

# Ireland's Provisional Greenhouse Gas Emissions 1990-2018



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## IRELAND'S PROVISIONAL GREENHOUSE GAS EMISSIONS IN 2018

### KEY HIGHLIGHTS

- The EPA has produced provisional estimates of greenhouse gas emissions for the period 1990 – 2018 that indicate that Ireland will exceed its 2018 annual limit set under the EU's Effort Sharing Decision (ESD), 406/2009/EC<sup>1</sup> by 5.17 Mt CO<sub>2</sub>eq.
- For 2018, total national greenhouse gas emissions are estimated to be 60.51 million tonnes carbon dioxide equivalent (Mt CO<sub>2</sub>eq). This is 0.2% lower (0.14 Mt CO<sub>2</sub>eq) than emissions in 2017.
- In 2018, emissions in the European Union's Emissions Trading Sector<sup>2</sup> (ETS) decreased by 8.2% or 1.38 Mt CO<sub>2</sub>eq and ESD emissions increased by 2.8% or 1.24 Mt CO<sub>2</sub>eq.
- Emissions in the *Energy Industries* sector show a decrease of 11.7% or 1.38 Mt CO<sub>2</sub>eq which is attributable to a 44% decrease in coal used in electricity generation and an increase of 13.6% for electricity generated from wind in 2018.
- *Agriculture* emissions increased by 1.9% or 0.38 Mt CO<sub>2</sub>eq in 2018. The most significant drivers for the increased emissions in 2018 are higher dairy cow numbers (+2.7%) with an increase in milk production of 4.4%. Nitrogen fertiliser use also increased by 10.7% in 2018.
- Greenhouse gas emissions from the *Transport* sector increased by 1.7% or 0.20 Mt CO<sub>2</sub>eq in 2018. This is the fifth year out of the last six with increased emissions in transport. In road transport in 2018, petrol use continued to decrease by 9.2% while diesel use increased by 4.6% and biofuels use decreased by 4.0%.
- *Agriculture* and *Transport* accounted for 72.9% of total ESD emissions in 2018.
- Greenhouse gas emissions from the *Residential* sector increased 7.9% or 0.46 Mt CO<sub>2</sub>eq due to a colder winter.
- Both *Commercial* and *Public services* sectors increased by 5.3% and 8.2% respectively in 2018 also due to a colder winter.
- Emissions from the *Manufacturing Combustion*<sup>3</sup> sector increased by 0.18 Mt CO<sub>2</sub>eq or 3.9% in 2018 with increases in combustion emissions for all sub sectors including cement which increased by 5.8% in 2018.
- The *Industrial Processes* sector emissions increased by 2.0% or 0.05 Mt CO<sub>2</sub>eq, mainly from increased cement production. Cement process emissions increased by 4.2% in 2018.
- Emissions from the *Waste* sector decreased by 2.8% or 0.03 Mt CO<sub>2</sub>eq in 2018.
- Ireland's National Policy position is to reduce CO<sub>2</sub> emissions in 2050 by 80% on 1990 levels across the Energy Generation, Built Environment and Transport sectors, with a goal of Climate

<sup>1</sup> [EU Effort Sharing Decision 406/2009/EC](#)

<sup>2</sup> [The European Union's Emissions Trading Scheme](#)

<sup>3</sup> Manufacturing Combustion; includes combustion of fuels in Industry and Construction, both in ETS and ESD

neutrality in the Agriculture and Land-Use sector. The 2018 emissions show a large decrease in Energy Generation, however, emissions in the Agriculture, Transport, Residential, Commercial and Public Services sectors are heading in the wrong direction.

## Introduction

The EPA is responsible for compiling the inventories of greenhouse gas emissions for Ireland and for reporting the data to the relevant European and international institutions. As such, Ireland's legal reporting obligations require that we submit data for the period 1990-2018 in January, March and April 2020 to the European Commission and the UNFCCC.

The provisional estimates of Ireland's greenhouse gas figures for the years 1990-2018, based on the SEAI's final energy balances released in September 2019 and are estimated using methodologies employed in the inventory in accordance with UNFCCC reporting guidelines and the latest available input data. In addition, verified emissions data from installations covered by the ETS are included. These estimates are, at this stage, provisional estimates of Ireland's greenhouse gas figures for the years 1990-2018 which will be further refined as methods and activity data are updated during the QC checking before official submission to the European Commission on 15<sup>th</sup> January 2020.

The 2018 estimates are given below, followed by an account of how these differ from the 2017 estimates. The longer-term trends in greenhouse gas emissions and their significance in relation to Ireland's target under the EU's Effort Sharing Decision on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 are also assessed.

## Ireland's Provisional Greenhouse Gas Emissions in 2018

For 2018, provisional total national greenhouse gas emissions are estimated to be 60.51 million tonnes carbon dioxide equivalent (Mt CO<sub>2</sub> eq) which is 0.2 % lower (or 0.14 Mt CO<sub>2</sub> eq) than emissions in 2017 (60.65 Mt CO<sub>2</sub> eq) and follows a 1.0% decrease in emissions reported for 2017. Emission reductions have been recorded in 7 of the last 10 years. In the last 2 years, national total emissions have only decreased by 1.2% or 0.74 Mt CO<sub>2</sub>eq, following very large increases of over 3.5% in both 2015 and 2016. In the same period, emissions in the stationary ETS sector have decreased by 12.5% or 2.22 Mt CO<sub>2</sub>eq whereas emissions under the ESD increased by 3.4% or 1.48 Mt CO<sub>2</sub>eq. Whilst there was a reduction in emissions in 2018, due to a significant reduction in coal used for electricity generation, there were considerably large increases in residential, commercial and public services due to a cold winter, highlighting Ireland's poorly performing housing and building stock.

The inter-annual change in total greenhouse gas emissions is presented in Figure 1 and sectoral emissions in Figures 2 and 3. Detailed sectoral data are shown in Table 3.

*Agriculture* remains the single largest contributor to the overall emissions at 34.0% of the total. *Transport* and *Energy Industries* are the second and third largest contributors at 20.2% and 17.1% respectively. *Residential* and *Manufacturing Combustion* emissions account for 10.2% and 7.8 % respectively. These five sectors accounted for almost 90% of national total emissions in 2018. The remainder is made up by the *Industrial Processes* at 3.8%, *Commercial Services* at 1.9%, *F-Gases* at 1.8%, *Public Services* at 1.6% and *Waste* at 1.5%. Figure 2 shows the contributions from each of the sectors in 1990 and 2018.

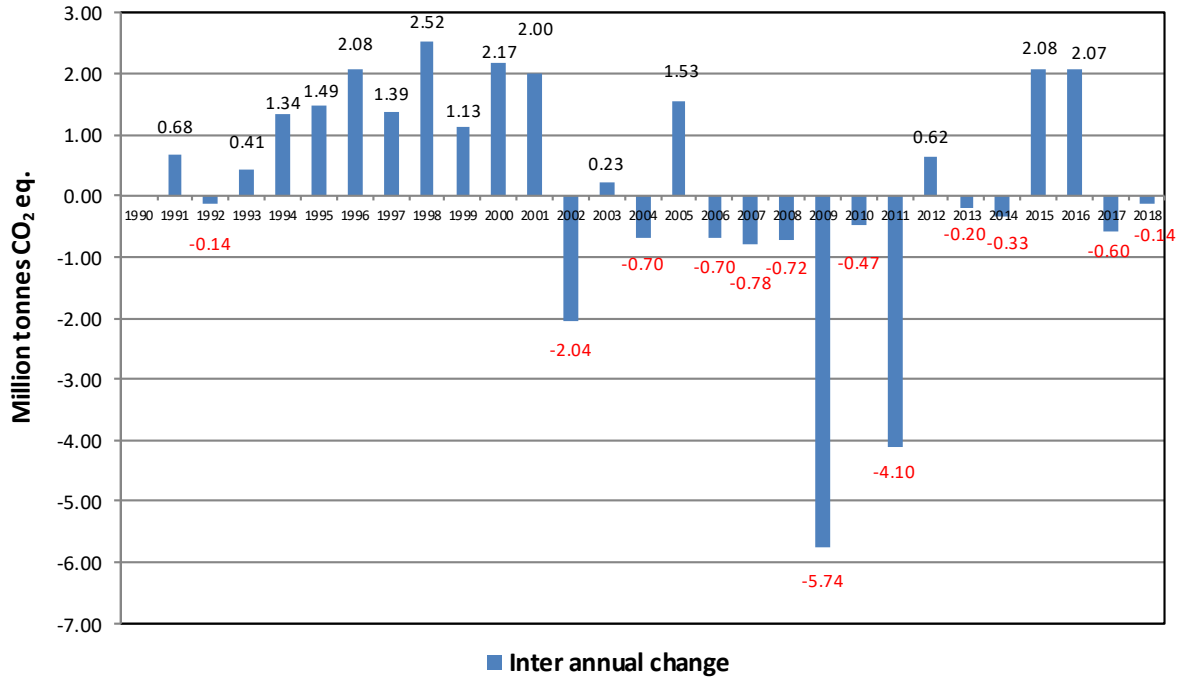


Figure 1. Inter annual changes in GHG emissions 1990-2018

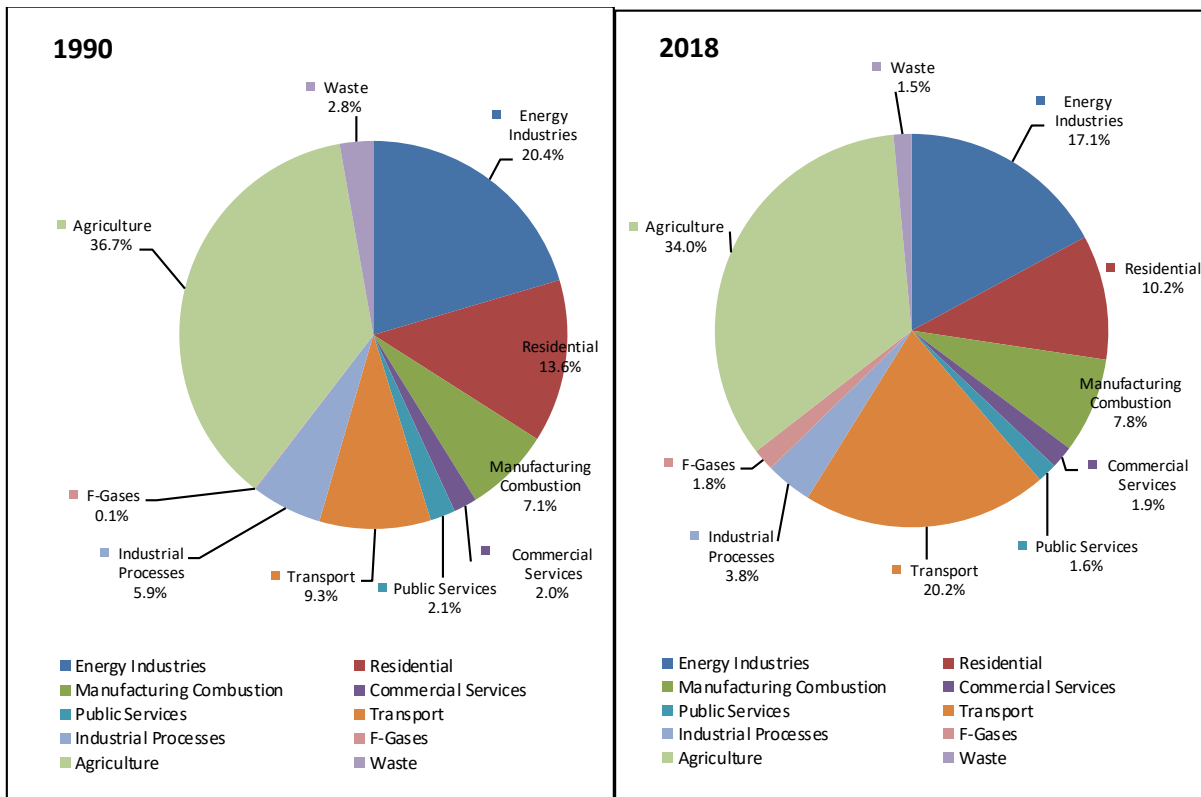


Figure 2. Greenhouse Gas Emissions in 1990 and 2018 by Sector

## Changes in Emissions from Sectors between 2017 and 2018

An overview of changes in emissions since the previous year is presented in Table 1.

**Table 1. Provisional greenhouse gas emissions for 2017 and 2018 for Ireland**

Mt CO <sub>2</sub> eq	2017	2018	% Change
Agriculture	20.221	20.597	1.9%
Transport	12.005	12.203	1.7%
Energy Industries	11.744	10.365	-11.7%
Residential	5.741	6.197	7.9%
Manufacturing Combustion	4.565	4.741	3.9%
Industrial Processes	2.270	2.316	2.0%
Commercial Services	1.072	1.129	5.3%
F-Gases	1.212	1.088	-10.2%
Public Services	0.906	0.980	8.2%
Waste	0.916	0.891	-2.8%
<b>Total</b>	<b>60.651</b>	<b>60.507</b>	<b>-0.2%</b>

*Agriculture* emissions increased by 1.9% or 0.38 Mt CO<sub>2</sub>eq in 2018 following an increase in 2017 of 2.9%. The most significant drivers for the increased emissions in 2018 are higher dairy cow numbers (+2.7%) with an increase in milk production of 4.4%. In the last 5 years, dairy cow numbers have increased by 27% and corresponding milk production by 40%. This reflects national plans to expand milk production under Food Wise 2025 and the removal of the milk quota in 2015. In 2018, there were also increased CO<sub>2</sub>eq emissions from synthetic fertiliser application on agricultural soils (+10.6%). Other cattle and sheep numbers decreased by 1.2%, 1.7 respectively, whereas pig and poultry numbers increased by 0.7% and 0.5% respectively. Total fossil fuel consumption in agriculture/forestry/fishing activities increased by 7.8% in 2018.

*Transport* emissions increased by 1.7% in 2018 or 0.20 Mt CO<sub>2</sub>eq. This is the fifth year out of the last six with increased emissions in transport. Total energy consumption in road transport increased by 1.1% in 2018; petrol, -9.2%, diesel +4.6% and biofuels -4.0%. Looking at the underlying drivers, the number of passenger diesel cars increased by 7.7% in 2018 while the number of passenger petrol cars decreased by 4.5%, commercial vehicle numbers increased by 1.7% and employment grew by 2.3% between Q4 2017 and Q4 2018.

Sectoral emissions in the *Energy Industries* sector show a decrease of 11.7% which is attributable to decreases in consumption of coal and peat by 43.7% and 3.3% respectively, whilst there were increases in natural gas, oil, biomass and non-renewable wastes of 1.5%, 2.3%, 24.8% and 60.9% respectively for electricity generated. The increases in biomass and non-renewable waste were due to the new waste to energy facility in Dublin operating at full capacity in 2018. In 2018, electricity generated from wind and hydro increased by 13.6% and 0.4% respectively, reflected in a 13.6% decrease in the emissions intensity of power generation in 2018 (377 g CO<sub>2</sub>/kWh) compared with 2017 (436 g CO<sub>2</sub>/kWh). Renewables now account for 32.6% of electricity generated in 2018 (up from 29.0% in 2017).

Emissions in the *Residential* sector increased by 7.9% or 0.46 Mt of CO<sub>2</sub>eq in 2018. Within the different fuels used in household space and water heating, all fuels showed increases; coal, peat, gasoil, kerosene, natural gas and biomass increased by 4.4%, 4.4%, 9.0%, 10.2%, 8.7% and 3.7% respectively in 2018. There were 7.6% more degree days in 2018, with all 25 weather stations showing more heating days especially during the months January to April 2018.

Emissions from the *Manufacturing Combustion* sector increased by 3.9% or 0.18 Mt CO<sub>2</sub>eq in 2018. There were increases in combustion emissions for all sub sectors including cement which increased by 5.8% in 2018. Increased emissions from companies within the ETS were evident in the chemicals, food and drink and cement sectors, with emissions increasing by 1.0%, 0.9% and 5.8% respectively.

Emissions from the *Industrial Processes* sector continue to increase by 2.0% (0.05 Mt CO<sub>2</sub>eq) in 2018 following a 5.6% increase in 2017, mainly from increased cement production. Total process emissions from the mineral products subsector (including cement) increased by 2.7%.

In 2018, total emissions (combustion and process) from the cement sector increased by 4.7% and amount to 2.91 Mt CO<sub>2</sub>eq, or 4.8% of national total emissions. Cement sector emissions have now increased by 91.2% since 2011.

Emissions from *Commercial Services* and *Public Services* both increased by 5.3% and 8.2% respectively, with increases of 9.9% and 3.8% in natural gas and gasoil use in both sectors in 2018. There was a decrease in biomass/biogas use of 14.1% in commercial services and a decrease of 0.5% in public services.

Emissions from the *Waste* sector decreased by 2.8% in 2018, with a decrease in sub category; landfills of 3.5%. Overall emissions decreased by 0.03 Mt CO<sub>2</sub>eq.

### **Long-term Changes in Sectoral Emissions 1990 – 2018**

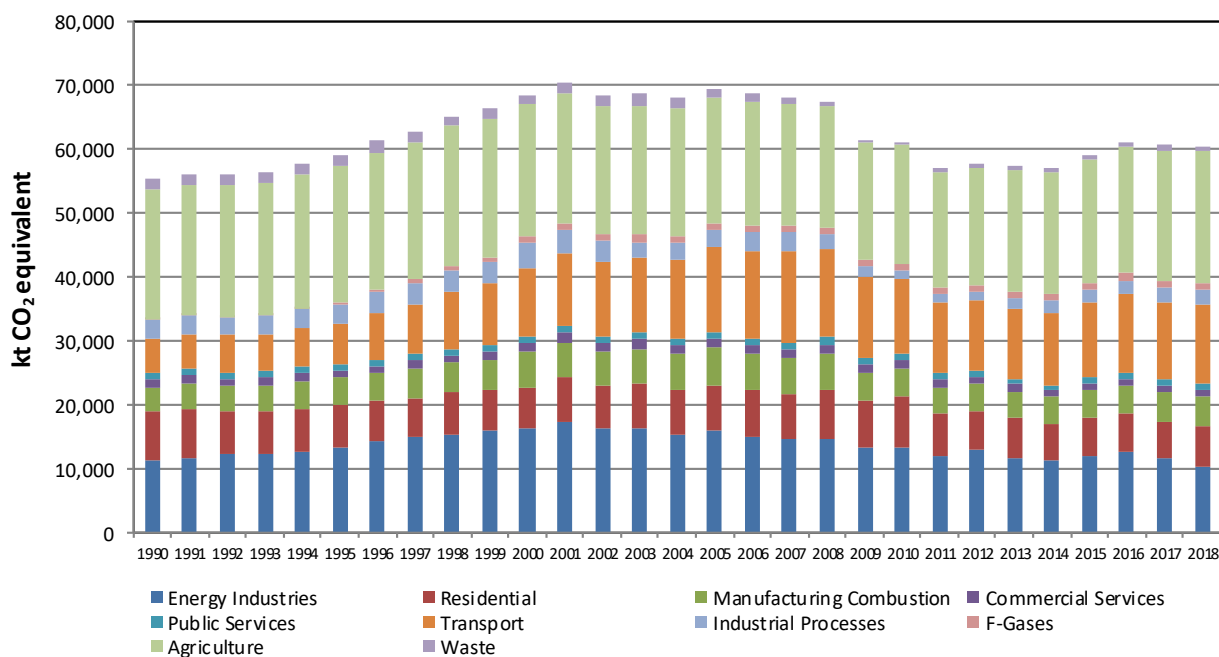
The trend in emissions from 1990 to 2018 is shown in Figures 3 and 4 and Table 3. The share of CO<sub>2</sub> in total greenhouse gas emissions has increased to 63.5% of total greenhouse gas emissions in 2018 compared to 59.3% in 1990. In contrast, CH<sub>4</sub> and N<sub>2</sub>O emissions, primarily from the agriculture sector, have fallen from 40.6% of total greenhouse gas emissions in 1990 to 34.7% in 2018. Emissions from F-gases account for 1.8% of the total in 2018.

Between 1990 and 2018, *Transport* shows the greatest overall increase at 137.1%, with road transport increasing by 143.4%. Emissions increased by 1.7% in 2018, the fifth year out of the last six with increased emissions in *Transport* emissions. *Transport* emissions have decreased by 15.3% below peak levels in 2007 primarily due to the economic downturn, improving vehicle fuel efficiency due to the changes in vehicle registration tax, the increase use in biofuels and significant decreases in fuel tourism in recent years. The increase up to 2007 can be attributed to general economic prosperity, increasing population with a high reliance on private car travel as well as rapidly increasing road freight transport.

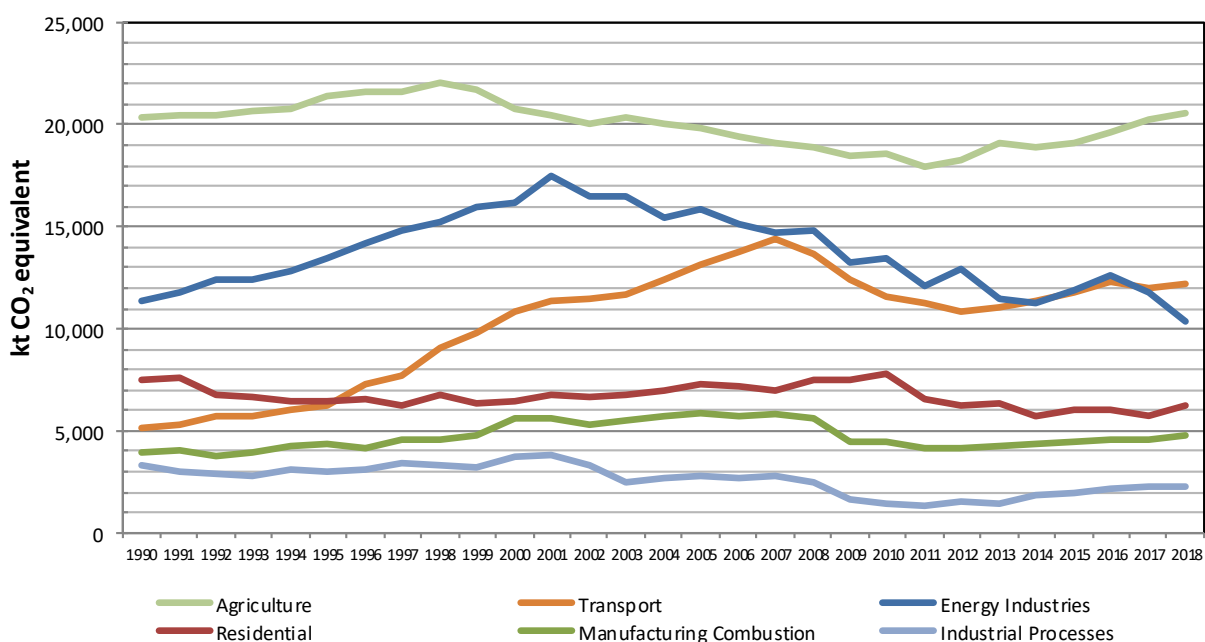
*Energy Industries* shows a decrease in emissions of 8.5% over the period 1990 – 2018. Over the time series, emissions from electricity generation have decreased by 10.3% whereas total electricity consumption has increased by 128.7%. Emissions from electricity generation increased from 1990 to 2001 by 54.2% and have decreased by 41.9% between 2001 and 2018. This decrease reflects the improvement in efficiency of modern gas fired power plants replacing older peat and oil-fired plants and the increased share of renewables, primarily, wind power along with increased interconnectivity. This year was the lowest year in the 29-year time series for coal fired electricity generation, 44% less than in 2017, as Ireland's only coal fired plant was off line from August 2018 to the second half of 2019.

Emissions from *Agriculture* reached a peak in 1998 and have decreased to below their 1990 level since 2002, reflecting long-term decline in livestock populations and in fertiliser use due to the Common Agricultural Policy. Emissions from *Agriculture* in 2018 are now 1.1% above their 1990 levels and have increased for 6 out of the last 7 years. The changes in *Agriculture* emissions are underpinned by higher animal numbers; in the 5-year period 2013-2018, dairy cow numbers have increased by 26.9% with a corresponding milk production by 39.8% and nitrogenous fertiliser use increased by 15.7%. This reflects national plans to expand milk production under Food Wise 2025 and the removal of the milk quota in 2015.

Increased housing stock drove the gradual upward trend in the emissions from the *Residential* sector after 1998 following a sharp reduction in the early 1990s that resulted from fuel switching to reach a peak in 2010. The 2018 emissions in this sector are 7.9% higher than 2017 levels and are 17.6% lower than their 1990 level whereas the housing stock has increased by 77% in the same period. Winter heating demand is the most important variable determining emissions from this sector with 7.6% more degree days in 2018.



**Figure 3. GHG emissions by sector 1990-2018**



**Figure 4. Trend in emissions for largest sectors 1990-2018**



## Compliance with EU and international commitments

The greenhouse gas emission inventory for 2018 is the sixth year that compliance under the European Union's Effort Sharing Decision (Decision 406/2009/EC) will be assessed. This Decision sets 2020 targets for sectors outside of the Emissions Trading Scheme (known as ESD emissions) and annual binding limits for the period 2013-2020. Ireland's target is to reduce ESD emissions by 20% by 2020 compared with 2005 levels.

The final inventory reviews for the years up to 2017 were completed in April 2019, following the submission of official data in March 2019 to the European Commission. Ireland has currently 7.13 Mt CO<sub>2</sub> eq additional annual emission allowances (AEAs) compared with greenhouse gas emissions for the period 2013 to 2017, see Table 2 and Figure 5.

Ireland's annual limit for 2018 is 39.81 Mt CO<sub>2</sub> eq. Ireland's provisional 2018 greenhouse gas ESD emissions are 44.97 Mt CO<sub>2</sub> eq, 5.17 Mt CO<sub>2</sub> eq more than the annual limit for 2018. This value is the national total emissions less emissions covered by the EU's emissions trading scheme for stationary and aviation operators. Agriculture and Transport accounted for 72.9% of total ESD emissions in 2018. This indicates that Ireland will not be in compliance with its 2018 Effort Sharing Decision annual limit, the third year in a row exceeding the assigned allowances.

**Table 2. Compliance with EU ESD Targets 2013-2020**

		2013	2014	2015	2016	2017	2018	2019	2020	
<b>A</b>	Total greenhouse gas emissions without LULUCF <sup>1</sup>	57,903.4	57,626.0	59,878.2	61,545.8	60,743.7	60,506.9	0.0	0.0	kt CO <sub>2</sub> eq
<b>B</b>	NF <sub>3</sub> emissions	0.9	1.0	1.0	1.0	1.3	1.3	0.0	0.0	kt CO <sub>2</sub> eq
<b>C</b>	Total greenhouse gas emissions without LULUCF and without NF <sub>3</sub> emissions	57,902.5	57,625.1	59,877.3	61,544.9	60,742.5	60,505.6	0.0	0.0	kt CO <sub>2</sub> eq
<b>D</b>	Total verified emissions from stationary installations under Directive 2003/87/EC <sup>2</sup>	15,685.7	15,952.7	16,829.7	17,737.0	16,896.4	15,515.0	0.0	0.0	kt CO <sub>2</sub> eq
<b>E</b>	CO <sub>2</sub> emissions from 1.A.3.a. domestic aviation	10.0	9.4	10.4	9.7	17.3	16.6	0.0	0.0	kt CO <sub>2</sub> eq
<b>F</b>	<b>Total ESD emissions (= C-D-E)</b>	42,206.8	41,663.0	43,037.2	43,798.2	43,828.7	44,974.0	0.0	0.0	kt CO <sub>2</sub> eq
<b>G</b>	<b>EU ESD Targets</b>	46,891.9	45,760.9	44,629.9	43,498.9	40,885.1	39,807.1	38,729.2	37,651.3	kt CO <sub>2</sub> eq
	<b>Distance to target (= F-G)</b>	-4,685.1	-4,097.9	-1,592.7	299.3	2,943.7	5,166.8			kt CO <sub>2</sub> eq

Note: Shaded cells show data that has been reviewed, and compliance agreed, by the European Commission under Article 19 of the MMR No. 525/2013

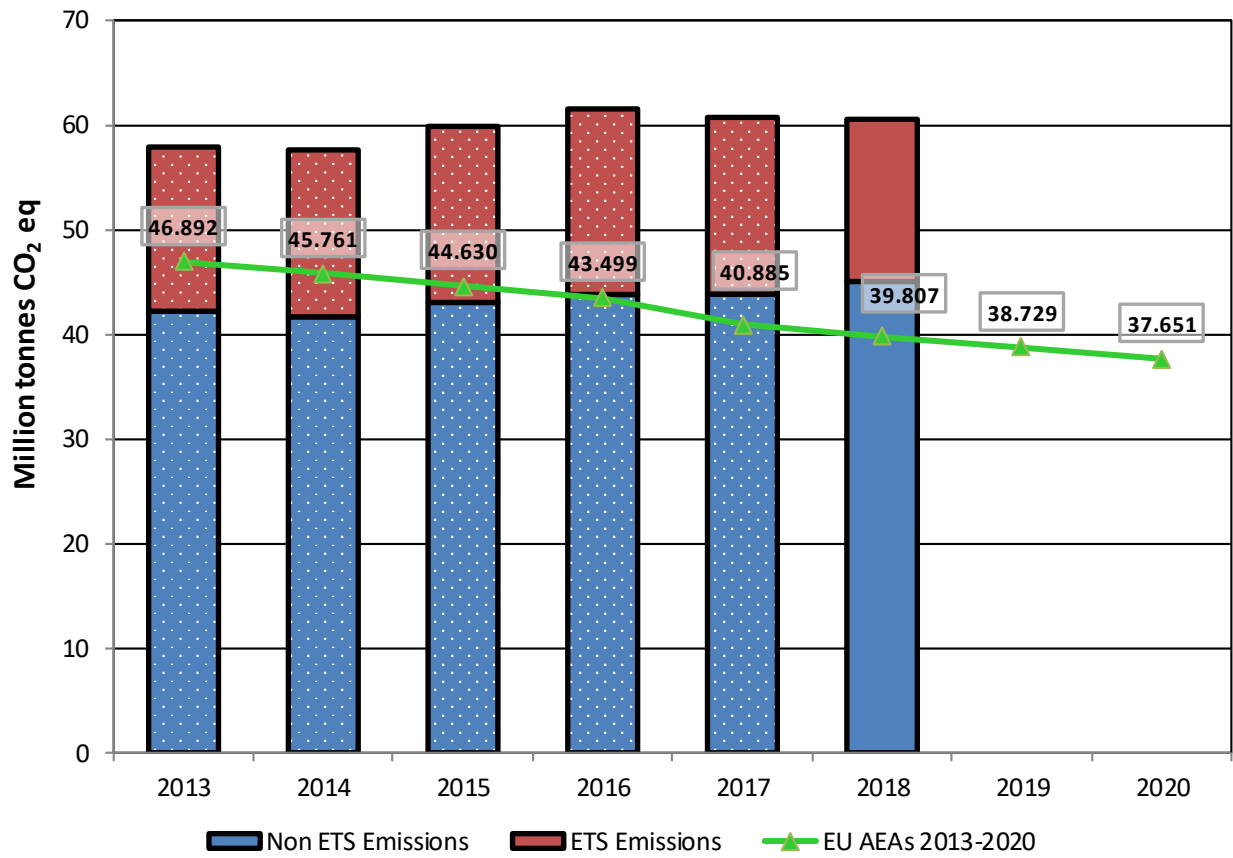


Figure 5. Compliance with ESD Targets 2013-2020

**Table 3. Ireland's provisional GHG Emissions by Sector 1990-2018 (kilotonnes CO<sub>2</sub> equivalent)**

1990-2018 Submission 2020 Provisional	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Annual change	kt CO <sub>2</sub>
<b>Energy Industries</b>	11328.06	13479.88	16204.68	15908.20	14799.78	13202.43	13468.46	12063.08	12903.26	11496.12	11272.05	11891.33	12608.20	11743.87	10364.73	<b>-11.7%</b>	<b>-1379.14</b>
Public electricity and heat production	10953.92	13132.91	15754.35	15244.75	14155.13	12610.63	12895.10	11556.06	12356.28	10952.93	10771.89	11328.27	12076.43	11206.21	9823.18	-12.3%	-1383.03
Petroleum refining	168.67	181.27	274.80	411.87	367.48	315.39	310.47	285.42	313.55	294.55	279.50	358.72	313.59	311.19	322.18	3.5%	11.00
Solid fuels and other energy industries	100.54	69.44	87.15	171.89	187.87	193.09	174.66	137.46	146.29	162.01	134.84	115.75	126.26	129.41	119.33	-7.8%	-10.08
Fugitive emissions	104.94	96.26	88.38	79.69	89.30	83.32	88.23	84.14	87.15	86.64	85.82	88.58	91.91	97.06	100.03	3.1%	2.97
<b>Residential</b>	7523.66	6452.05	6462.60	7271.61	7521.49	7466.98	7800.88	6609.71	6232.29	6395.38	5745.58	6041.31	6046.48	5740.91	6197.18	<b>7.9%</b>	<b>456.27</b>
Manufacturing Combustion	3961.75	4347.62	5642.37	5870.42	5629.34	4486.92	4476.47	4142.36	4176.51	4239.35	4322.99	4469.57	4526.18	4564.73	4741.39	<b>3.9%</b>	<b>176.66</b>
Commercial Services	1083.49	1165.57	1374.71	1475.61	1547.87	1294.91	1293.65	1192.01	1181.74	1063.37	954.05	967.37	1004.67	1072.11	1128.52	<b>5.3%</b>	<b>56.41</b>
Public Services	1160.65	936.34	989.43	952.44	1053.01	995.63	1014.35	902.82	916.65	855.63	798.15	832.15	849.35	905.78	979.84	<b>8.2%</b>	<b>74.06</b>
Transport	5146.53	6280.18	10796.67	13143.43	13673.98	12451.44	11534.98	11222.73	10836.23	11067.61	11348.68	11814.05	12295.59	12004.98	12203.10	<b>1.7%</b>	<b>198.12</b>
Domestic aviation	48.40	45.73	69.64	80.21	80.53	65.62	49.51	24.65	14.99	15.37	14.69	15.55	16.78	17.45	16.78	-3.9%	-0.68
Road transportation	4789.38	5892.03	10374.07	12561.86	13086.62	11898.57	10985.64	10735.95	10366.20	10595.66	10842.85	11316.81	11752.12	11496.34	11655.86	1.4%	159.52
Railways	148.87	124.51	137.65	136.58	156.54	137.36	136.31	136.52	131.93	131.38	120.53	122.83	125.10	129.14	130.49	1.0%	1.35
Domestic navigation	85.77	92.10	152.65	211.19	204.73	199.52	200.12	173.73	183.60	179.59	224.81	221.73	266.46	235.28	260.23	10.6%	24.95
Other transportation	74.12	125.80	62.65	153.60	145.56	150.36	163.40	151.88	139.52	145.61	145.79	137.13	135.13	126.77	139.74	10.2%	12.97
<b>Industrial Processes</b>	3274.57	2990.95	3789.50	2764.69	2472.24	1658.26	1464.85	1335.28	1561.71	1477.73	1820.15	2007.32	2149.62	2269.66	2315.93	<b>2.0%</b>	<b>46.27</b>
Mineral industry	1116.73	1084.18	1908.78	2552.80	2301.58	1486.14	1300.01	1168.75	1393.44	1301.70	1650.45	1830.36	1968.40	2039.86	2094.55	2.7%	54.69
Chemical industry	1985.55	1754.44	1663.30	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
Metal industry	26.08	24.80	28.80	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
Non-energy products from fuels and solvent use	114.87	95.33	154.74	174.94	130.56	131.59	124.12	125.63	127.28	134.98	128.48	135.52	138.65	187.03	178.41	-4.6%	-8.63
Other product manufacture and use	31.34	32.20	33.88	36.96	40.10	40.53	40.72	40.90	40.99	41.06	41.21	41.44	42.57	42.77	42.98	0.5%	0.20
<b>F-Gases</b>	34.59	298.12	968.40	1021.45	1036.05	1028.41	996.08	1007.45	986.12	1017.57	1073.26	1087.27	1174.20	1212.14	1088.07	<b>-10.2%</b>	<b>-124.08</b>
<b>Agriculture</b>	20363.73	21430.94	20767.92	19813.67	18895.52	18479.52	18558.88	17940.23	18317.68	19142.90	18914.31	19141.83	19658.51	20220.79	20597.33	<b>1.9%</b>	<b>376.54</b>
Enteric fermentation	11356.97	11480.10	11260.82	10843.14	10539.09	10376.70	10155.39	10045.18	10379.27	10532.74	10655.91	10880.29	11212.11	11537.81	11543.21	0.0%	5.39
Manure management	1904.53	1937.12	1916.22	1881.76	1797.39	1775.21	1739.54	1736.19	1812.79	1832.21	1840.20	1872.41	1936.82	1972.42	1970.84	-0.1%	-1.59
Agricultural soils	5884.26	6312.77	6159.24	5695.56	5223.23	5085.81	5361.17	4980.84	5117.13	5566.32	5393.46	5379.63	5439.69	5711.62	5907.36	3.4%	195.74
Liming	355.04	494.60	366.38	266.73	262.21	307.32	427.93	360.68	229.40	515.69	391.07	401.15	433.60	332.75	457.45	37.5%	124.70
Urea application	44.47	39.68	42.25	27.90	30.76	40.93	45.16	32.32	21.32	21.66	25.09	28.31	35.80	35.04	38.13	8.8%	3.08
Agriculture/Forestry fuel combustion	730.62	1008.11	909.76	953.63	939.19	796.63	753.49	721.93	687.92	596.55	534.52	514.94	540.70	560.34	595.84	6.3%	35.50
Fishing	87.85	158.55	113.24	144.94	103.65	96.92	76.18	63.10	69.85	77.73	74.06	65.11	59.79	70.80	84.51	19.4%	13.71
<b>Waste</b>	1546.80	1823.02	1489.09	1290.68	687.39	515.21	499.72	590.77	515.09	671.03	852.47	933.52	938.96	916.31	890.83	<b>-2.8%</b>	<b>-25.48</b>
Landfills	1318.08	1592.76	1268.16	1007.00	463.84	284.80	278.65	381.56	302.79	460.97	648.10	726.93	749.56	717.91	692.71	-3.5%	-25.20
Biological treatment of solid waste	0.00	0.00	0.00	13.77	16.44	21.07	20.99	22.91	22.41	22.73	19.30	20.66	19.89	25.64	25.64	0.0%	0.00
Incineration and open burning of waste	92.48	94.43	75.83	131.19	62.64	64.11	55.63	43.34	46.11	43.57	39.14	39.65	22.39	24.62	24.62	0.0%	0.00
Wastewater treatment and discharge	136.24	135.83	145.10	138.72	144.46	145.22	144.46	142.96	143.77	143.76	145.93	146.29	147.12	148.15	147.87	-0.2%	-0.29
<b>National Total</b>	<b>55423.85</b>	<b>59204.67</b>	<b>68485.37</b>	<b>69512.20</b>	<b>67316.68</b>	<b>61579.71</b>	<b>61108.31</b>	<b>57006.44</b>	<b>57627.29</b>	<b>57426.70</b>	<b>57101.69</b>	<b>59185.72</b>	<b>61251.75</b>	<b>60651.28</b>	<b>60506.90</b>	<b>-0.2%</b>	<b>-144.38</b>

## Notes

**Units:** 1 Mt = 1,000 kilotonnes

**CO<sub>2</sub> Equivalent:** greenhouse gases other than CO<sub>2</sub> (i.e. methane, nitrous oxide and F-gases) may be converted to CO<sub>2</sub> equivalent using their global warming potentials (GWPs).

**F-gases:** These gases comprise HFCs (Hydrofluorocarbons), PFCs (Perfluorocarbons), SF<sub>6</sub> (Sulphur Hexafluoride) and NF<sub>3</sub> (Nitrogen Trifluoride). They are much more potent than the naturally occurring greenhouse gas emissions (carbon dioxide, methane and nitrous oxide).

### GWPs:

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon
		IPCC 4 <sup>th</sup> assessment report (AR4)
Carbon dioxide	CO <sub>2</sub>	1
Methane	CH <sub>4</sub>	25
Nitrous oxide	N <sub>2</sub> O	298
Hydrofluorocarbons	HFCs	12 to 14,800
Perfluorinated compounds	PFCs	7,390 to >17,340
Sulphur hexafluoride	SF <sub>6</sub>	22,800
Nitrogen trifluoride	NF <sub>3</sub>	17,200

**Ireland's GHG Sectors:** include the following ten sectors for analysis;

1. Energy Industries (electricity generation, waste to energy incineration, oil refining, briquetting manufacture and fugitive emissions)
2. Residential (combustion for domestic space and hot water heating)
3. Manufacturing Combustion (combustion for Manufacturing industries in ETS and non-ETS)
4. Commercial Services (combustion for Commercial Services space and hot water heating)
5. Public Services (combustion for Public services space and hot water heating)
6. Transport (combustion of fuel used in road, rail, navigation, domestic aviation and pipeline gas transport)
7. Industrial Processes (process emissions from mineral, chemical, metal industries, non-energy products and solvents)
8. F-Gases (gases used in refrigeration, air conditioning and semiconductor manufacture)
9. Agriculture (emissions from fertiliser application, ruminant digestion, manure management, agricultural soils and fuel used in agriculture/forestry/fishing)
10. Waste (emissions from solid waste disposal on land, solid waste treatment (composting), wastewater treatment, waste incineration and open burning of waste).