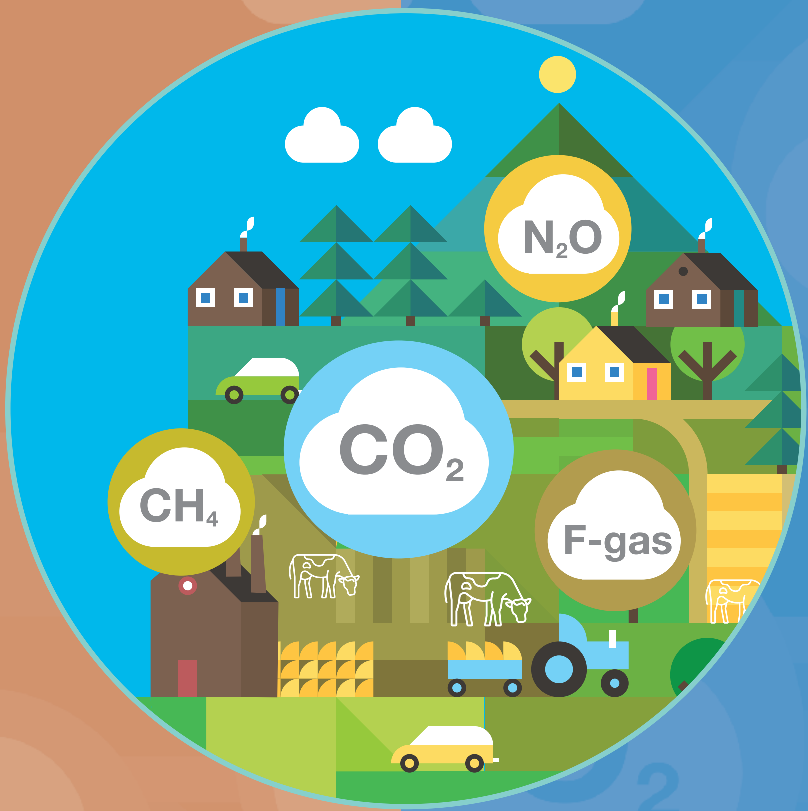
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Quarterly Greenhouse Gas Emissions Indicator Report

2025 Quarter 1

July 2025



Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

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1. Key Findings

Please note that all quoted figures in Key Findings are comparing emissions at the end of Quarter 1 2025 with emissions at the end of Quarter 1 2024 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 1 2025 compared to Quarter 1 2024:

- Overall greenhouse gas emissions increased by +2.9% (+360.6 kt CO_2 eq) compared to Quarter 1 2024.
- The largest increase in emissions occurred in the Agriculture (+388.4 kt CO_2 eq) sector, followed by the Electricity (+69.0 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Transport (-121.0 kt CO_2 eq) sector, followed by the Buildings (-20.5 kt CO_2 eq) sector.

Table 1: Key Findings

Sector	Key Finding
Q1 2024 vs. Q1 2025	GHG emissions increased by +2.9% (+361 kt CO_2 eq) driven mainly by increases in the Agriculture sector (+388 kt CO_2 eq) due to increased fertiliser sales, and the Electricity sector (+69 kt CO_2 eq) driven by a 4.1% increase in electricity generation from fossil fuels.
Agriculture	There was a +8.7% (+388 kt CO_2 eq) increase in emissions compared to the same quarter last year. This was driven by increased fertiliser sales. Fertiliser sales last year were impacted by adverse weather and ground conditions in the early part of the year, and likely delayed purchasing decisions following the introduction of a lower maximum stocking rate of 220 kg N ha^{-1} under the nitrates regulations.
Transport	The primary driver of the -4.1% (-121 kt CO_2 eq) decrease in emissions this quarter was decreased sales of diesel (-7.2%) compared to the same quarter last year, and increased biofuel blending rates for petrol (from 8.0% to 9.8% by volume).
Electricity	Emissions increased by +4.5% (+69 kt CO_2 eq) due to a 3.3% increase in overall electricity supply which was achieved by an increase in the share of imported electricity to 13.7%, and a 4.1% increase in electricity generation from fossil fuels.
Buildings – Commercial & Public	Emissions increased by +1.4% (+5 kt CO_2 eq) in the Commercial Services sector due to increased energy demand in buildings during the quarter.
Buildings – Residential	Emissions decreased by -1.8% (-26 kt CO_2 eq) due to a marginal decrease in energy demand. This decrease in demand was not due to differences in the number of days requiring heating in this quarter compared to the same quarter last year.
Industry	Industry emissions were up +2.9% (+39 kt CO_2 eq), driven by increased emissions from the Mineral Industry (largely represented by the cement production sector) (+24 kt CO_2 eq).
GHG Emissions Q4 2024 to Q1 2025	Overall GHG emissions increased marginally by +0.2% (+26 kt CO_2 eq) compared to Quarter 4 2024, on a seasonally adjusted basis, driven mainly by increases in the Industry (+86 kt CO_2 eq) and Other (+38 kt CO_2 eq) sectors, counteracted by a decrease in the Electricity sector (-128 kt CO_2 eq) due to a decline of -8.5% in electricity generation from fossil fuels.

Table 2 shows the year-on-year changes for 2025 Quarter 1 compared to 2024 Quarter 1 and quarter-on-quarter changes for 2025 Quarter 1 compared to 2024 Quarter 4.

Table 2: Key Findings

Sector	Emissions Q1 2025 (kt CO_2 eq)	Comparison with Q1 2024 (%)	Comparison with Q4 2024 (%)
Overall	**12798.5**	**2.9**	**0.2**
Agriculture	4868.1	8.7	0.3
Buildings	1755.3	-1.2	1.4
Electricity	1587.7	4.5	-7.5
Industry	1389.7	2.9	6.6
Other	358.7	1.7	11.7
Transport	2839.0	-4.1	-0.2

2. 2025 Quarter 1 Summary

This section presents the key high-level emissions estimates for Quarter 1 2025, 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 Q1 2025

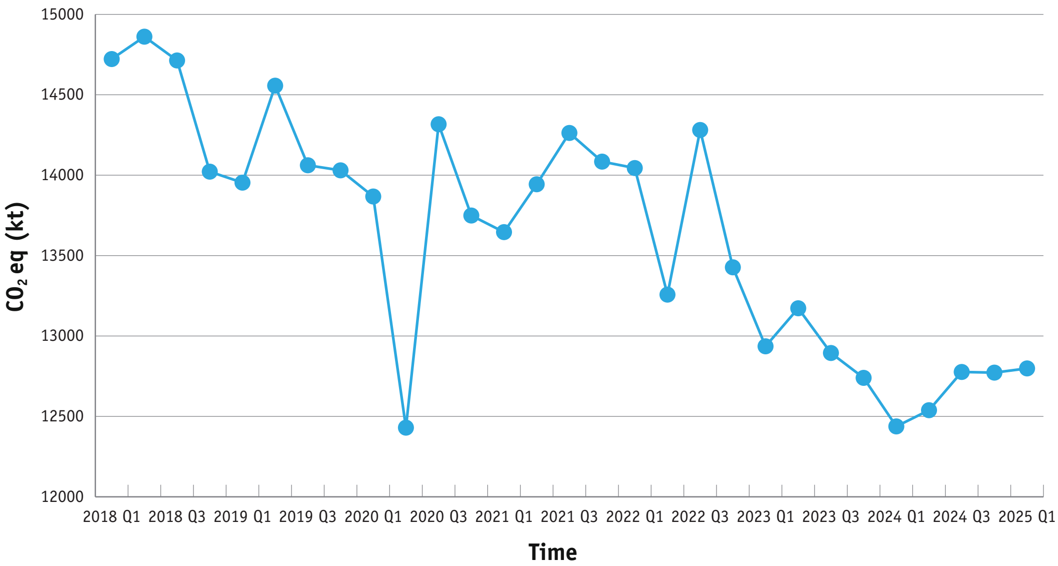
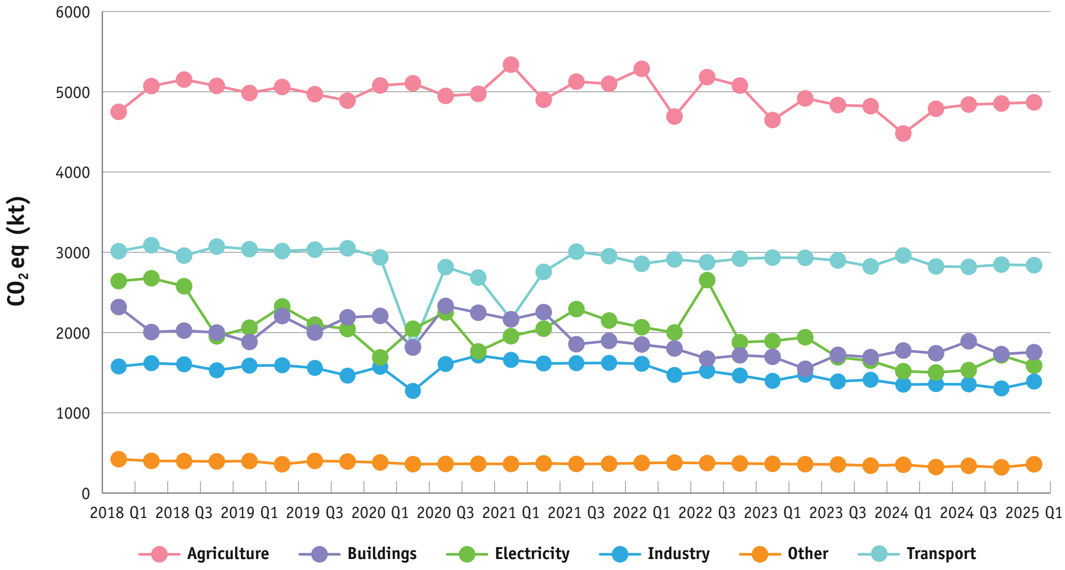


Figure 2: Overall quarterly movement in greenhouse gas emissions for all sectors from Q1 2018 to Q1 2025



2.1 Year-on-Year Change

In this section the emissions for Quarter 1 2025 are compared to Quarter 1 2024.

Key finding:

- Overall GHG emissions increased by +2.9% (+360.6 kt CO_2 eq) compared to Quarter 1 2024, driven mainly by increases in the Electricity sector (+69.0 kt CO_2 eq) due to a 4.1% increase in electricity generated from fossil fuels, and the Agriculture sector (+388.4 kt CO_2 eq) driven by increased fertiliser sales (fertiliser sales in 2024 were impacted by bad weather in the early part of the year).

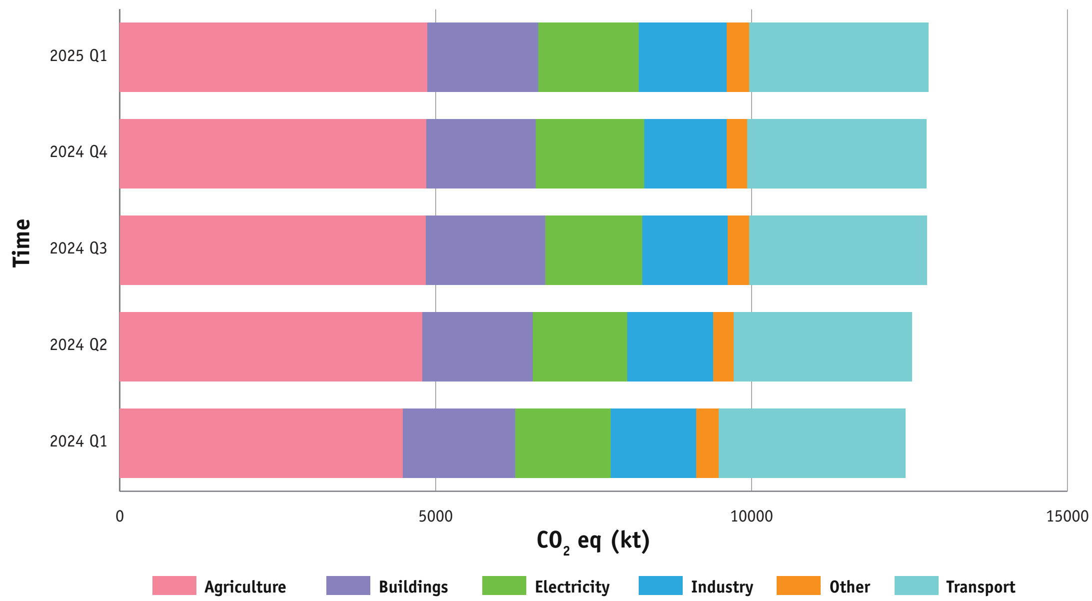
Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Overall greenhouse gas emissions increased by +2.9% (+360.6 kt CO_2 eq) compared to Quarter 1 2024.
- The largest increase in emissions occurred in the Agriculture (+388.4 kt CO_2 eq) sector, followed by the Electricity (+69.0 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Transport (-121.0 kt CO_2 eq) sector, followed by the Buildings (-20.5 kt CO_2 eq) sector.

Table 3: Summary Q1 2025 compared to Q1 2024

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Overall		**12798.5**	**360.6**	**2.9**
Agriculture	CH_4, CO_2, N_2O	4868.1	388.4	8.7
Transport	CO_2	2839.0	-121.0	-4.1
Electricity	CO_2	1587.7	69.0	4.5
Buildings	CH_4, CO_2	1755.3	-20.5	-1.2
Industry	CO_2	1389.7	38.7	2.9
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	358.7	5.9	1.7

Figure 3: Overall quarterly movement in greenhouse gas emissions for all sectors from Q1 2024 to Q1 2025



2.2 Quarter-on-Quarter Change

Key finding:

- Overall GHG emissions increased marginally by +0.2% (+26.2 kt CO_2 eq) compared to Quarter 4 2024, on a seasonally adjusted basis, driven mainly by increases in the Industry (+85.8 kt CO_2 eq) and Other (+37.5 kt CO_2 eq) sectors, counteracted by a decrease in the Electricity sector (-128.3 kt CO_2 eq).

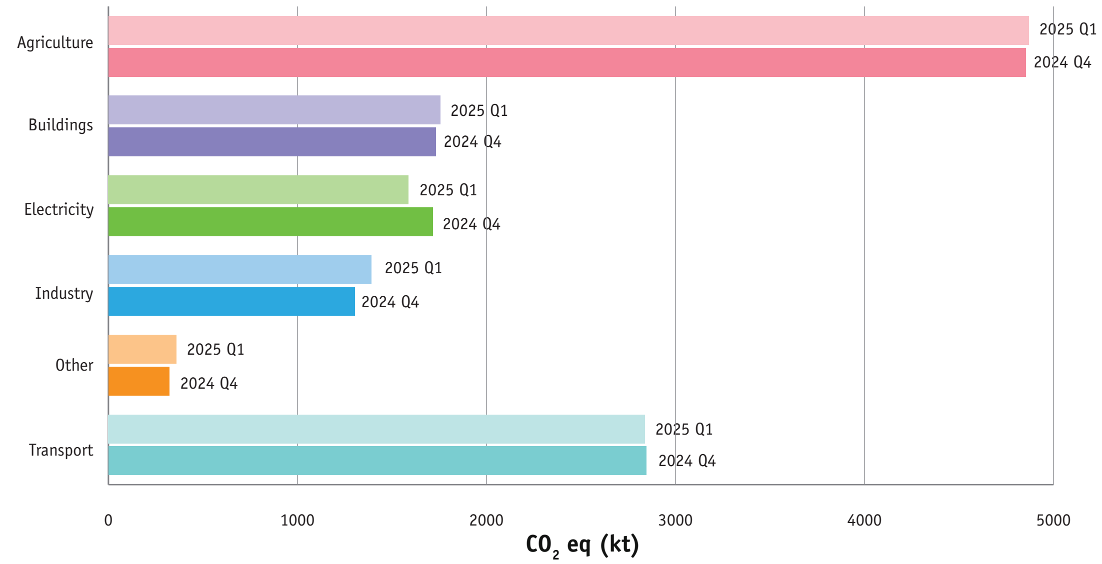
Looking at Quarter 1 2025 compared to Quarter 4 2024:

- Overall greenhouse gas emissions increased by +0.2% (+26.2 kt CO_2 eq) compared to Quarter 4 2024.
- The largest increase in emissions occurred in the Industry (+85.8 kt CO_2 eq) sector, followed by the Other (+37.5 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Electricity (-128.3 kt CO_2 eq) sector.

Table 4: Summary Q1 2025 compared to Q4 2024

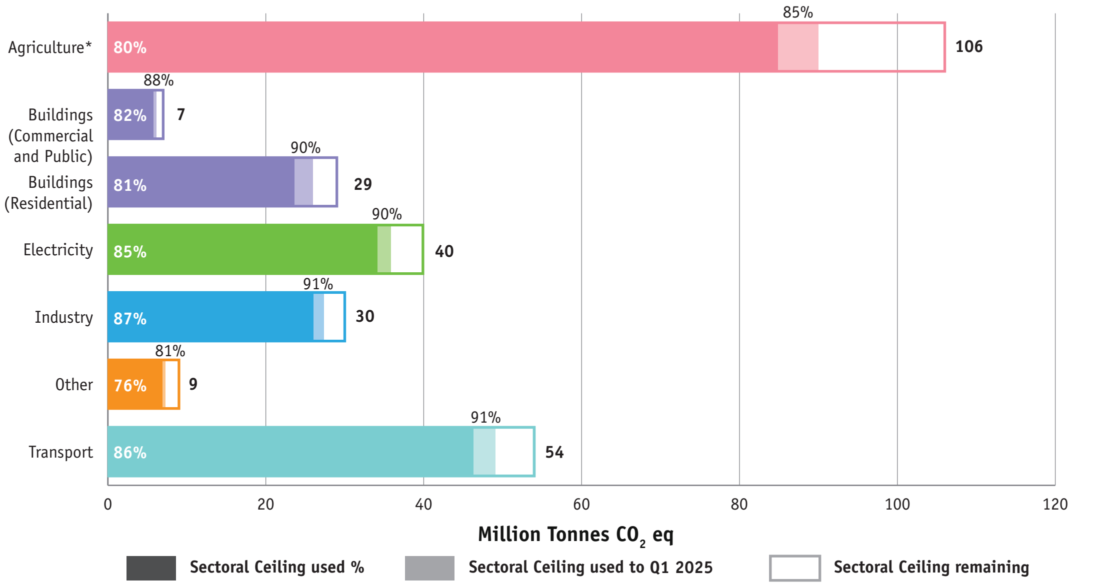
			Comparison to 2024 Q4	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Overall		**12798.5**	**26.2**	**0.2**
Agriculture	CH_4, CO_2, N_2O	4868.1	14.5	0.3
Buildings	CH_4, CO_2	1755.3	23.9	1.4
Electricity	CO_2	1587.7	-128.3	-7.5
Industry	CO_2	1389.7	85.8	6.6
Other	CH_4, N_2O, HFC, PFC, SF_6, NF_3	358.7	37.5	11.7
Transport	CO_2	2839.0	-7.0	-0.2

Figure 4: Comparing Q1 2025 to Q4 2024 by sector



With regards to Sectoral Emissions Ceilings, looking specifically at the first Carbon Budget period of 2021-2025, Figure 5 shows the emissions used and the remaining CAP emissions until the ceiling is reached. The amount of sectoral budget used ranges from 85% in the Agriculture sector to 91% in the Industry and Transport sectors.

Figure 5: Summary of Sectoral Ceiling Emissions Used across 2021 to 2024 as reported in the Provisional Greenhouse Gas Emissions 1990-2024 (dark), Emissions Used in Q1 2025 (bright) and the Sectoral Ceiling Emissions Remaining (outline)



* A direct comparison of emissions in the Agriculture sector against its SEC is no longer viable due to significant refinement of the Agriculture inventory. The current distance to SEC target is largely a result of the integration of updated science into the Agricultural inventory as outlined in the Final 1990-2023 Greenhouse Gas Inventory Report and Ireland's Greenhouse Gas Emissions Projections 2024-2055 Report. To support the achievement of the national target of a 51% reduction by 2030 on 2018 levels, the indicative percentage reduction for Agriculture is ~10% by 2025 and ~25% by 2030.

3. Sectoral Summaries

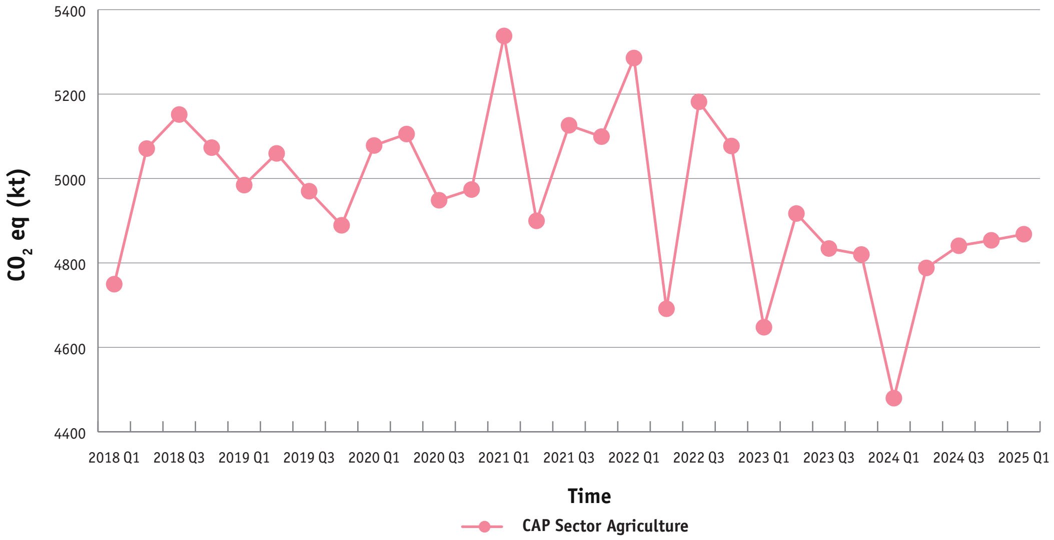
3.1 Agriculture

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 6: Changes in emissions in the Agriculture sector from Q1 2018 to Q1 2025, based on seasonally adjusted data



3.1.1 Agriculture Year-on-Year Change

Key findings:

There was a +8.7% (+388.4 kt CO_2 eq) increase in emissions compared to the same quarter last year. This was driven by increased fertiliser sales (up +108.8% compared to the same quarter in 2024, and 16% above the 5-year rolling average for Q1). Fertiliser sales last year were impacted by adverse weather and ground conditions in the early part of the year. In addition, they may have been impacted by likely delayed purchasing decisions following the introduction of a lower maximum stocking rate of 220 kg N ha^{-1} under the nitrates regulations.

Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Agriculture greenhouse gas emissions increased by +8.7% (+388.4 kt CO_2 eq) compared to Quarter 1 2024.
- The largest increase in emissions occurred in the Agricultural soils (+409.8 kt CO_2 eq) sector, followed by the Liming (+32.4 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Enteric fermentation (-69.4 kt CO_2 eq) sector, followed by the Manure management (-16.9 kt CO_2 eq) sector.

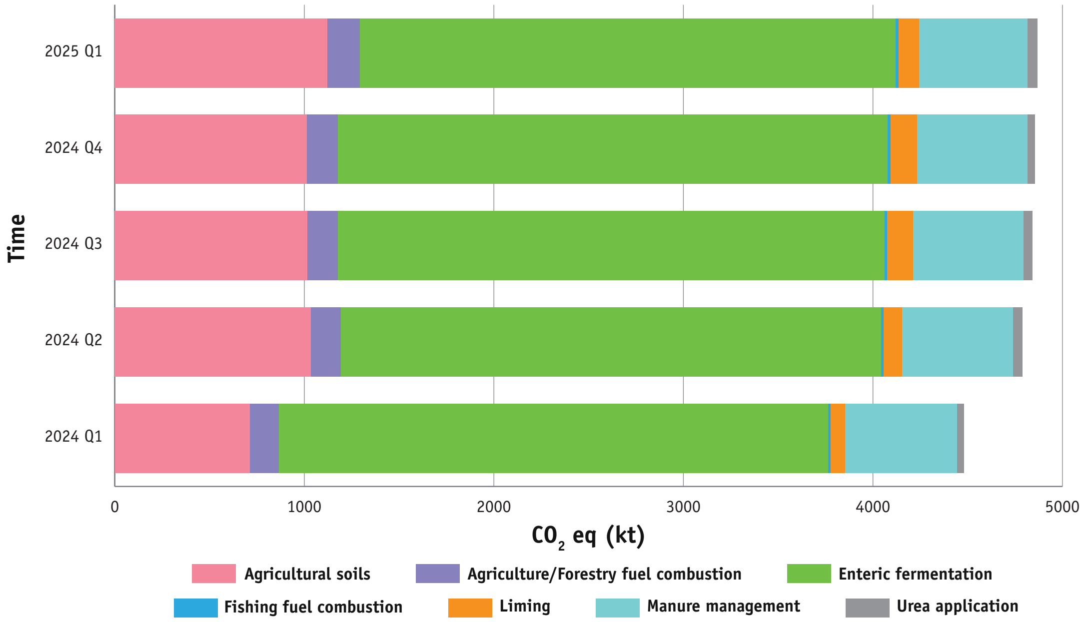
Table 5: Summary Q1 2025 compared to Q1 2024 - Agriculture

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Agriculture	**CH_4, CO_2, N_2O**	**4868.1**	**388.4**	**8.7**
Agricultural soils	N_2O	1121.1	409.8	57.6
Agriculture/Forestry fuel combustion	CO_2	170.8	17.3	11.2
Enteric fermentation	CH_4	2827.8	-69.4	-2.4
Fishing fuel combustion	CO_2	15.0	-0.2	-1.3
Liming	CO_2	107.6	32.4	43.1
Manure management	CH_4, N_2O	573.3	-16.9	-2.9
Urea application	CO_2	52.3	15.5	42.0

Note:

* Liming subsector: Direct CO2 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 7: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data



3.1.2 Agriculture Quarter-on-Quarter Change

Key findings:

There was a +0.3% (+14.5 kt CO_2 eq) increase in emissions compared to the previous quarter. This was driven by increased emissions from Agricultural Soils (+109.5 kt CO_2 eq), counteracted by decreased methane production from Enteric fermentation by livestock (-72.2 kt CO_2 eq).

Looking at Quarter 1 2025 compared to Quarter 4 2024:

- Agriculture greenhouse gas emissions increased by +0.3% (+14.5 kt CO_2 eq) compared to Quarter 4 2024.
- The largest increase in emissions occurred in the Agricultural soils (+109.5 kt CO_2 eq) sector, followed by the Urea application (+13.8 kt CO_2 eq) sector.
- The largest decrease in emissions occurred in the Enteric fermentation (-72.2 kt CO_2 eq) sector, followed by the Liming (-34.6 kt CO_2 eq) sector.

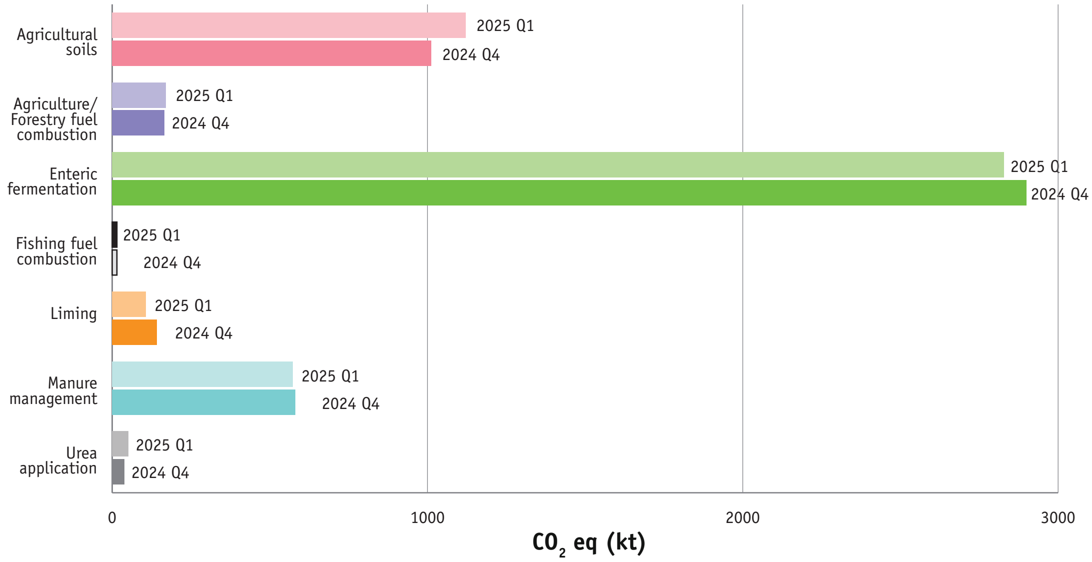
Table 6: Summary Q1 2025 compared to Q4 2024 - Agriculture

			Comparison to 2024 Q4	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Agriculture	**CH_4, CO_2, N_2O**	**4868.1**	**14.5**	**0.3**
Agricultural soils	N_2O	1121.1	109.5	10.8
Agriculture/Forestry fuel combustion	CO_2	170.8	5.6	3.4
Enteric fermentation	CH_4	2827.8	-72.2	-2.5
Fishing fuel combustion	CO_2	15.0	0.0	0.3
Liming	CO_2	107.6	-34.6	-24.3
Manure management	CH_4, N_2O	573.3	-7.6	-1.3
Urea application	CO_2	52.3	13.8	35.9

Note:

* Liming subsector: Direct CO2 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: Quarter-on-Quarter changes in emissions in the Agriculture Subsectors, based on seasonally adjusted data



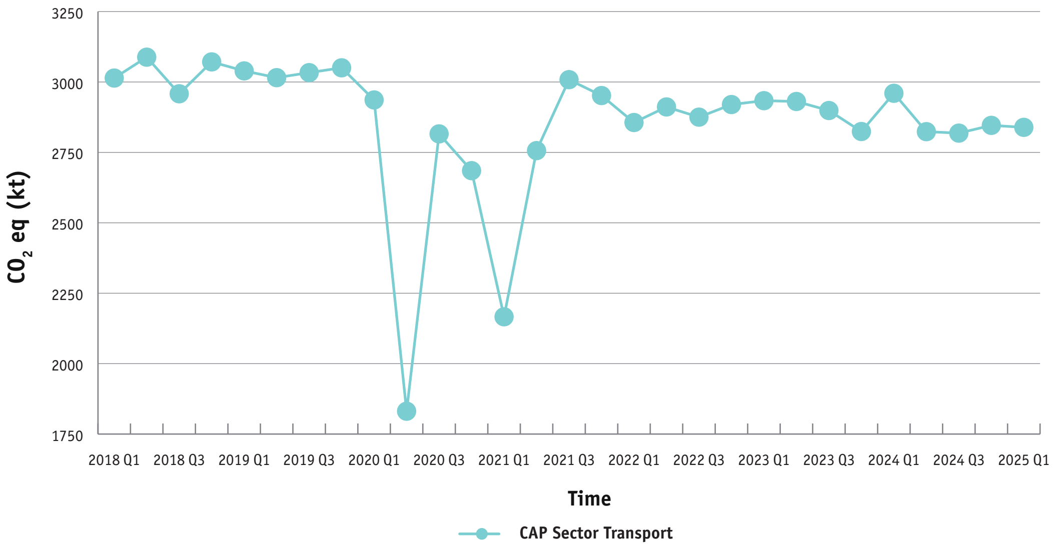
3.2 Transport

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 9: Changes in emissions in the Transport sector from Q1 2018 to Q1 2025, based on seasonally adjusted data



3.2.1 Transport Year-on-Year Change

Key finding:

The primary driver of the -4.1% (-121.0 kt CO_2 eq) decrease in emissions this quarter was decreased sales of diesel (-7.2%) compared to the same quarter last year. Petrol sales increased +1.2%, but this was offset by a rise in biofuel blending rates (from 8% to 9.8% by volume) which reduced the net fossil fuel content.

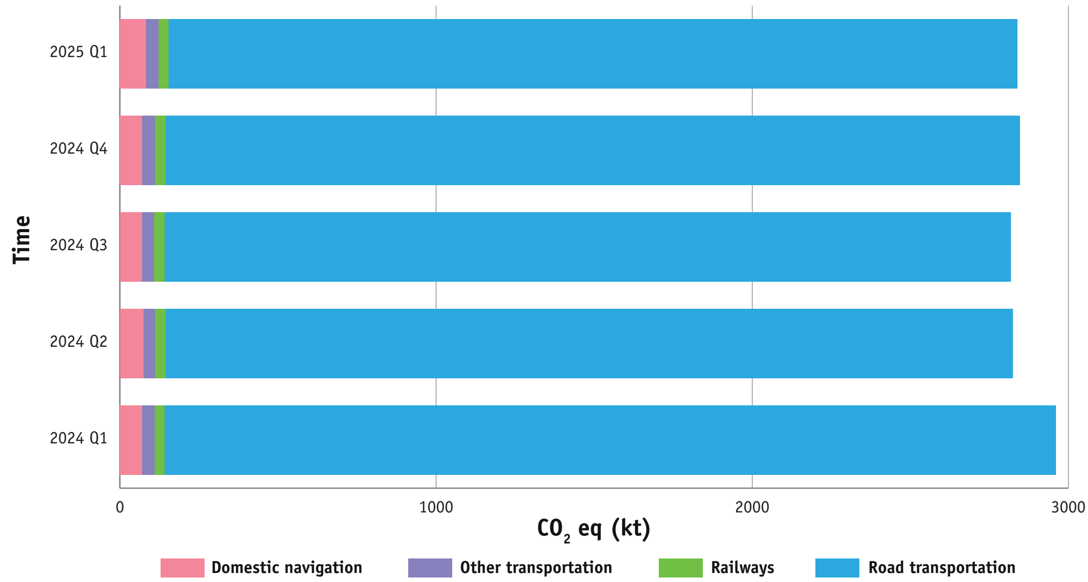
Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Transport greenhouse gas emissions decreased by -4.1% (-121.0 kt CO_2 eq) compared to Quarter 1 2024.
- The largest decrease in emissions occurred in the Road transportation (-134.5 kt CO_2 eq) sector.
- The largest increase in emissions occurred in the Domestic navigation (+12.3 kt CO_2 eq) sector.

Table 7: Summary Q1 2025 compared to Q1 2024 - Transport

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Transport	**CO_2**	**2839.0**	**-121.0**	**-4.1**
Domestic navigation	CO_2	82.5	12.3	17.6
Other transportation	CO_2	38.9	0.7	1.8
Railways	CO_2	32.9	0.5	1.6
Road transportation	CO_2	2684.7	-134.5	-4.8

Figure 10: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data



3.2.2 Transport Quarter-on-Quarter Change

Key finding:

The primary drivers of the -0.2% (-7.0 kt CO_2 eq) decrease in emissions this quarter was decreased sales of diesel (-6.0%) and petrol (-5.5%) compared to the previous quarter.

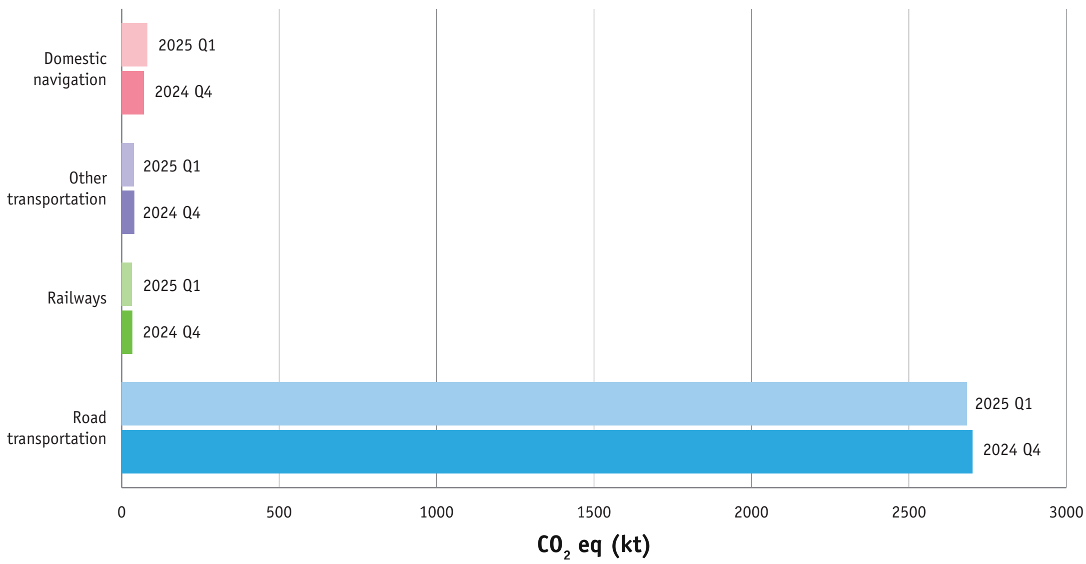
Looking at Quarter 1 2025 compared to Quarter 4 2024:

- Transport greenhouse gas emissions decreased by -0.2% (-7.0 kt CO_2 eq) compared to Quarter 4 2024.
- The largest decrease in emissions occurred in the Road transportation (-17.1 kt CO_2 eq) sector.
- The largest increase in emissions occurred in the Domestic navigation (+12.2 kt CO_2 eq) sector.

Table 8: Summary Q1 2025 compared to Q4 2024 - Transport

			Comparison to 2024 Q4	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Transport	**CO_2**	**2839.0**	**-7.0**	**-0.2**
Domestic navigation	CO_2	82.5	12.2	17.4
Other transportation	CO_2	38.9	-1.4	-3.5
Railways	CO_2	32.9	-0.8	-2.3
Road transportation	CO_2	2684.7	-17.1	-0.6

Figure 11: Changes in emissions in the Transport Subsectors from Q4 2024 to Q1 2025, based on seasonally adjusted data



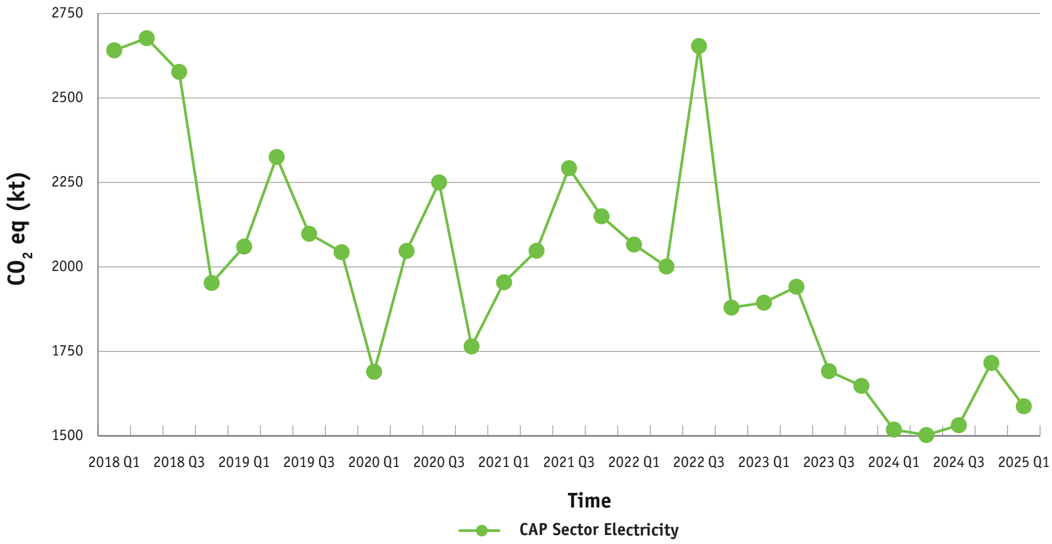
3.3 Electricity

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 12: Changes in emissions in the Electricity sector from Q1 2018 to Q1 2025, based on seasonally adjusted data



3.3.1 Electricity Year-on-Year Change

Key finding:

Greenhouse gas emissions increased by +4.5% (+69.0 kt CO_2 eq) due to a 3.3% increase in overall electricity supply which was achieved by an increase in the share of imported electricity from 11.2% to 13.7% and a 4.1% increase in non-renewable sources of electricity generation. The share of the energy supply in Q1 2025 from renewables (44%), non-renewables (42%) and imports (14%) did not markedly change compared to Q1 2024.

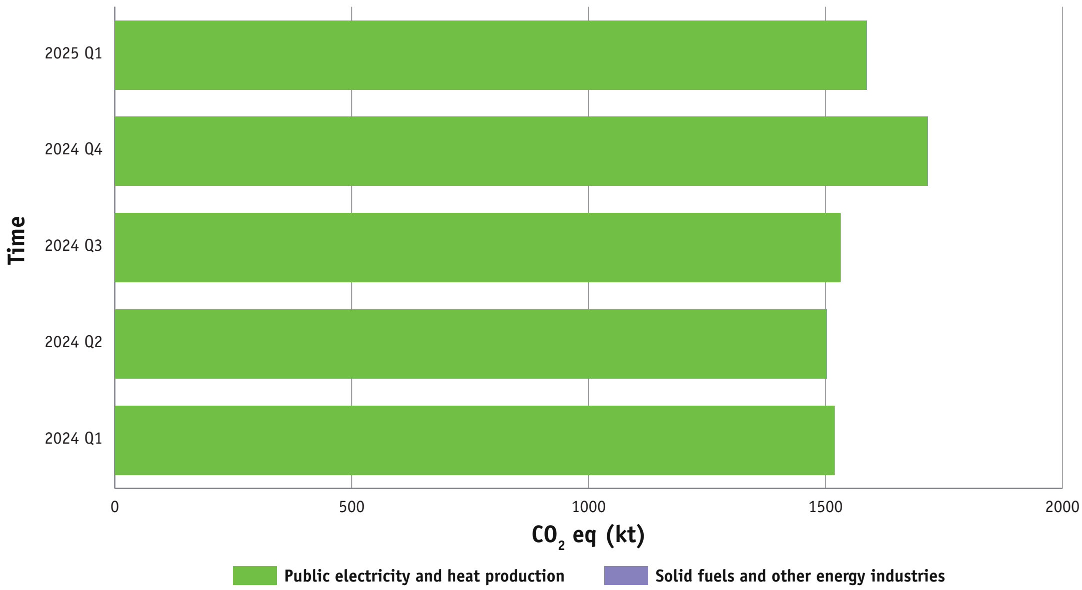
Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Electricity greenhouse gas emissions increased by +4.5% (+69.0 kt CO_2 eq) compared to Quarter 1 2024.
- The largest increase in emissions occurred in the Public electricity and heat production (+68.9 kt CO_2 eq) sector.

Table 9: Summary Q1 2025 compared to Q1 2024 - Electricity

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Electricity	**CO_2**	**1587.7**	**69.0**	**4.5**
Public electricity and heat production	CO_2	1586.6	68.9	4.5
Solid fuels and other energy industries	CO_2	1.1	0.1	8.0

Figure 13: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data



3.3.2 Electricity Quarter-on-Quarter Change

Key finding:

Greenhouse gas emissions decreased by -7.5% (-128.3 kt CO_2 eq) due to a decline of -8.5% in electricity generation from fossil fuels, and increases of +12.7% in renewable energy and +16.1% in interconnector imports.

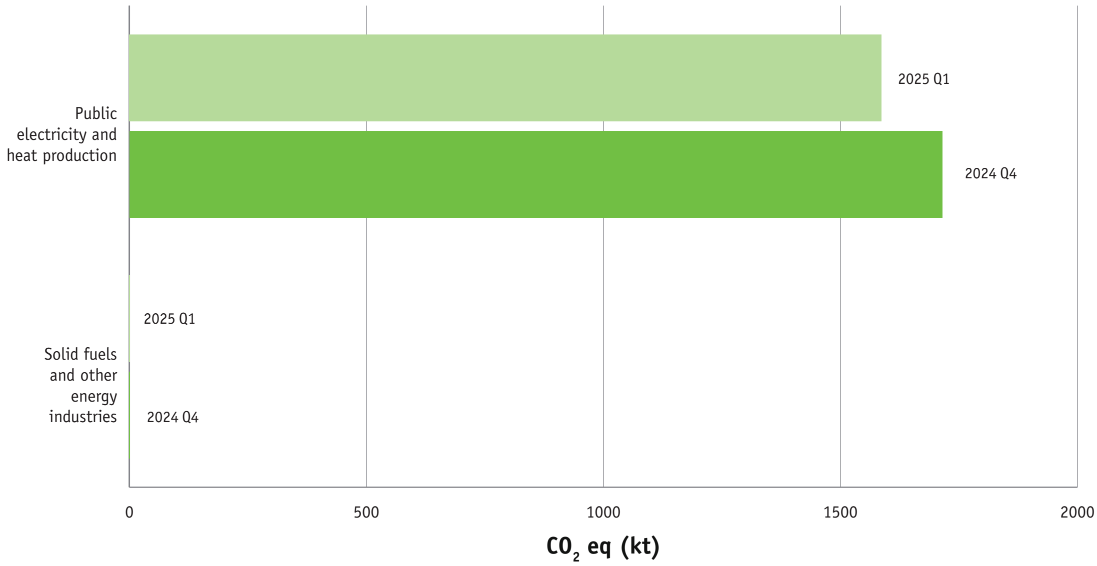
Looking at Quarter 1 2025 compared to Quarter 4 2024:

- Electricity greenhouse gas emissions decreased by -7.5% (-128.3 kt CO_2 eq) compared to Quarter 4 2024.
- The largest decrease in emissions occurred in the Public electricity and heat production (-128.3 kt CO_2 eq) sector.

Table 10: Summary Q1 2025 compared to Q4 2024 - Electricity

			Comparison to 2024 Q4	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Electricity	**CO_2**	**1587.7**	**-128.3**	**-7.5**
Public electricity and heat production	CO_2	1586.6	-128.3	-7.5
Solid fuels and other energy industries	CO_2	1.1	0.0	-1.8

Figure 14: Changes in emissions in the Electricity subsectors from Q1 2025 to Q4 2024, based on seasonally adjusted data



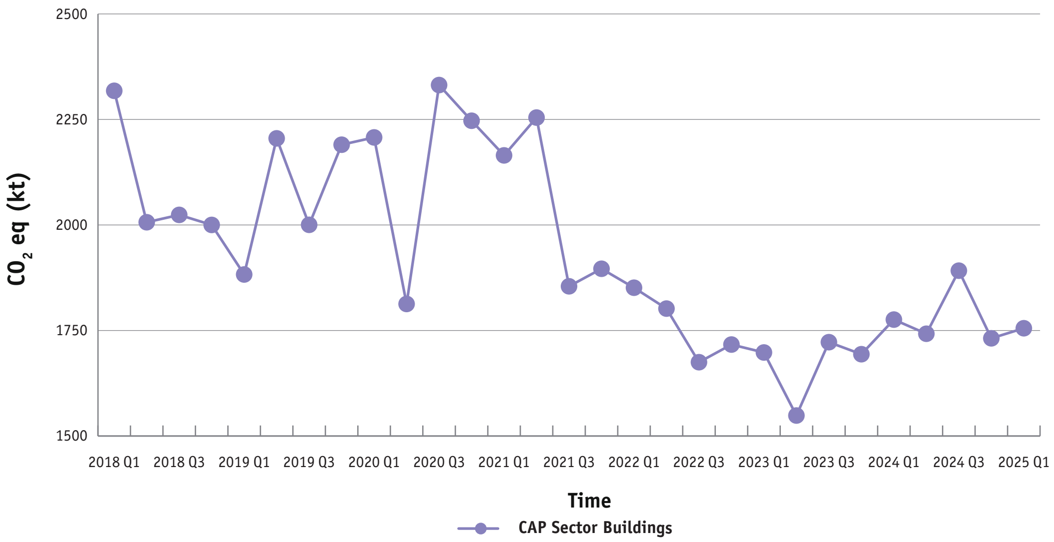
3.4 Buildings

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 15: Changes in emissions in the Buildings sector from Q1 2018 to Q1 2025, based on seasonally adjusted data



3.4.1 Buildings Year-on-Year Change

Key finding:

Emissions from Buildings reduced by -1.2% (-20.5 kt CO_2 eq) due to decreased energy demand from Residential Buildings (-1.8%, -25.9 kt CO_2 eq). The number of heating degree days (HDD, defined as days with an average temperature below 15.5°C, indicating a need for heating) was effectively the same (-0.02%) in Q1 2025 compared to Q1 2024.

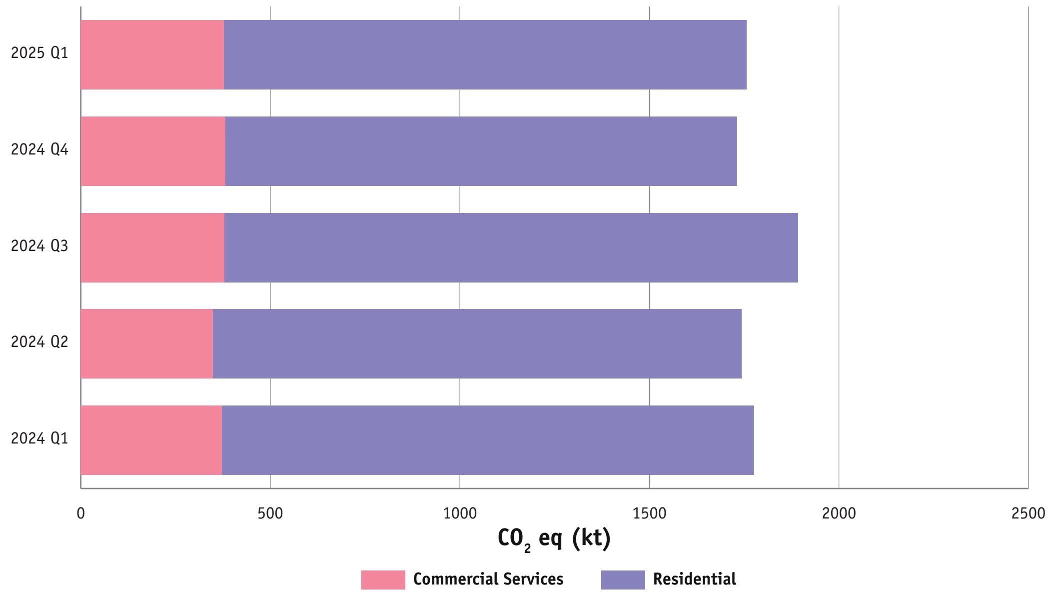
Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Buildings greenhouse gas emissions decreased by -1.2% (-20.5 kt CO_2 eq) compared to Quarter 1 2024.
- The largest decrease in emissions occurred in the Residential (-25.9 kt CO_2 eq) sector.

Table 11: Summary Q1 2025 compared to Q1 2024 - Buildings

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Buildings	**CH_4, CO_2**	**1755.3**	**-20.5**	**-1.2**
Commercial Services	CO_2	377.6	5.3	1.4
Residential	CH_4, CO_2	1377.8	-25.9	-1.8

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



3.4.2 Buildings Quarter-on-Quarter Change

Key finding:

- Emissions from Buildings increased by +1.4% (+23.9 kt CO_2 eq) on a seasonally adjusted basis, driven by increased emissions from Residential Buildings (+26.9 kt CO_2 eq).

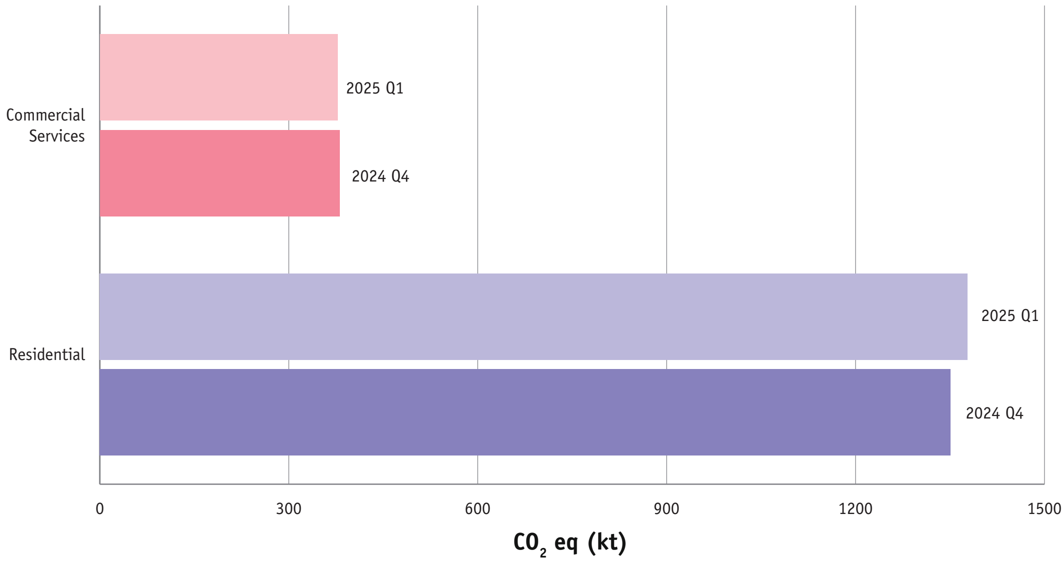
Looking at Quarter 1 2025 compared to Quarter 4 2024:

- Buildings greenhouse gas emissions increased by +1.4% (+23.9 kt CO_2 eq) compared to Quarter 4 2024.
- The largest increase in emissions occurred in the Residential (+26.9 kt CO_2 eq) sector.

Table 12: Summary Q1 2025 compared to Q4 2024 - Buildings

			Comparison to 2024 Q4	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Buildings	**CH_4, CO_2**	**1755.3**	**23.9**	**1.4**
Commercial Services	CO_2	377.6	-3.1	-0.8
Residential	CH_4, CO_2	1377.8	26.9	2.0

Figure 17: Changes in emissions in the Building Subsectors from Q4 2024 to Q1 2025, based on seasonally adjusted data



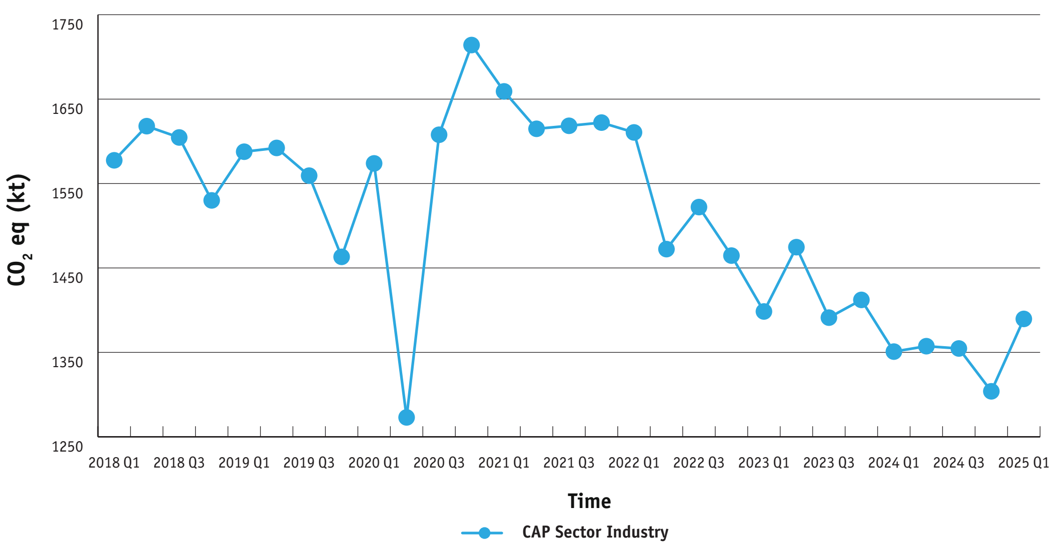
3.5 Industry

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 18: Changes in emissions in the Industry sector from Q1 2018 to Q1 2025, based on seasonally adjusted data



3.5.1 Industry Year-on-Year Change

Key finding:

Industry emissions were up +2.9% (+38.7 kt CO_2 eq), driven by increased emissions from the Mineral Industry (largely represented by the cement production sector and includes lime, brick and ceramic sectors) (+23.5 kt CO_2 eq).

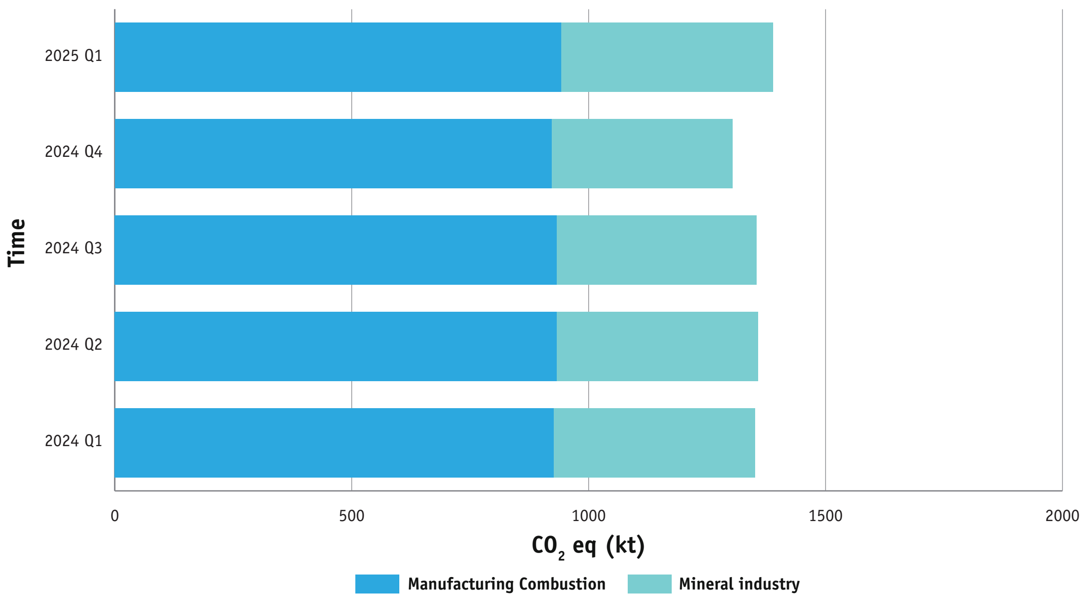
Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Industry greenhouse gas emissions increased by +2.9% (+38.7 kt CO_2 eq) compared to Quarter 1 2024.
- The largest increase in emissions occurred in the Mineral industry (+23.5 kt CO_2 eq) sector, followed by the Manufacturing Combustion (+15.3 kt CO_2 eq) sector.

Table 13: Summary Q1 2025 compared to Q1 2024 - Industry

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Industry	**CO_2**	**1389.7**	**38.7**	**2.9**
Manufacturing Combustion	CO_2	941.5	15.3	1.6
Mineral industry	CO_2	448.2	23.5	5.5

Figure 19: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data



3.5.2 Industry Quarter-on-Quarter Change

Key finding:

- Industry emissions were up +6.6% (+85.8 kt CO_2 eq), driven by increases in both process and combustion emissions from the Mineral Industry on a seasonally adjusted basis (+66.0 kt CO_2 eq).

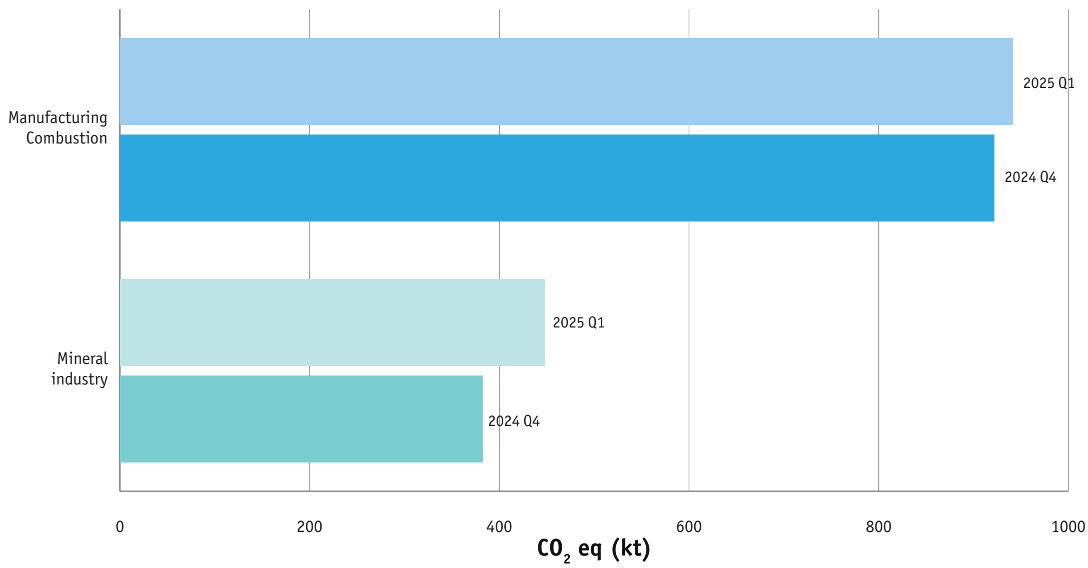
Looking at Quarter 1 2025 compared to Quarter 4 2024:

- Industry greenhouse gas emissions increased by +6.6% (+85.8 kt CO_2 eq) compared to Quarter 4 2024.
- The largest increase in emissions occurred in the Mineral industry (+66.0 kt CO_2 eq) sector, followed by the Manufacturing Combustion (+19.8 kt CO_2 eq) sector.

Table 14: Summary Q1 2025 compared to Q4 2024 - Industry

			Comparison to 2024 Q4	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Industry	**CO_2**	**1389.7**	**85.8**	**6.6**
Manufacturing Combustion	CO_2	941.5	19.8	2.1
Mineral industry	CO_2	448.2	66.0	17.3

Figure 20: Quarter-on-Quarter Changes in emissions in the Industry Subsectors, based on seasonally adjusted data



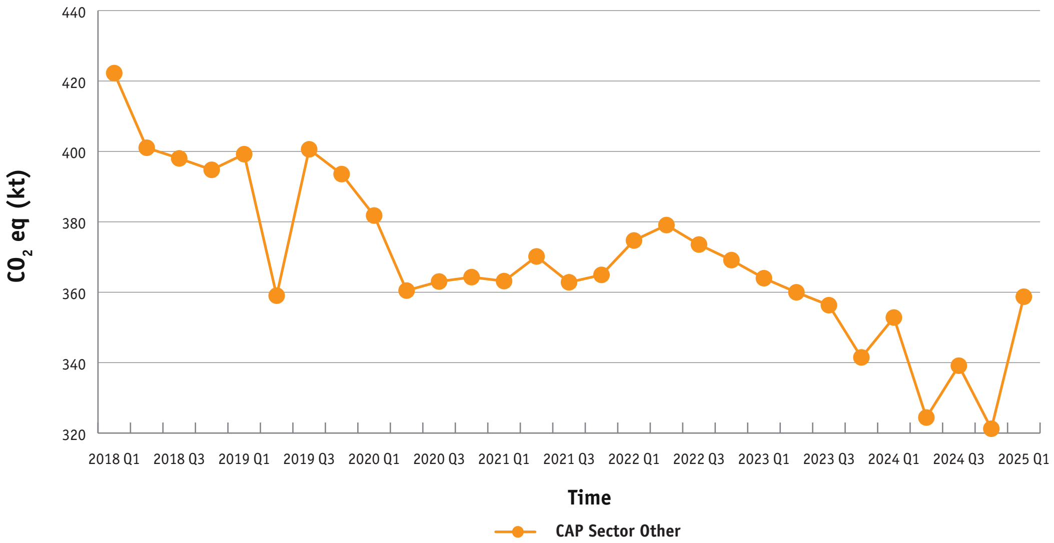
3.6 Other

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 21: Changes in emissions in the Other sector from Q1 2018 to Q1 2025, based on seasonally adjusted data



3.6.1 Other Year-on-Year Change

Key finding:

The primary driver of the +1.7% (+5.9 kt CO_2 eq) change in emissions this quarter was an increase in emissions from Petroleum Refining (+4.6 kt CO_2 eq) compared to the year ago quarter. A refinery was offline for essential maintenance for extended periods last year thus impacting emissions.

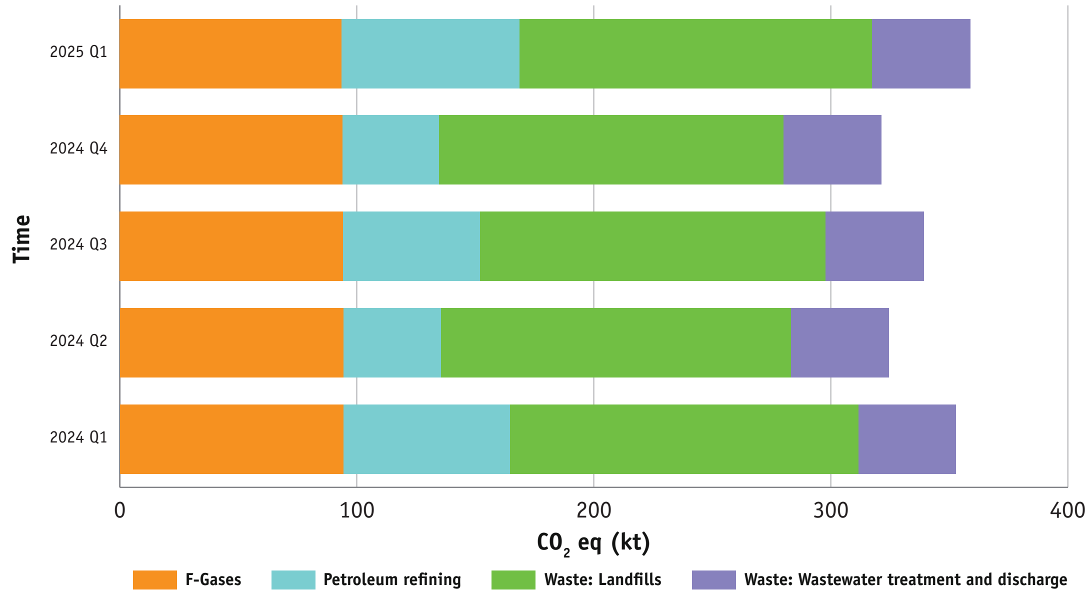
Looking at Quarter 1 2025 compared to Quarter 1 2024:

- Other greenhouse gas emissions increased by +1.7% (+5.9 kt CO_2 eq) compared to Quarter 1 2024.

Table 15: Summary Q1 2025 compared to Q1 2024 - Other

			Comparison to 2024 Q1	
Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	(kt CO_2eq)	(%)
Other	**CH_4, N_2O, HFC, PFC, SF_6, NF_3**	**358.7**	**5.9**	**1.7**
F-Gases	HFC, PFC, SF_6, NF_3	93.6	-0.7	-0.7
Petroleum refining	CO_2	75.0	4.6	6.6
Waste: Landfills	CH_4	148.8	1.8	1.2
Waste: Wastewater treatment and discharge	CH_4, N_2O	41.4	0.2	0.4

Figure 22: Comparison of subsectoral breakdown in emissions for this quarter vs last four quarters, based on seasonally adjusted data



3.6.2 Other Quarter-on-Quarter Change

Key finding:

Emissions from Other sectors increased +11.7% (+37.5 kt CO_2 eq) driven by a quarter-over-quarter increase in gas and liquid fuel combustion in Petroleum Refining (+34.5 kt CO_2 eq) due to a refinery being offline for essential maintenance for extended periods last year.

Looking at Quarter 1 2025 compared to Quarter 4 2024:

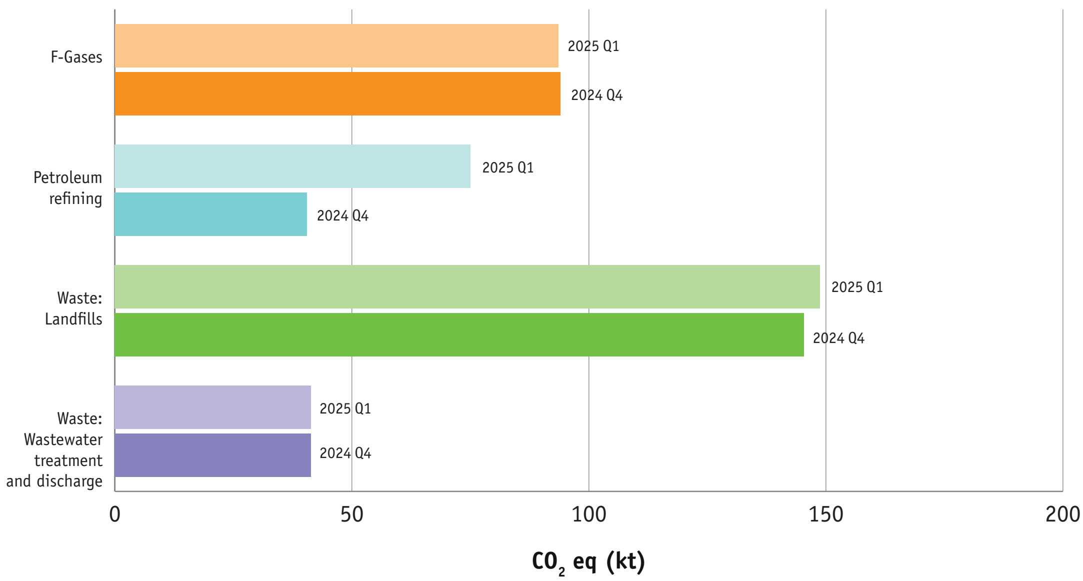
- Other greenhouse gas emissions increased by +11.7% (+37.5 kt CO_2 eq) compared to Quarter 4 2024.

- The largest increase in emissions occurred in the Petroleum refining sector (+34.5 kt CO_2 eq).

Table 16: Summary Q1 2025 compared to Q4 2024 – Other

Sector	Greenhouse Gas	Emissions 2025 Q1 (kt CO_2eq)	Comparison to 2024 Q4 (kt CO_2eq)	Comparison to 2024 Q4 (%)
Other	**CH_4, N_2O, HFC, PFC, SF_6, NF_3**	**358.7**	**37.5**	**11.7**
F-Gases	HFC, PFC, SF_6, NF_3	93.6	-0.4	-0.4
Petroleum refining	CO_2	75.0	34.5	85.0
Waste: Landfills	CH_4	148.8	3.4	2.3
Waste: Wastewater treatment and discharge	CH_4, N_2O	41.4	0.0	0.0

Figure 23: Changes in emissions in the Other subsectors from Q1 2025 to Q4 2024, based on seasonally adjusted data



4. Data

All source data for this report are 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

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 adhering 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, and 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 data are available, the implementation of a statistical 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. If at least two out of the three tests find seasonality, seasonal adjustment is implemented. If the visual inspection, Kruskal-Wallis and Friedman tests all 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 Kruskal-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 methodologies are consulted to identify improvement actions.

5.2 Revisions and Methodological Changes of Note

As part of ongoing efforts to enhance the accuracy and transparency of quarterly emissions estimates, a refined model selection framework was introduced for the Agriculture and 'Other' sectors in this reporting cycle to evaluate candidate models across multiple performance dimensions. Given the sector's reliance on multiple proxy data series for each indicator, a composite scoring system was developed to evaluate candidate temporal disaggregation models more holistically. This system integrates several performance metrics; adjusted R-squared, AIC, BIC, RMSE, and model rank, into a single score that balances model fit, complexity, and predictive reliability.

Models are filtered to exclude outliers and poor fits, and then scored using scaled values of these metrics to balance explanatory power against parsimony and predictive accuracy. Additional penalties are applied to models exhibiting truncated autocorrelation structures. This refinement ensures that the selected model not only fits the historical data well but also maintains stability and interpretability, thereby improving the reliability of quarterly emissions estimates.

5.2.1 Scoring Framework for Temporal Disaggregation Model Selection

To support the selection of the most appropriate temporal disaggregation model in the Agriculture sector, a composite scoring system was developed to evaluate candidate models across multiple diagnostic criteria. This approach was necessary due to the presence of multiple proxy indicators per emissions category, which increased the complexity of model evaluation.

Each candidate model was assessed using the following metrics:

- **Adjusted R-squared (adj_rsq)**: Measures explanatory power, adjusted for model complexity.
- **Akaike Information Criterion (AIC)** and **Bayesian Information Criterion (BIC)**: Penalise model complexity while rewarding goodness of fit.
- **Root Mean Square Error (RMSE)**: Captures average prediction error magnitude.
- **Residual variance (s^2_{gls}):** Reflects model residual dispersion.

- **Model rank (rank)**: A domain-informed ordinal ranking of model plausibility.
- **Scale ratio (scale_ratio)**: Ratio of standard deviations between disaggregated and original series.
- **Coefficient magnitude (coef_magnitude)**: Sum of absolute model coefficients, used as a proxy for overfitting.
- **Truncation flag (rho_truncated)**: Indicates whether autocorrelation structure was truncated.

5.2.1.1 Scoring Formula

Each metric was standardised (z-scored) across all valid models. The final **composite score** was calculated as:

$$\text{Score} = w_1 \cdot Z(\text{adj\_rsq}) - w_2 \cdot Z(\text{AIC}) - w_3 \cdot Z(\text{BIC}) - w_4 \cdot Z(\text{s}^2_{\text{gls}}) - w_5 \cdot Z(\text{RMSE}) - w_6 \cdot Z(\text{rank})$$

Where:

- $Z(\cdot)$ denotes the standardised (z-score) value of each metric.
- w_1 through w_6 are user-defined weights reflecting the relative importance of each metric.

An additional penalty of 2 points was subtracted from the score if the model exhibited truncated autocorrelation (i.e., rho_truncated = TRUE).

Only models passing quality filters (e.g. RMSE below the 95th percentile, scale_ratio < 10) were considered. The model with the highest final score was selected as the best fit for quarterly disaggregation.

5.3 Forecast Validation Test

To assess the predictive accuracy of the temporal disaggregation methodology, a retrospective quality test was conducted. Annual emissions data for the period 1990-2023 were disaggregated into quarterly estimates, and the model was then used to forecast emissions for the four quarters of 2024. These predicted quarterly values were aggregated to produce a modelled annual total for 2024, which was then compared against the actual reported annual emissions change for that year (from Ireland's Provisional Greenhouse Gas Emissions 1990-2024).

The percentage change from 2023 to 2024 in the predicted series was compared with the observed percentage change over the same period. This comparison served as a practical validation of the model's ability to capture year-on-year trends, providing an additional measure of confidence in the disaggregation approach.

5.3.1 Forecast Accuracy Results (based on 2024 Q4 results)

Comparison of Predicted vs. Actual Percentage Change in Emissions (2023-2024)

This table presents a comparison between actual percentage changes in greenhouse gas emissions by sector (based on the 2024 Provisional Inventory) and predicted changes from two forecasting approaches: the published 2024 Q4 Report and the updated methodology. It also includes the differences in percentage points between actual and predicted values to highlight forecasting accuracy and methodological impacts.

	Actual Change (%) 2024 vs. 2023	Predicted Change (%) 2024 vs. 2023		Difference (pp)	
Sector	2024 Provisional Inventory	2024 Q4 Report	Updated Methodology	Q4 Report vs Actual	Updated vs. Actual
Agriculture	-1.7	0.8	-1.1	2.5	0.6
Electricity	-8.1	-6.4	-6.4	1.7	1.7
Transport	-1.2	-1.3	-1	-0.1	0.2
Buildings	5.6	6.6	6.6	1	1
Industry	-4.6	-7.4	-7.4	-2.8	-2.8
Other	-4	0.1	-3.3	4.1	0.7
Overall	-2	-0.6	-1.4	1.4	0.6

ISBN 978-1-80009-244-0

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil