater than 2.0, then the outliers are included in the final model.

The quality of the seasonal adjustment is examined using different outputs from RJDemetra. The idempotency test checks for residual seasonality in the adjusted series. The model decomposition is checked and visual inspections on the diagnostic plots completed. An important output from RJDemetra is the Statistics Canada's Seasonal Adjustment Dashboard. The dashboard report includes graphs of the series, as well as summaries of individual seasonal effects and patterns. Additionally, key seasonal adjustment diagnostics are presented in a traffic light display, and the net effect of seasonal adjustment is decomposed into its various components. Red warnings on the Statistics Canada's Seasonal Adjustment Dashboard indicate poor seasonal adjustment.

If the combination of the model and seasonal adjustment is of superior quality, then the model is implemented, and the resulting seasonally adjusted estimates used for reporting. However, if both the model and seasonal adjustment are of inadequate quality, seasonal adjustment is not implemented, and the unadjusted estimates are used for reporting. In cases where either the model or seasonal adjustment are poor, CSO methodology are consulted to identify improvement actions.

5.2 Revisions and Methodological Changes of Note

For future reports, any revisions to past reported data or methodological changes implemented in latest data will be reported in this section.

For the calculation of emissions from the Liming sub sector of Agriculture, limestone application was imputed based on an analysis of historical trends (2018-2023) and initial limestone sales figures for Quarter 1 2024. Figures will be updated in future reports when official limestone sales data become available.

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