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**IRELAND'S PROVISIONAL GREENHOUSE GAS EMISSIONS IN 2013**

**KEY HIGHLIGHTS**

- The EPA has produced initial estimates of greenhouse gas emissions for the time period 1990 - 2013.
- For 2013, total national greenhouse gas emissions are estimated to be 57.81 million tonnes carbon dioxide equivalent (Mt CO<sub>2</sub>eq). This is 0.7% lower (0.41 Mt CO<sub>2</sub>eq) than emissions in 2012.
- In 2013, emissions in the ETS sector decreased by 7.2% or 1.21 Mt CO<sub>2</sub>eq whereas non-ETS emissions increased by 1.9% or 0.80 Mt CO<sub>2</sub>eq.
- Emissions from *Energy* (principally electricity generation) decreased by 11.1% (1.42 Mt CO<sub>2</sub> eq) in 2013. This reflects decreases in coal and peat used in conventional fossil fuel fired power stations for electricity generation, by 16.4% and 9.5% respectively, and also a decrease in natural gas use of 8.3% in 2013. Electricity generated from renewables increased by 6.6% between 2012 and 2013.
- *Industry and Commercial* emissions decreased by 0.7% (0.06 Mt CO<sub>2</sub>eq) in 2013. Total combustion emissions within the industrial sector grew by 1.3% in 2013. However, combustion emissions within the commercial services sector declined by 8.0% mainly due to a 14.7% reduction in oil use and a 28.1% increase in biomass use.
- *Agriculture* emissions are 2.6% higher (0.48 Mt CO<sub>2</sub>eq) in 2013 compared with 2012 levels. The most significant driver for the increase in emissions in 2013 is increased use of synthetic fertiliser by 19.1%. Also, increases in emissions are due to a 2.2% increase in cattle numbers, a 1.5% increase in sheep numbers.
- Greenhouse gas emissions from the *Transport* sector are 2.1% higher (0.23 Mt CO<sub>2</sub>eq) in 2013 compared with 2012 levels. This is the first increase in *Transport* emissions since 2007. In 2013, gasoline use continued to decrease by 5.8% while diesel use increased by 6.4% and biofuels use increased by 20.5%.
- Greenhouse gas emissions from the *Residential* sector are 2.6% higher (0.16 Mt CO<sub>2</sub>eq) in 2013 compared with 2012 levels mainly from increased solid fuel consumption, coal (+4.9%), smokeless coal (+26.9%). There was also marginal increase use of oil (+0.8%) and natural gas (+1.0%) for space and hot water heating in homes in 2013

- Emissions from *Waste* sector increased by 15.2% (0.19 Mt CO<sub>2</sub>eq) in 2013 compared with 2012 levels. This is due to a reduction of 15.0% in landfill gas utilised or flared. Emissions from incineration also increased by 0.07 Mt CO<sub>2</sub> eq in 2013 which reflects the increase in municipal solid waste (MSW) incinerated at Indaver Ireland's Carranstown, Co. Meath site.
- *Transport* and *Agriculture* account for 51.4% of total emissions in 2013 and 70.5% of non EU ETS emissions. Emissions from both of these sectors increased in 2013.
- These figures indicate that Ireland will be in compliance with its 2013 annual limit set under the EU's Effort Sharing Decision (Decision 406/2009/EC).

## 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 1990-2013 in January, March and April 2015 to the European Commission and the UN. These estimates are, at this stage, provisional estimates of Ireland's greenhouse gas figures for the years 1990-2013 which will be further refined as methods and activity are updated during the QC checking before official submission to the European Commission on January 15<sup>th</sup> 2015.

These provisional estimates are calculated using **new** methodologies employed in the inventory for the first time in accordance with **new** UNFCCC reporting guidelines and using latest available input data. Additional information on the new methodologies and guidelines is attached in Appendix I.

The 2013 estimates are given below, followed by an account of how these differ from the 2012 estimates. The longer-term trends in greenhouse gas emissions and their significance in relation to Ireland's target under the European Union's Decision 406/2009/EC<sup>1</sup> (ESD) 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 Greenhouse Gas Emissions in 2013

For 2013, total national greenhouse gas emissions are estimated to be 57.81 million tonnes carbon dioxide equivalent (Mt CO<sub>2</sub> eq) which is 0.7 % lower (or 0.41 Mt CO<sub>2</sub> eq) than emissions in 2012 (58.22 Mt CO<sub>2</sub> eq). This reverses the 1.0% increase in emissions reported for 2012. The inter annual change in total greenhouse gas emissions is presented in Figure 1. Detailed sectoral data are shown in Table 1.

*Agriculture* remains the single largest contributor to the overall emissions at 32.3% of the total. *Energy* and *Transport* are the second and third largest contributors at 19.6% and 19.1% respectively. The remainder is made up by the *Industry and Commercial* at 15.4%, *Residential* sector at 11.1% and *Waste* at 2.5%. Figure 2 shows the contributions from each of the sectors in 1990 and 2013.

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

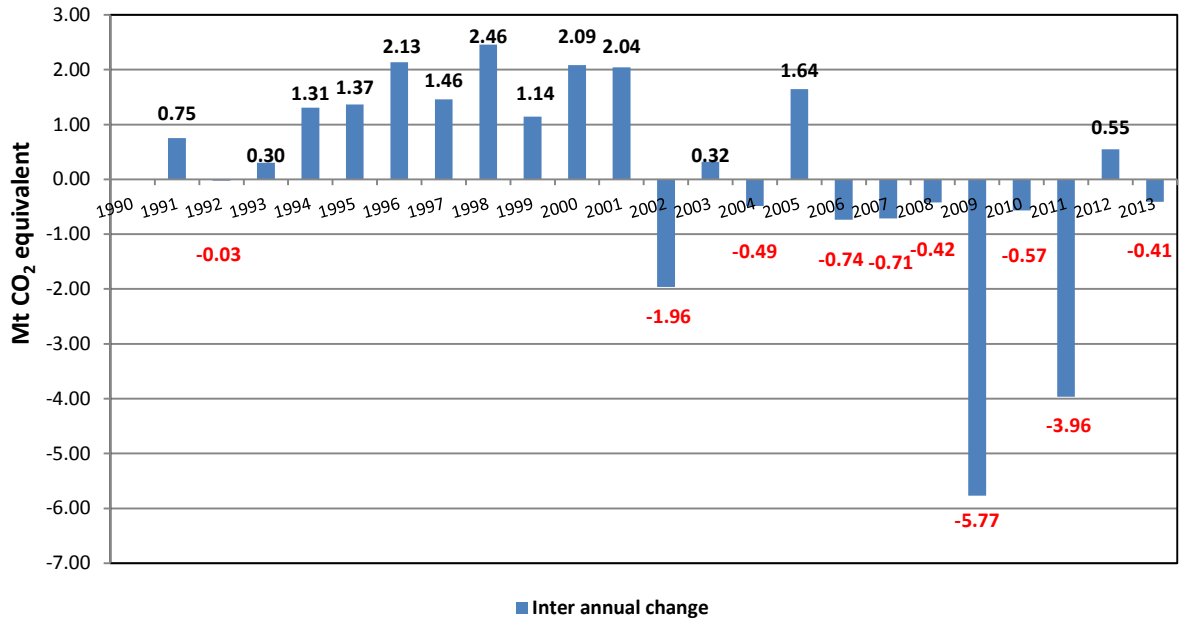


Figure 1 Inter annual changes in GHG emissions 1990-2013

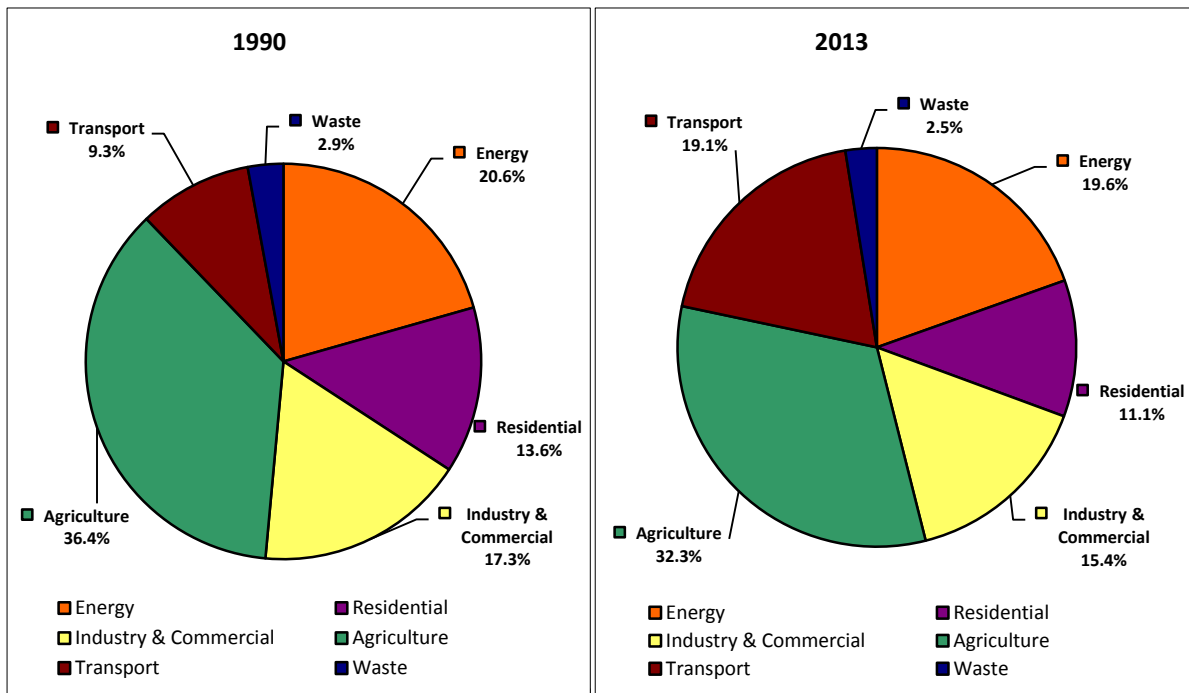


Figure 2 Greenhouse Gas Emissions in 1990 and 2013 by Sector

## Changes in Emissions from Sectors between 2012 and 2013

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

**Table 1. Draft greenhouse gas emissions for 2012 and 2013 for Ireland**

<i>Mt CO<sub>2</sub> equivalent</i>	<b>2012</b>	<b>2013</b>	<b>% Change</b>
Energy	12.722	11.306	-11.1%
Industry and Commercial	8.987	8.929	-0.7%
Agriculture	18.169	18.647	2.6%
Transport	10.837	11.068	2.1%
Residential	6.233	6.396	2.6%
Waste	1.272	1.466	15.2%
<b>Total</b>	<b>58.221</b>	<b>57.813</b>	<b>-0.7%</b>

The most significant change in sectoral emissions is in the *Energy* sector (i.e power generation) which shows a decrease of 11.1%. This is despite electricity consumption increasing by 0.2% in 2013. The decrease in emissions is attributable to a reduction in electricity generation from coal (-16.4%), peat (-9.5%) and natural gas (-8.3%). There was a significant increase (+6.6%) in electricity generated from renewables with wind increasing by 13.2%, biomass by 20.8% and a 27.9% decrease in hydro. The changes in renewables are a result of additional installed wind capacity, higher co-firing of biomass at peat power plant and CHP plants and low rainfall in 2013. There was also a significant increase (+220%) in electricity imported through the interconnectors which represents 8.7% of total final consumption of electricity. The associated emissions are not included in Ireland's greenhouse gas inventory estimates. The high voltage interconnector with the UK began commercial operation in December 2012. There was an 11.2% decrease in the CO<sub>2</sub>/kWh generated in 2013 (0.47 kg CO<sub>2</sub>/kWh) compared with 2012 (0.53 kg CO<sub>2</sub>/kWh).

*Industry and Commercial* services emissions show a decrease of 0.7% in 2013. Total combustion emissions within the industrial sector grew by 1.3% in 2013. However, combustion emissions within the commercial services sector declined by 8.0% mainly due to a 14.7% reduction in oil use and a 28.1% increase in biomass use. Total emissions from the cement sector (process and combustion) declined by 2.2% in 2013 whereas emissions from industrial gases (F-gases) increased by 12.4% mainly due to increased uses of HFCs in refrigeration and air conditioning systems.

*Agriculture* emissions increased by 2.6% in 2013 (0.48 Mtonnes of CO<sub>2</sub>eq). While *Agriculture* emissions have been on a downward trend since 1999, emissions increased in both 2012 and 2013. The most significant driver for higher emissions in 2013 is an increase in the use of synthetic fertiliser by 19.1%. This increase is underpinned by higher animal numbers, with dairy cows 2.0% higher in 2013 compared with 2012. This reflects national plans to expand milk production under Food Harvest 2020 and following removal of milk quota in 2015. 'Other cattle' livestock, which includes beef cattle, have increased by 2.2% in 2013. In addition, sheep numbers have increased by 1.5% which is the third year that this animal category has shown an increase and is consistent with favourable sheep market conditions in recent years. In contrast, pig numbers decreased by 1.4%.

*Transport* emissions increased by 2.1% in 2013 (0.23 Mtonnes of CO<sub>2</sub>eq). This is the first increase in *Transport* emissions since 2007. In 2013, gasoline use continued to decrease by 5.8% while diesel use increased by 6.4% and biofuels use increased by 20.5%. The biofuel obligation scheme increased the percentage of biofuel by volume from 4.0% to 6.3% in 2013. Looking at the underlying drivers, the number of passenger diesel cars increased by 11.4% in 2013 while the number of passenger petrol cars decreased by 3.6% and commercial vehicle numbers increased by 2.8% in 2013.

There is a 2.6% increase in emissions from the *Residential* sector mainly from increased solid fuel consumption - coal and smokeless coal increased by 4.9% and 26.9% respectively and by 12.8% overall. There has been a move to solid fuel stove use due to higher oil and natural gas prices and the preference for buying fuel on a week-to-week basis. There was also a marginal increase in the use of

oil (+0.8%) and natural gas (+1.0%) for space and hot water heating in homes in 2013. The weather in 2013 was slightly milder overall than in 2012, however, there was a long cold spell from January to May.

Emissions from the *Waste* sector account for 2.5% of total national emissions with a 15.2% increase in emissions in 2013. Methane generated at landfill sites decreased by 3.9% in 2013, however, overall methane emissions increased substantially by 19.7% due to a reduction of 15.0% in landfill gas utilised or flared. Emissions from incineration also increased by 0.07 Mtonnes of CO<sub>2</sub>eq in 2013 which reflects the increase in municipal solid waste incinerated at Indaver Ireland's Carranstown, Co. Meath site in 2013.

### **Long-term Changes in Sectoral Emissions 1990 – 2013**

The trend in emissions from 1990 to 2013 is shown in Figure 3 and Figure 4. The share of CO<sub>2</sub> in total greenhouse gas emissions has increased to 63.8% of total greenhouse gas emissions in 2013 compared to 59.4% in 1990. In contrast, CH<sub>4</sub> and N<sub>2</sub>O emissions, primarily from the agriculture sector, have fallen from 40.5% of total greenhouse gas emissions in 1990 to 33.9% in 2013. Emissions from F-gases account for 2.3% of the total in 2013.

Between 1990 and 2013, *Transport* shows the greatest overall increase at 115.5%. Emissions increased by 2.1% in 2013, the first increase in *Transport* emissions since 2007. However, *Transport* emissions have decreased by 23.1% below peak levels in 2007 primarily due to the economic downturn, improving vehicle standards due to the changes in vehicle registration tax and the increase use in biofuels. 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* (mainly electricity generation) shows a small decrease in emissions over the period 1990 – 2013. Over the time series, CO<sub>2</sub> emissions from electricity generation have decreased by 0.8% whereas electricity consumption has increased by 104%. Emissions from electricity generation increased from 1990 to 2001 by 54.5% and have decreased by 36.1% between 2001 and 2013. 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.

Emissions from *Agriculture* reached a peak in 1998 and have decreased to below their 1990 level since 2004, reflecting long-term decline in livestock populations and in fertiliser use due to the Common Agricultural Policy. Emissions from *Agriculture* in 2013 are now 7.2% below their 1990 levels but have increased for the last 2 years. The increase in *Agriculture* emissions is underpinned by increasing animal numbers with dairy cows 2.0% higher in 2013 compared with 2012. This reflects national plans to expand milk production under Food Harvest 2020 following removal of milk quota in 2015. 'Other cattle' numbers, which include beef cattle, have increased by 2.2% in 2013. This year also sees a significant increase of 19.1% in fertiliser use. In addition, sheep numbers have increased by 1.5% which is the third year that this animal category has shown an increase and is consistent with favourable sheep market conditions in recent years.

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 and stabilisation that resulted from fuel switching. The 2013 emissions in this sector show 2.6% increase on 2012 levels and are 15.0% lower than their 1990 level. Winter heating demand is the most important variable determining emissions from this sector.

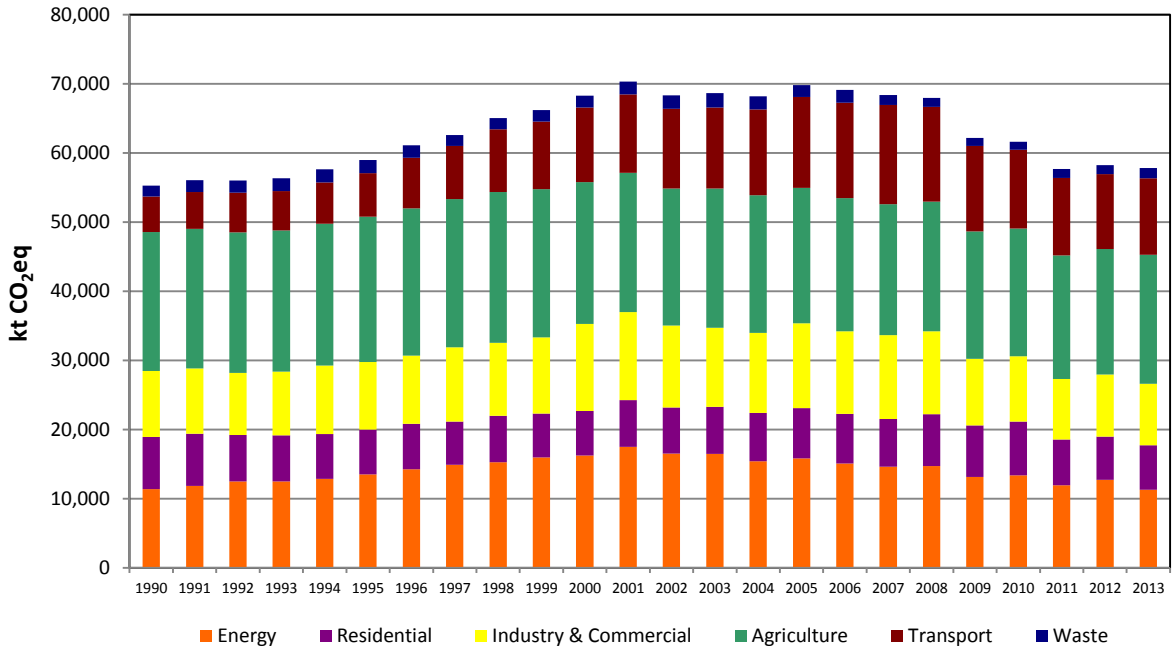


Figure 3 NCCS GHG emissions 1990-2013

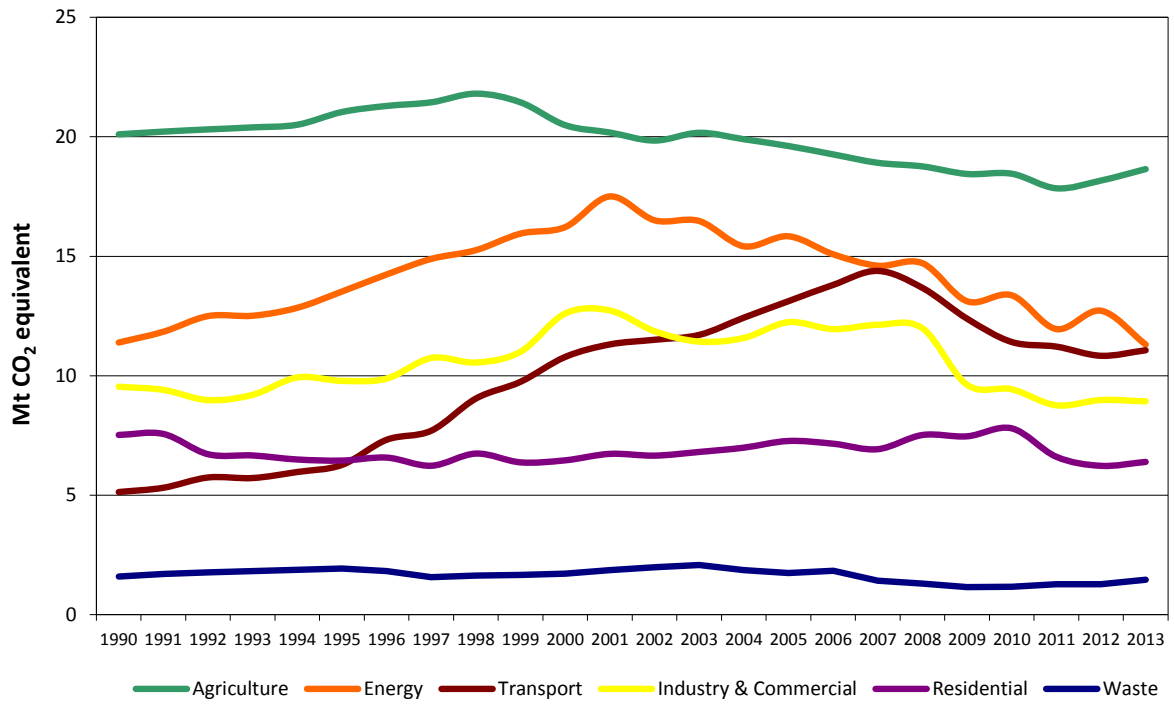


Figure 4 Trends in Greenhouse Gas Emissions 1990-2013

## Compliance with EU and international commitments

The greenhouse gas emission inventory for 2013 is the first year that compliance under the European Union's Effort Sharing Decision (Decision 406/2009/EC<sup>2</sup>) will be assessed. This Decision sets 2020 targets for sectors outside of the Emissions Trading Scheme (known as non-ETS sector emissions) and annual binding limits for the period 2013-2020. Ireland's target is to reduce non-ETS emissions by 20% by 2020 compared with 2005 levels.

Ireland's provisional 2013 greenhouse gas emissions for non-ETS sectors are 42.122 Mt CO<sub>2</sub> eq. 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 70.5% of total non-ETS emissions in 2013 and both showed an increase in emissions in 2013.

Ireland's annual target for 2013 is 46.892 Mt CO<sub>2</sub> eq which is 4.770 Mt CO<sub>2</sub> eq higher than the 2013 initial estimates. See Figure 5 for detail. This indicates that Ireland will be in compliance with its 2013 Effort Sharing annual limit. Final compliance for 2013 will be determined following submission of official data in January 2015 and review of this data by the European Commission. The compliance transactions will subsequently be carried out on the Registry in late 2015.

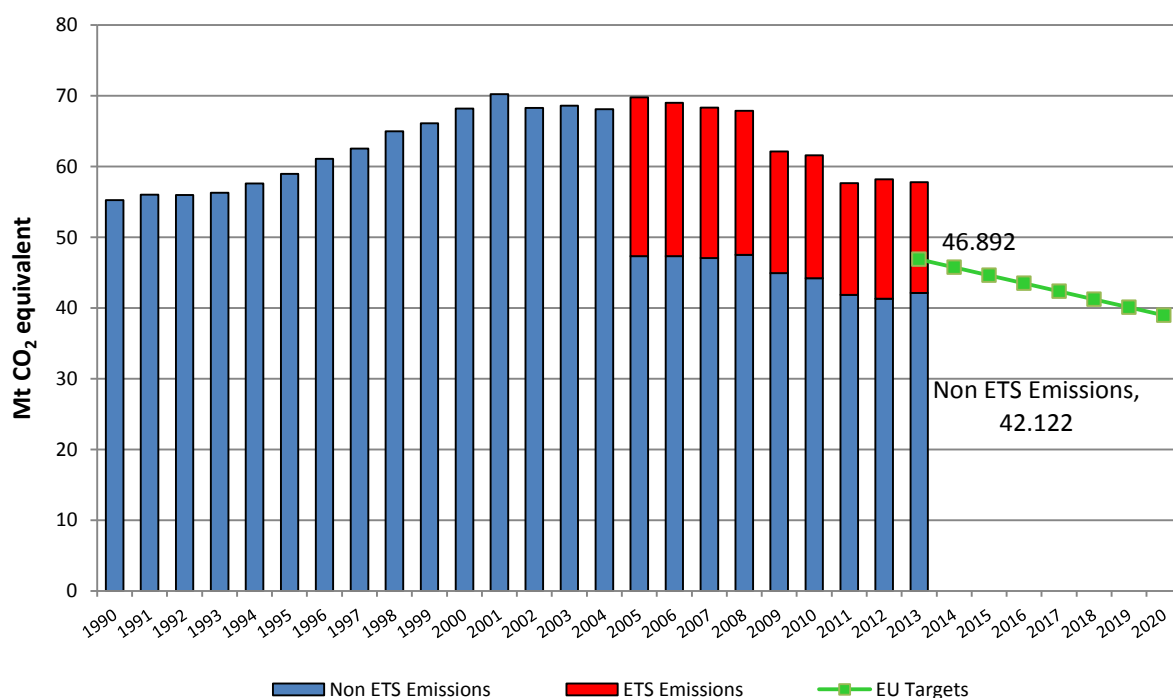


Figure 5 ESD Targets 2013-2020

In relation to international commitments, 2013 is also the first year of the second commitment period (CP2) under the UNFCCC Kyoto Protocol, the Doha Amendment<sup>3</sup>, which will be ratified by the EU and its Member States before April 2015. The EU and its Member States along with Iceland have decided to jointly fulfil its commitments (QELRC) under the Doha Amendment as allowed by Article 4 of the Kyoto Protocol. Ireland's compliance with the Doha Amendment will be assessed at the end of the commitment period based on the GHG inventory submission in 2022 for 1990-2020 data.

<sup>2</sup> [EU Effort Sharing Decision 406/2009/EC](#)

<sup>3</sup> [KP Doha Amendment](#)

**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 so-called F-gases) may be converted to CO<sub>2</sub> equivalent using their global warming potentials.

**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).

**National Climate Change Strategy Sectors:** The Government Strategy to combat Climate Change uses the following six sectors for analysis:

1. Energy (electricity generation, oil refining, briquetting manufacture)
2. Residential (combustion for domestic heating)
3. Industry and Commercial (combustion emissions from industrial and commercial activities, industrial process emissions, fluorinated gas emissions, solvent emissions),
4. Agriculture (ruminant digestion, agricultural soils, manure management, gasoil used on farms)
5. Transport (road, rail, navigation, domestic aviation, pipeline gas transport)
6. Waste (solid waste disposal on land, solid waste treatment (composting), wastewater treatment, waste incineration & open burning at landfills)



**Table 2. Emissions by National Climate Change Strategy Sectors (kt CO<sub>2</sub> eq)**

	Energy (A)	Residential (B)	Industry & Commercial (C)	Agriculture (D)	Transport (E)	Waste (F)	Total (A-F)	Carbon Sinks		
								Article 3.3 (ARD)	Article 3.4 (FM)	
1990	11,391.03	7,523.67	9,541.58	20,102.37	5,135.32	1,605.14	<b>55,299.11</b>			
1991	11,842.39	7,565.94	9,409.68	20,216.05	5,314.43	1,702.72	<b>56,051.21</b>			
1992	12,497.78	6,717.81	8,982.22	20,308.19	5,744.39	1,774.03	<b>56,024.41</b>			
1993	12,511.93	6,667.04	9,204.40	20,392.97	5,721.35	1,830.48	<b>56,328.18</b>			
1994	12,844.54	6,496.58	9,930.96	20,503.67	5,974.71	1,884.65	<b>57,635.10</b>			
1995	13,524.44	6,452.05	9,781.41	21,035.91	6,271.48	1,932.74	<b>58,998.03</b>			
1996	14,239.14	6,576.67	9,877.25	21,290.00	7,321.95	1,826.35	<b>61,131.36</b>			
1997	14,890.95	6,235.93	10,741.69	21,442.96	7,702.10	1,572.41	<b>62,586.04</b>			
1998	15,255.35	6,744.75	10,549.98	21,804.50	9,048.42	1,642.57	<b>65,045.57</b>			
1999	15,948.71	6,377.88	11,002.15	21,440.95	9,748.95	1,671.40	<b>66,190.04</b>			
2000	16,221.49	6,462.60	12,606.48	20,486.48	10,788.67	1,714.15	<b>68,279.88</b>			
2001	17,503.26	6,732.30	12,738.16	20,178.47	11,311.73	1,864.23	<b>70,328.15</b>			
2002	16,506.12	6,658.64	11,865.17	19,842.03	11,506.64	1,982.03	<b>68,360.63</b>			
2003	16,475.17	6,812.59	11,431.87	20,166.58	11,710.03	2,087.34	<b>68,683.57</b>			
2004	15,417.42	6,992.51	11,582.82	19,897.90	12,430.49	1,874.05	<b>68,195.18</b>			
2005	15,837.51	7,271.95	12,243.54	19,613.12	13,121.54	1,751.58	<b>69,839.24</b>			
2006	15,083.54	7,157.48	11,952.05	19,262.70	13,801.79	1,846.08	<b>69,103.64</b>			
2007	14,604.91	6,928.50	12,133.19	18,910.93	14,388.62	1,425.71	<b>68,391.85</b>			
2008	14,710.95	7,521.57	11,989.67	18,760.99	13,678.97	1,306.69	<b>67,968.84</b>	-2,311.59		Kyoto Protocol Commitment Period 1 (CP1)
2009	13,116.62	7,466.99	9,622.03	18,443.16	12,388.96	1,163.05	<b>62,200.82</b>	-2,733.26		
2010	13,367.27	7,800.92	9,433.34	18,454.11	11,413.33	1,164.93	<b>61,633.90</b>	-3,101.00		
2011	11,954.07	6,609.84	8,765.01	17,844.55	11,220.41	1,277.73	<b>57,671.60</b>	-3,121.29		
2012	12,722.07	6,232.77	8,987.46	18,169.29	10,836.76	1,272.48	<b>58,220.83</b>	-3,207.19		
2013	11,306.02	6,396.43	8,928.89	18,647.11	11,067.68	1,466.48	<b>57,812.59</b>	-3,479.07	-410.26	Kyoto Protocol CP2 and EU ESD
2014										
2015										
2016										
2017										
2018										
2019										
2020										

Article 3.3 activities include emissions/removals from; Afforestation, Reforestation and Deforestation (ARD).

Article 3.4 mandatory activities include emissions/removals from; Forest Management (FM).

The FM value reported here will be subject to net-net accounting using an agreed Forest Management Reference Level (FMRL) and a technical correction in accordance with Decision 2/CMP.7 at the end of the 2<sup>nd</sup> Commitment Period in 2022. The likely result of net-net accounting and technical correction is that the FM accounted value at the end of CP2 would be a marginal emission or removal.

## Appendix I – New methodologies and UNFCCC reporting guidelines

New UNFCCC reporting guidelines<sup>4</sup>, for compilation of annual inventories for Parties included in Annex I to the United Nations Framework Convention on Climate Change, were adopted by the Conference of Parties (COP) (Decision 24/CP.19) in Warsaw in November 2013. These new reporting guidelines are used for the first time for reporting greenhouse gas inventories for the period 1990-2013 to the European Commission on 15<sup>th</sup> January 2015 and to the UN in April 2015. The new reporting guidelines make mandatory the use of the methodologies provided in the IPCC 2006 Guidelines<sup>5</sup> and in the Annexes - new Common Reporting Format (CRF) (Annex II), new greenhouse gases and new global warming potentials (GWPs) (Annex III). The new and additional greenhouse gases and the revised GWPs are presented in Table 1.

**Table 1. New Greenhouse Gases and GWPs**

Chemical	Chemical Formula	GWP for 100-year time horizon	
		Second assessment report (SAR)	4th assessment report (AR4)
Carbon Dioxide	CO <sub>2</sub>	1	1
Methane	CH <sub>4</sub>	21	25
Nitrous Oxide	N <sub>2</sub> O	310	298
<b>HFCs</b>			
HFC-23	CHF <sub>3</sub>	11,700	14,800
HFC-32	CH <sub>2</sub> F <sub>2</sub>	650	675
HFC-41	CH <sub>3</sub> F	150	92
HFC-43-10mee	C <sub>5</sub> H <sub>2</sub> F <sub>10</sub>	1,300	1,640
HFC-125	C <sub>2</sub> H <sub>2</sub> F <sub>5</sub>	2,800	3,500
HFC-134	C <sub>2</sub> H <sub>2</sub> F <sub>4</sub>	1,000	1,100
HFC-134a	CH <sub>2</sub> FCF <sub>3</sub>	1,300	1,430
HFC-143	C <sub>2</sub> H <sub>3</sub> F <sub>3</sub>	300	353
HFC-143a	C <sub>2</sub> H <sub>3</sub> F <sub>3</sub>	3,800	4,470
HFC-152	CH <sub>2</sub> FCH <sub>2</sub> F		53
HFC-152a	C <sub>2</sub> H <sub>4</sub> F <sub>2</sub>	140	124
HFC-161	CH <sub>3</sub> CH <sub>2</sub> F		12
HFC-227ea	C <sub>3</sub> HF <sub>7</sub>	2,900	3,220
HFC-236cb	CH <sub>2</sub> FCF <sub>2</sub> CF <sub>3</sub>		1,340
HFC-236ea	CHF <sub>2</sub> CHFCF <sub>3</sub>		1,370
HFC-236fa	C <sub>3</sub> H <sub>2</sub> F <sub>6</sub>	6,300	9,810
HFC-245ca	C <sub>3</sub> H <sub>3</sub> F <sub>5</sub>	560	693
HFC-245fa	CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>		1,030
HFC-365mfc	CF <sub>3</sub> CH <sub>2</sub> CF <sub>2</sub> CH <sub>3</sub>		794
<b>PFCs</b>			
Perfluoromethane-PFC-14	CF <sub>4</sub>	6,500	7,390
Perfluoroethane-PFC-116	C <sub>2</sub> F <sub>6</sub>	9,200	12,200
Perfluoropropane-PFC-218	C <sub>3</sub> F <sub>8</sub>	7,000	8,830
Perfluorobutane-PFC-3-1-10	C <sub>4</sub> F <sub>10</sub>	7,000	8,860
Perfluorocyclobutane-PFC-318	c-C <sub>4</sub> F <sub>8</sub>	8,700	10,300
Perfluoropentane-PFC-4-1-12	C <sub>5</sub> F <sub>12</sub>	7,500	9,160
Perfluorohexane-PFC-5-1-14	C <sub>6</sub> F <sub>14</sub>	7,400	9,300
Perfluorodecalin-PFC-9-1-18	C <sub>10</sub> F <sub>18</sub>		7,500
Perfluorocyclopropane	c-C <sub>3</sub> F <sub>6</sub>		17,340
Sulphur hexafluoride	SF <sub>6</sub>	23,900	22,800
Nitrogen trifluoride	NF <sub>3</sub>		17,200

New GHGs are highlighted. The new GWPs are taken from table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon.

<sup>4</sup> [Decision 24/CP.19, COP 19 Warsaw](#)

<sup>5</sup> [2006 IPCC Guidelines for National Greenhouse Gas Inventories](#)