



Central Statistics Office
An Phríomh-Oifig Stáidrimh

Greenhouse Gas and Acid Rain Precursor Accounts for Ireland

1998-2007

July 2009

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Foreword

Background

The national accounts provide a comprehensive framework within which economic data can be presented in a coherent, consistent manner. They present information on the performance of the economy in a condensed manner, using internationally agreed standards.

However, such accounts can be incomplete depending on the focus and scope of particular analyses. In particular, the effects or the potential effects of pollution are not considered. Hence satellite accounts are generated to organise information to supplement the broad orientation of the national accounts.

The Irish national accounts are basically compiled in accordance with the European System of Accounts 1995 (ESA 95) which is used in all member states of the European Community.

Greenhouse Gas and Acid Rain Satellite Accounts

The objective of the present accounts is to outline the potential environmental impact of economic and social activities and to list in quantifiable terms the amount of potential air pollutants produced by industry and households, which may in turn be compared to the employment and the value of output produced by these sectors. Due to the difficulties in dealing with aspects of environmental accounts in monetary terms, physical data is used instead which can be linked to the main accounts to describe the effects of pollution.

This publication represents the eleventh set of environmental satellite accounts for Ireland. They set out a longitudinal series of air emissions in respect of the years 1998-2007.

The CSO publishes these results as a potentially useful adjunct to the National Income & Expenditure (NIE) annual report.

The contributions of the Environmental Protection Agency, Sustainable Energy Ireland and An Bord Gáis in compiling this report are gratefully acknowledged.

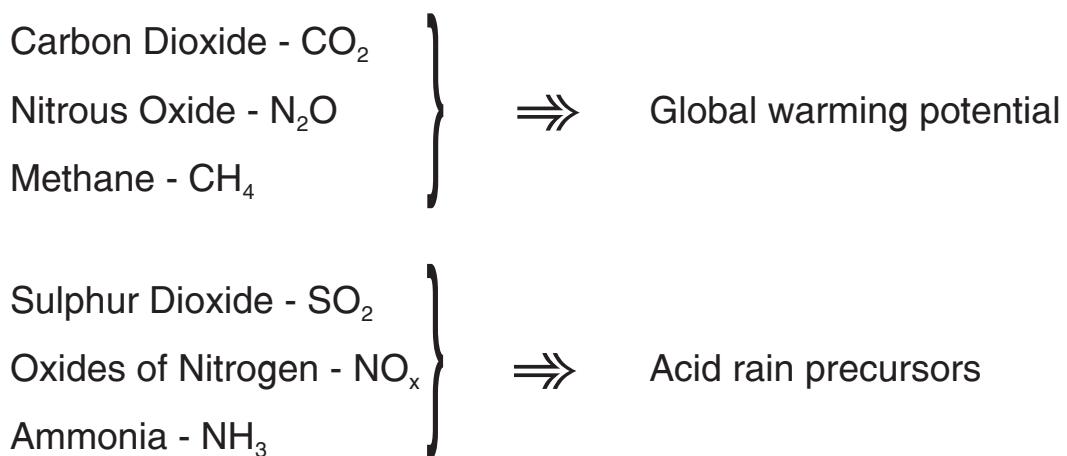
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Chapter 1 Introduction

These satellite accounts breakdown, by economic sector, emissions of greenhouse gases and acid rain precursors into the environment, two phenomena that can impinge on our future well-being. **The allocations are based on the sector of the end-user as distinct from the sector of emissions generation/production.** The accounts are not estimates of pollution levels; emissions relate to the flow into the environment whereas the level of pollution depends on the state of the receiving medium and its capacity to absorb and assimilate emissions without damage occurring now or in the future.

The six gases examined in these environmental accounts are classified into two separate themes based on their potential effects on the environment:



In the context of global warming, under the EU “burden sharing” agreement in place to meet the targets set by the Kyoto Protocol, Ireland has committed to limit the growth in the basket of greenhouse gases emissions to an increase of 13% over the 1990 baseline levels within the 2008-2012 period. Indeed the EU post-Kyoto strategy is to cut overall greenhouse gas emissions to at least 20% below 1990 levels by 2020, a commitment that will rise to 30% if other industrialised countries agree to do the same (plenary talks to produce a deal on a successor to the Kyoto Protocol take place in December 2009 in Copenhagen). Ireland is to reduce emissions by 20% below 2005 levels under this policy.

Ireland is also committed to reducing the emissions of four acid rain precursor air pollutants by 2010 under the 1999 Gothenburg Protocol. These pollutants contribute to regional acidification, eutrophication and local air pollution. The EU has put in place a Directive setting National Emissions Ceilings (2001) for each Member State.

While official estimates of Irish air emissions are compiled and published by the Environmental Protection Agency (EPA), the aim of this publication is to further attribute air emissions to economic sub-sectors rather than the physical processes that generate the emissions. When analysing these air emissions accounts it should be borne in mind that the figures are estimates and are subject to revision as more up-to-date data becomes available, particularly in relation to the core work undertaken by the EPA and Sustainable Energy Ireland (SEI).

The data in the CSO tables has been normalised to agree with EPA published totals, which is in line with the approach taken in all previous publications. Furthermore, the data incorporates revisions to the estimates previously published in respect of the years 1998-2006.

Technical Notes

- 1 Forestry sequestration: For the EPA methodology see the National Inventory Report 2009, section 7.2, available for download at <http://coe.epa.ie/ghg/nirdownloads.jsp>
- 2 Air Transport Greenhouse gases: Only the gases resulting from domestic flight LTO's (landings and take-offs) and cruising from an Irish airport to another Irish airport are accounted for under IPCC guidelines. No emissions from international flights are accounted for. For further details, see section 3.5 of National Inventory Report 2009, section entitled 'Memo Items' (or download from: <http://coe.epa.ie/ghg/nirdownloads.jsp>)
- 3 Air Transport Acid Rain gases: (SO_x, NOx and NH₃). This is treated differently than Greenhouse gases. The emissions from both domestic and international LTO's are accounted for, but nothing from cruising is taken into account, whether internally or internationally.

Chapter 2 Environmental Themes

Global warming potential

The three main Greenhouse gases included in this publication are **carbon dioxide** (CO_2), **nitrous oxide** (N_2O) and **methane** (CH_4). CO_2 emissions result from burning fossil fuels such as coal, turf and petroleum. However, CO_2 is also sequestered (absorbed) by vegetation growth, the most important in this context being by trees. N_2O emissions arise from a few industrial processes and from nitrogen fertilisers. The digestive systems of ruminant animals and waste treatment systems lead to CH_4 emissions.

There are other greenhouse gases (i.e. HFC, PFC and SF_6) which are not considered in this exercise. The emissions from these gases are estimated to comprise 1 per cent (in terms of CO_2 equivalent) of the total greenhouse gas emissions for Ireland in 2007 (see details in Table 4.3 of National Inventory Report 2009 <http://coe.epa.ie/ghg/nirdownloads.jsp> and also in Table10s 5.2 in the EPA publication IRL-2009-2007-v1.1.xls)

The relative contribution of each gas to the greenhouse effect can be expressed in terms of global warming potential. This is measured in tonnes of CO_2 equivalent. The relevant conversions used are as follows:

Emitted gas	Global warming potential over 100 years (CO_2 equivalent per tonne of gas emitted)
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310

These conversion factors are provided by the Inter Governmental Panel on Climate Change (IPCC) and are used by the EPA in its work (*Annex - Table A.1 National Inventory Report 2009*). However, it should be noted that they may be subject to revision over time.

Acid rain precursors

Acid rain occurs when acidic gases and particles are transported in the air before falling as wet or dry deposition. High concentrations can be harmful to health, to water and soil quality, to buildings, and can reduce plant growth and damage forests. Emissions *per se* are not necessarily harmful but they have acidification potential and are therefore aggregated into an acid rain precursor theme.

The three main Acid Rain precursor emissions included in this publication are **sulphur dioxide** (SO_2), **oxides of nitrogen** (NO_x) and **ammonia** (NH_3). Burning of coal with high sulphur content is a significant source of SO_2 . NO_x arise when fossil fuels are burnt under certain conditions. NH_3 emissions arise primarily from animal manure and nitrogen based fertilisers. There are other acid rain precursors (e.g. **volatile organic compounds** (VOC) and **carbon monoxide** (CO) that are not considered in this exercise (see details on Table 2.2 of National Inventory Report 2009 <http://coe.epa.ie/ghg/nirdownloads.jsp> (EPA website)).

Acid Rain precursor emissions can be expressed in sulphur dioxide (SO_2) equivalents using the following conversion factors:

Emitted gas	Acid rain precursors (SO_2 equivalent per tonne of gas emitted)
Sulphur Dioxide (SO_2)	1
Oxides of Nitrogen (NO_x)	0.6957
Ammonia (NH_3)	1.8824

Chapter 3 Sources of Data

Estimates of air emissions in both the Global Warming Potential and Acid Rain Precursors themes derive from the same data sources. Both involve emissions to air and are primarily due to the combustion of fossil fuels and agriculture. The EPA compiles the official air emissions estimates, which it submits annually to the United Nations Framework Convention on Climate Change (UNFCCC) and the European Environment Agency (EEA). This publication uses and complements EPA's work by estimating emissions by sector within the economy, primarily in the industry sector. Both the EPA's estimates and the data sources outlined below are used to attribute emissions to the relevant economic sectors.

Industry Sector

Most of the data for the industry sector is derived from the CSO's annual Census of Industrial Production (CIP). The work involves inferring from this economic data the extent of emissions to air attributable to each economic sector (i.e. from fuel expenditure data). Prior to 2004 the CIP collected detailed information on the breakdown of fuel expenditure on an infrequent basis and this detailed data was then also used to infer expenditure by fuel type in the intervening years. Expenditure on fuel is now collected on an annual basis in the CIP. Quantities of fuels consumed are estimated by dividing fuel expenditure by average fuel prices using fuel price time series maintained by SEI. Standard conversion factors are then used to convert the fuel quantities consumed into estimates of air emissions. The methodology employed, where fuel consumption is inferred from fuel expenditure, was the best available in the absence of sectoral data on quantities of fuel consumption.

Figures for the services sectors, both market and non-market, and the residential sector, are derived from the SEI's Energy Balance Sheets. These balance sheets disaggregate consumption by fuel type into five major sectors: Industry, Transport, Agriculture, Commercial and Public services, and the Residential sector.

Electricity-related emissions are attributed to the individual economic sectors in proportion to their final demand for electricity. Emissions associated with natural

gas consumption are similarly attributed to individual economic sectors in proportion to their consumption except where natural gas is used as a production feedstock, in which case the associated emissions are estimated separately.

The estimates presented here are best interpreted as indicative in nature but it is hoped that they give further insights into the interaction which the different economic sectors have with the environment and, in particular, air.

Note on methodology for Industry

In the industry sector, the accounts include gas emissions from the Emissions Trading Scheme (ETS) group of companies. For 2005 and later years CO₂ emissions to air from this group are officially audited and therefore are not imputed or derived from underlying expenditure, price and emissions factor data. For years prior to 2005, estimates for the ETS industry sectors are based directly upon the numbers employed in the constituent companies. It is therefore assumed that gas emissions are proportional to the numbers employed by the ETS companies in the various sectors. Where energy consumption and numbers employed were accurately known for industries engaged in similar activities, this assumption proved to be reasonably accurate.

Furthermore, within all industry sectors defined at a NACE 2-digit level, it was assumed that demand for energy was approximately proportional to the numbers employed by organisations within those sectors. These assumptions were used, where necessary, to improve the robustness of data for all organisations (ETS and non-ETS).

Where no raw data is available for dis-aggregated energy spending (1999, 2000, 2002, and 2003) estimates are made for it by linear interpolation of data from the years 1998, 2001, and 2004 at a 2-digit NACE level.

Chapter 4 Results Air Emissions Accounts 1998-2007

Aspects of Economic Activity 1998-2007

	Units	1998	2007	% change
Gross domestic product (GDP) at 2007 prices	€ Million	107,466	189,751	+76.6%
Gross domestic fixed capital formation at 2007 prices	€ Million	27,948	49,429	+76.9%
Numbers in employment (Q2) ²	'000	1,505	2,114	+40.5%
Total Primary Energy Requirement ³	ktonne Oil equiv	12,557	16,132	+28.5%
Greenhouse Gas emissions	ktonne CO ₂ equiv	65,401	68,537	+4.8%
Acid Rain precursors	ktonne SO ₂ equiv	510	340	-33.0%

Trends in emissions of CO₂, which are lower than trends in energy consumption, can be explained by changes in the mix of energy sources such as increasing usage of natural gas in electricity generation and increasing imports of electricity. Emissions relating to such imports are not included in these accounts.

Greenhouse Gases

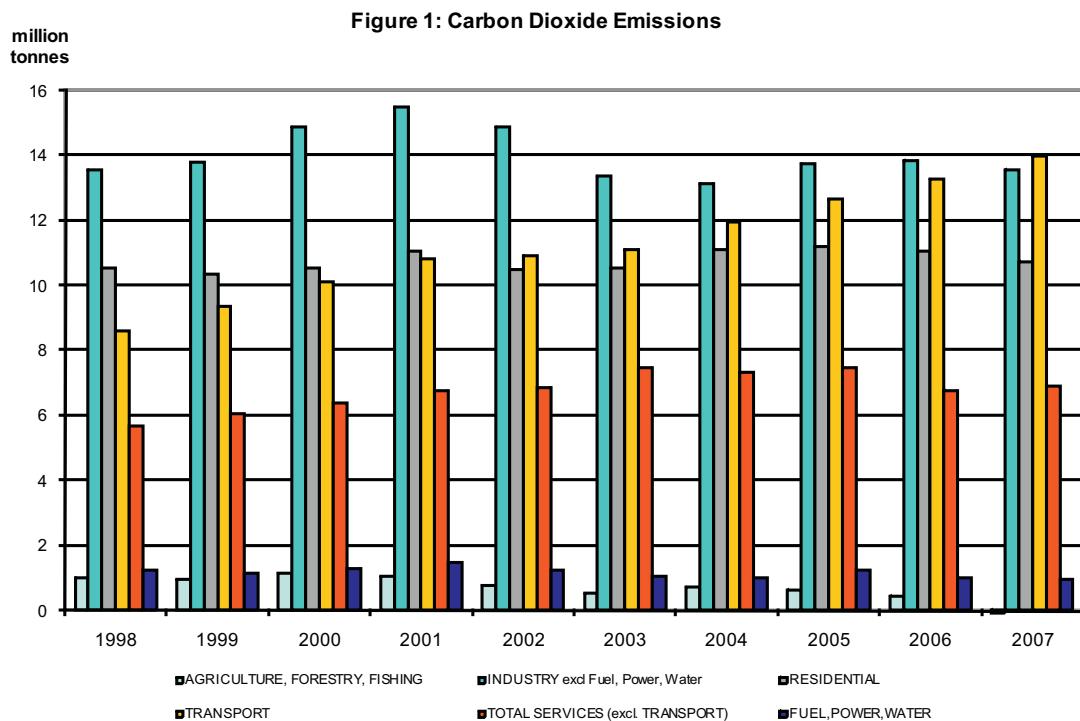
CO₂ emissions

Emissions estimates for carbon dioxide (CO₂) are presented in Table 1. In the period 1998 to 2007 aggregate national emissions increased by 15% from approximately 40 to 46 million tonnes. The most marked increase in CO₂ emissions occurred in transport⁴ where emissions increased by 65% between 1998 and 2007. Other increases for the period include the services sector (+23%) and the residential sector (+4%). The industrial sector remains unchanged over the period. Emissions trends are presented graphically in Figure 1.

² Source: Quarterly National Household Survey (QNHS), Quarter 2 (CSO).

³ Source: Sustainable Energy Ireland

⁴ Included here are both the Transport Sector and transport activities carried out in all other sectors (both private and business).



N₂O and CH₄ emissions

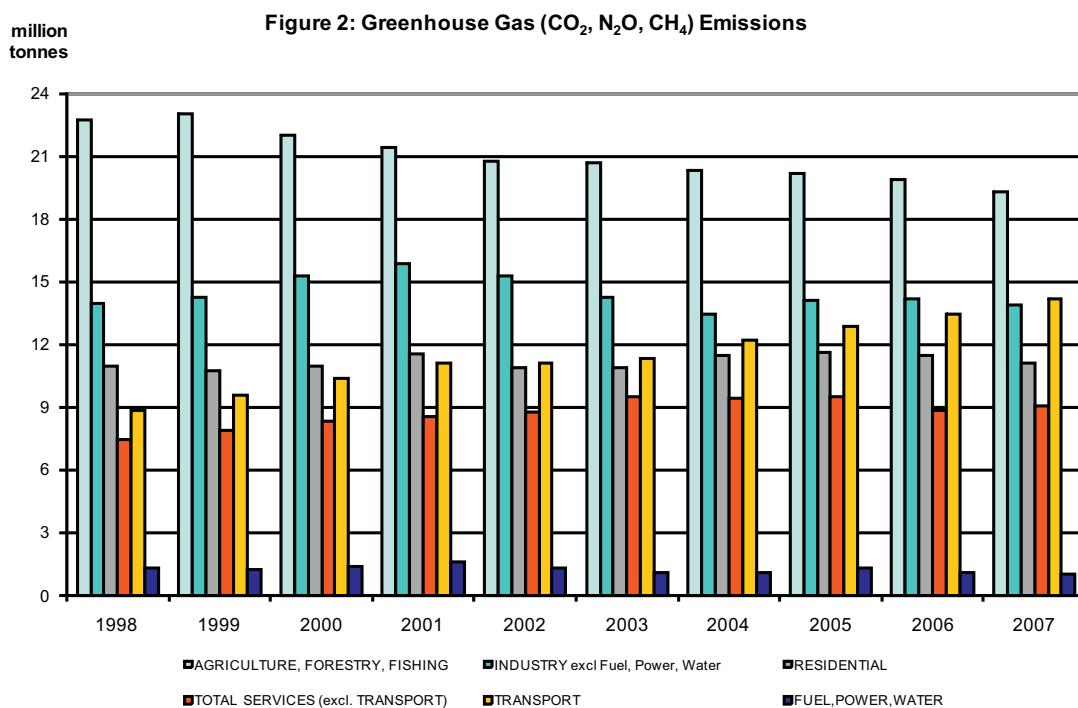
Emissions of nitrous oxide (N₂O) and methane (CH₄) are presented in Tables 2 and 3 respectively. Although the aggregate magnitude of emissions of these gases are significantly lower than those for CO₂ emissions, N₂O and CH₄ are significantly more potent in terms of global warming potential. Aggregate N₂O emissions decreased by 23% over the ten-year period under review.

Ruminant animals are the primary source of CH₄ emissions while natural gas distribution losses is another significant source. A unique production incident in 2003 was responsible for a large increase in emissions of CH₄ in the mining sector in that year.

Greenhouse Gases combined

Table 4 (and Figure 2) shows the three greenhouse gases as a single emissions estimate in terms of carbon dioxide equivalents. Although forestry acts as a large sink for CO₂ emissions, the high level of emissions of N₂O and CH₄ from farming (when expressed as CO₂ equivalents) contributes to agriculture, forestry and fishing being the sector with the highest level of greenhouse gas emissions. However, there was a 17% reduction in net emissions within the sector between 1998 and 2007 due primarily to a decrease in livestock numbers. Transport changed from having the fourth highest level of emissions in 1998 (after agriculture, industry and residential) to the second

highest in 2007 (after agriculture). The services sector recorded a 23% increase in emissions while the industrial sector's emissions, after peaking in 2001, decreased to approximately the same level in 2007 as they were in 1998.



The Kyoto protocol of the United Nations Framework Convention on Climate Change will be superceded in December 2009 at a conference to be held in Copenhagen. At EU level, in December 2008, Ireland committed to reduce its emissions of greenhouse gases to 20% below 2005 levels by 2020. Based on the EPA's official estimates, and for the three gases considered in this report, national greenhouse gas emissions for 2007 are 23% above and 1.5% below 1990 and 2005 levels, respectively.

Greenhouse gas emissions as a percentage of 1990 baseline* (1990=100)

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
118%	120%	124%	127%	123%	123%	123%	125%	125%	123%

* Calculations based on official aggregate emissions estimates compiled by the EPA and Kyoto definitions.

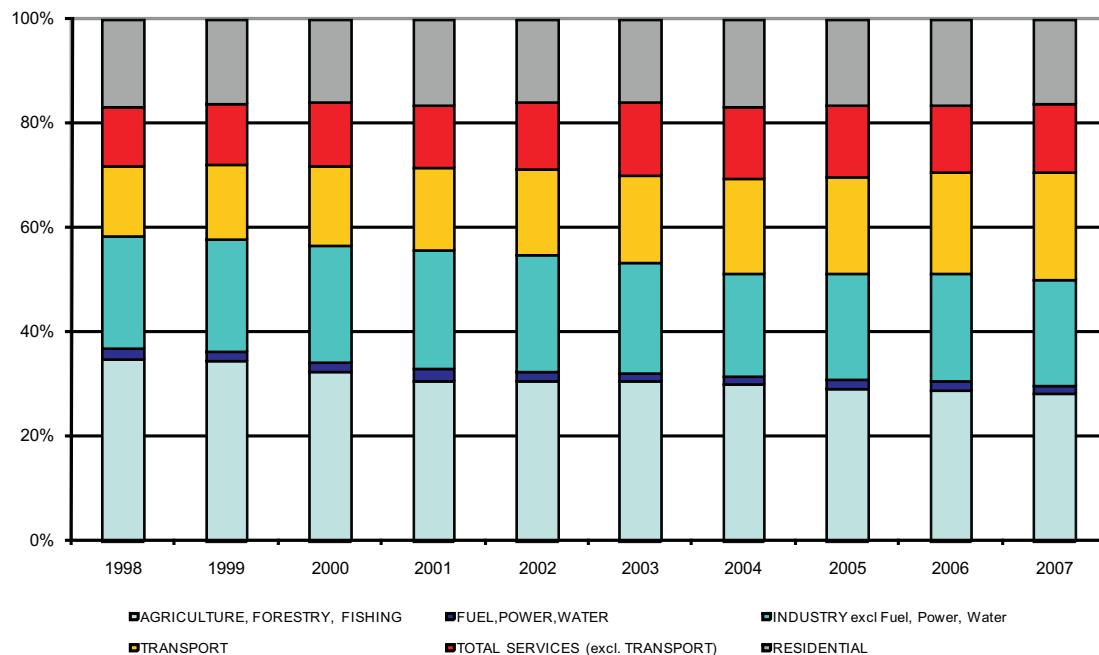
Greenhouse gas emissions as a percentage of 2005 baseline* (2005=100)

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
94%	96%	98%	101%	98%	98%	98%	100%	99%	98%

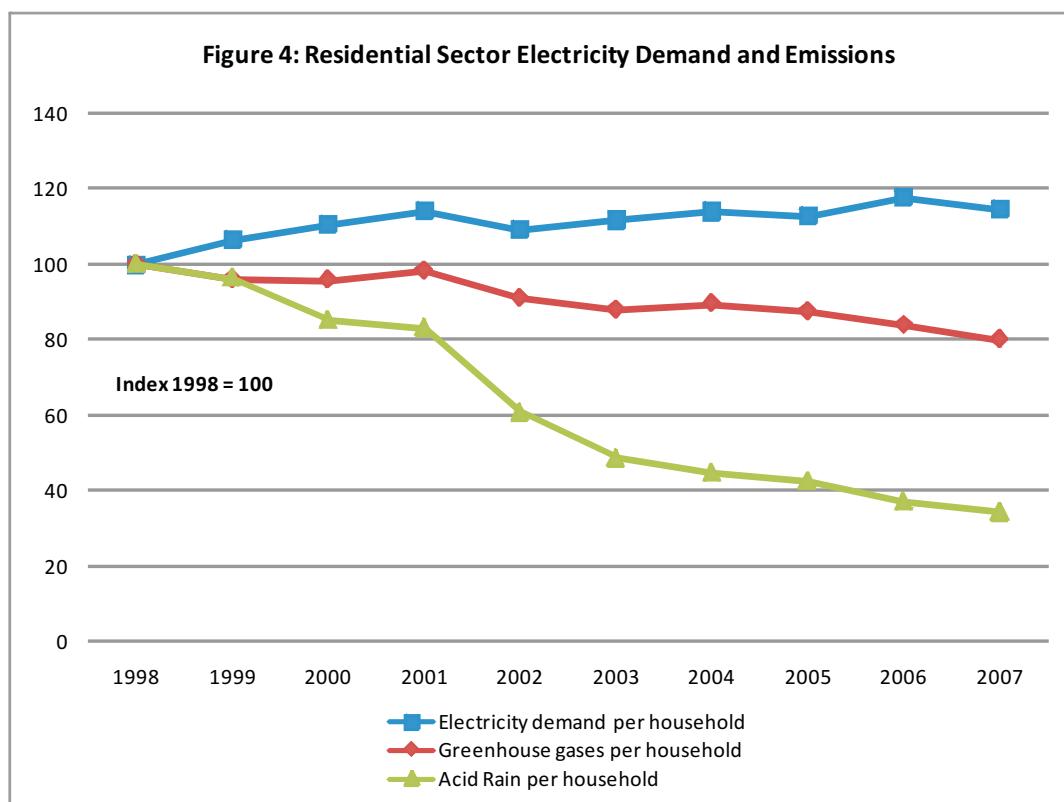
* Calculations based on official aggregate emissions estimates compiled by the EPA and Kyoto definitions.

Figures for 2007 show a decrease in greenhouse gas emissions to 2004 levels. The relative sectoral shares have also changed, as shown in Figure 3 (1998 to 2007). The share of emissions emanating from the agricultural sector has declined whereas share of emissions from the transport and services sectors increased.

Figure 3: Sector Shares - Greenhouse Gas (CO_2 , N_2O , CH_4) Emissions



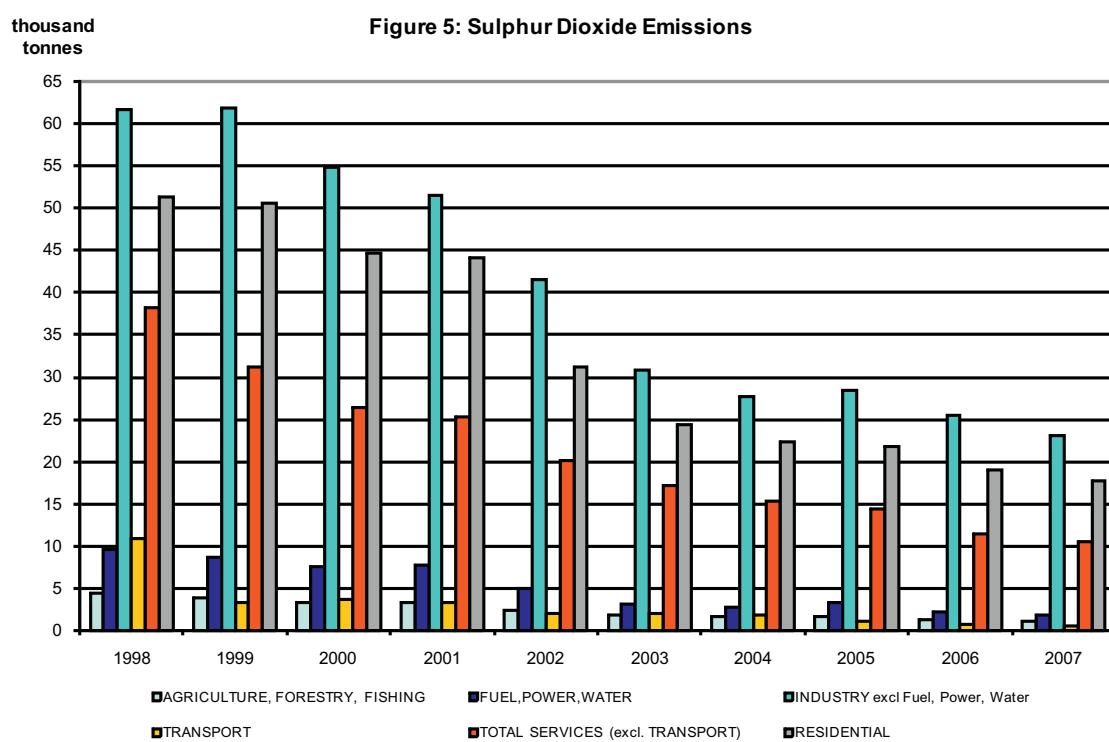
Residential greenhouse gas emissions were approximately 11 million tonnes per annum between 1998 and 2007. Over the period 2002 to 2007 the number of households increased from 1.3 million to 1.5 million (approximately 15%, based on Censuses of Population 2002 and 2006, and projections for 2007) suggesting that emissions per household declined. However, this hides the fact that households actually increased their demand for energy. Figure 4 shows that residential electricity demand per household increased by 15% between 1998 and 2007 while the greenhouse gas emissions per dwelling declined by 20% in the same period. This increase in per household electricity demand, alongside a large decline in per household emissions, is influenced by factors such as electricity generation becoming cleaner in recent years (in terms of intensity of greenhouse gas emissions) and less solid fuels used directly by households.



Acid rain precursors

SO₂ emissions

Sulphur dioxide (SO₂) emissions are presented in Table 5, which shows that emissions declined by 69% between 1998 and 2007. The decline occurred in all sectors of the economy, which is due principally to a decline in the volume of sulphur emissions from electricity generation and also the introduction in 1999 of low sulphur transport fuel. The industrial, residential and services sectors now emit 94% of all SO₂ emissions in contrast to 85% in 1998. The rate of decline has levelled off in recent years.

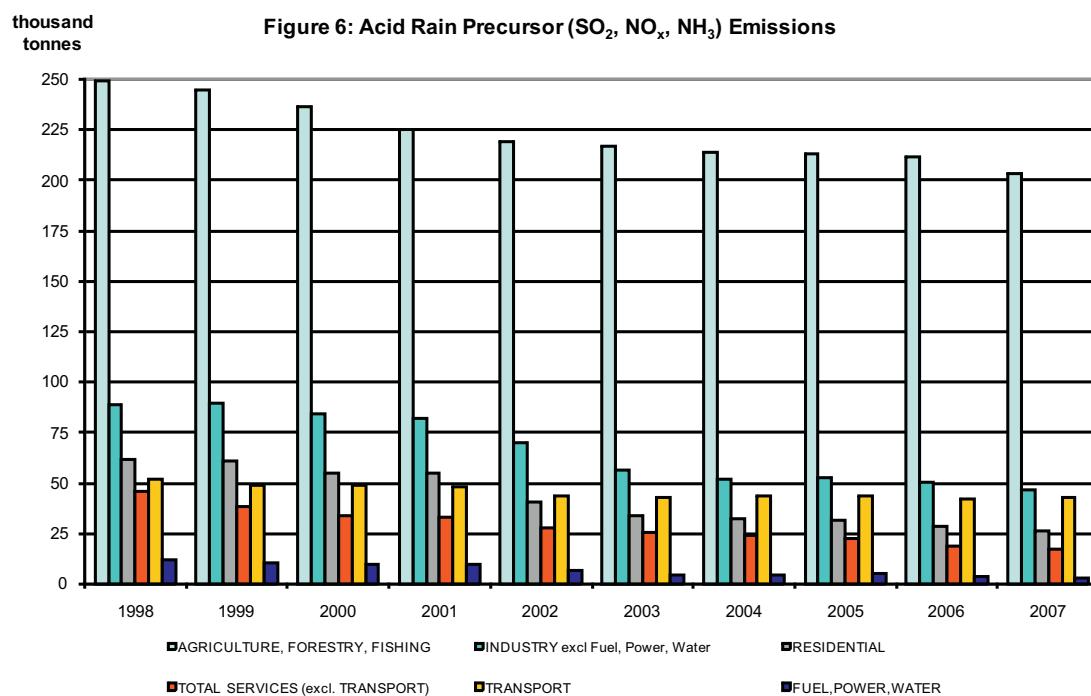


NO_x and NH₃ emissions

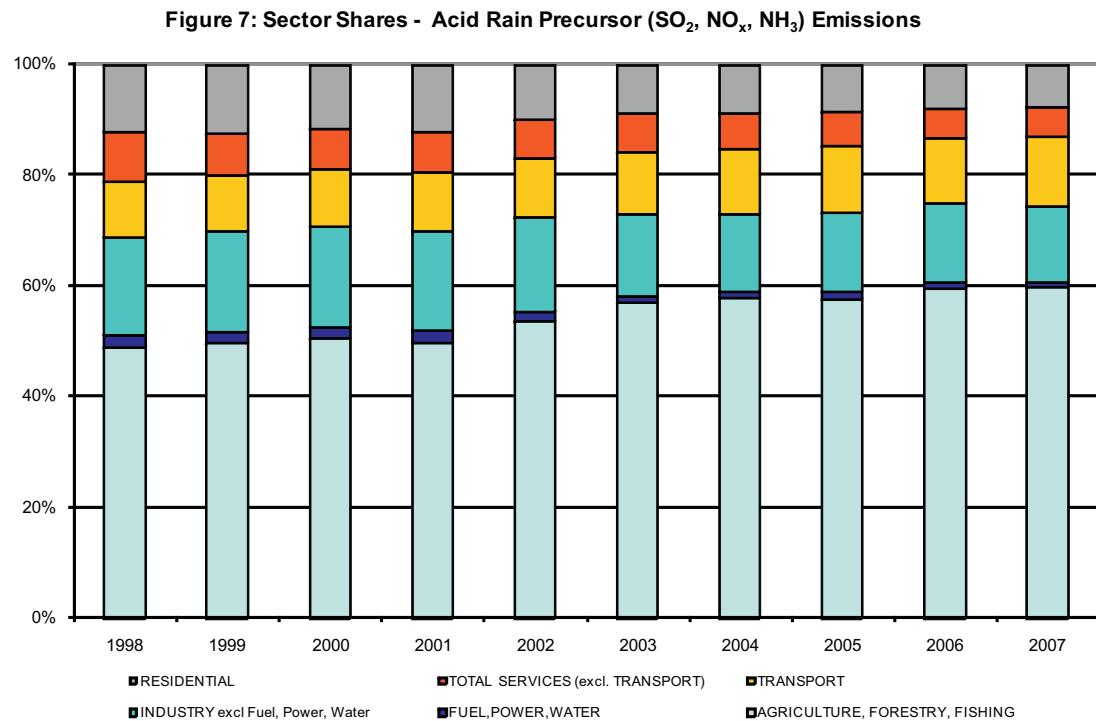
Tables 6 and 7 give emissions estimates for oxides of nitrogen (NO_x) and ammonia (NH₃). The decline in NO_x emissions between 1998 and 2007 was 11% overall. Ammonia (NH₃) emissions which predominantly derive from agricultural activities declined by 15% in the period 1998 to 2007. In this period, the June figures for cattle fell from 7.6 million to 6.7 million, and for sheep, from 8.3 million to 5.5 million⁵.

Acid Rain Precursors combined

Estimates of emissions of total acid rain precursors, expressed in SO₂ equivalents, are presented in Table 8 (and Figure 6). The emissions declined by 33% over the period reaching 340,000 tonnes in 2007. The agricultural sector which accounts for 60% of total emissions at present, fell by 17% in the period. Emissions have also declined in virtually all other sectors of the economy, as detailed in Table 8 and illustrated in Figure 6. In recent years in the transport sector, the decline in acid rain precursor emissions has levelled out at approximately 43,000 tonnes.



5 Source: Agricultural Livestock and Farm Numbers (CSO).



Ireland's targets under the Gothenburg Protocol

Under the Gothenburg Protocol (UNECE 1999) Ireland is committed to reducing the three acid rain precursor emissions before 2010. The subsequent National Emissions Ceilings Directive (EU 2001) set national emissions ceilings for EU member states which in Ireland's case are the same as the Gothenburg Protocol targets as outlined below. With the exception of ammonia, it is now highly unlikely that these targets will be met.

National Emissions Ceilings for Ireland

Pollutant	Emissions for 2007(kt)	Ceiling by 2010 (kt)	Reduction required to meet 2010 ceiling (kt)	Percentage reduction required
Sulphur Dioxide (SO_2)	55	42	13	24%
Nitrogen Oxides (NO_x)	125	65	60	48%
Ammonia (NH_3)	106	116	0	0%

Source: Department of the Environment and Local Government and EPA

Tables

Because of the uncertainties regarding the sectoral allocations of electricity and gas in recent years, the year-on-year changes must be regarded as indicative rather than absolute.

This report incorporates revisions to the estimates previously published in respect of the years 1998–2006.

Table 9 (Gross Value Added at Basic Prices) is included to show the relative national economic importance of the industry sectors covered.

Table 1: Carbon Dioxide (CO₂) Emissions

	NACE REV 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Emissions by Agriculture, Forestry, Fishing		1,455	1,534	1,611	1,648	1,475	1,557	1,396	1,419	1,384	1,424
Sequestration by forestry	-505	-592	-474	-625	-738	-1,060	-666	-811	-958	-958	-1,518
AGRICULTURE, FORESTRY, FISHING	1,2,5	950	942	1,137	1,023	736	497	730	607	426	-94
FUEL,POWER,WATER	40-41	1,199	1,129	1,268	1,464	1,216	1,022	1,011	1,243	995	945
Coal, peat, petroleum, metal ores, quarrying	10-14	870	999	1,025	1,090	1,095	1,067	1,080	1,156	1,324	1,282
Food, beverage, tobacco	15-16	2,451	2,490	2,586	2,712	2,525	2,310	2,095	2,164	2,230	2,143
Textiles, clothing, leather & footwear	17-19	190	199	209	203	181	153	137	156	84	57
Wood & wood products	20	252	259	264	270	253	226	220	234	239	213
Pulp, paper & print production	21-22	258	269	281	296	275	243	231	226	246	213
Chemical production	24	1,212	1,265	1,312	1,395	1,334	1,201	1,153	1,262	1,027	983
Rubber & plastic production	25	125	128	131	98	96	96	87	108	96	91
Non-metallic mineral production	26	4,881	4,918	5,625	5,822	5,593	4,827	4,991	4,956	4,691	4,782
Metal prod. excl. machinery & transport equip.	27-28	1,734	1,646	1,731	1,637	1,630	1,594	1,599	1,436	1,698	1,868
Agriculture & industrial machinery	29	796	815	831	1,015	1,010	864	804	853	946	844
Office and data process machines	30	62	70	73	103	92	84	62	63	56	57
Electrical goods	31-33	286	313	349	363	335	319	286	338	416	255
Transport equipment	34-35	93	99	106	112	103	90	84	91	91	93
Other manufacturing	36-37,23	281	290	299	299	280	251	233	639	630	642
Construction	45	40	40	41	43	54	43	43	41	37	36
INDUSTRY excl. Fuel, Power, Water		13,530	13,801	14,863	15,458	14,857	13,370	13,107	13,724	13,811	13,559
TRANSPORT*		8,478	9,366	10,086	10,817	10,893	11,092	11,956	12,639	13,244	13,965
SERVICES excl Transport		5,593	6,064	6,384	6,747	6,847	7,467	7,334	7,435	6,746	6,895
RESIDENTIAL		10,267	10,318	10,537	11,066	10,485	10,532	11,087	11,180	11,063	10,712
Total		40,017	41,619	44,274	46,575	45,035	43,981	45,226	46,827	46,285	45,981

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 2: Nitrous Oxide (N₂O) Emissions

	NACE REV 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGRICULTURE, FORESTRY, FISHING	1,2,5	29.34	29.31	27.73	25.94	24.81	24.64	24.03	23.68	23.11	22.08
FUEL,POWER,WATER	40-41	0.18	0.17	0.17	0.20	0.15	0.11	0.12	0.15	0.12	0.10
Coal, peat, petroleum, metal ores, quarrying	10-14	0.09	0.10	0.10	0.11	0.09	0.07	0.06	0.06	0.07	0.06
Food, beverage, tobacco	15-16	0.31	0.32	0.32	0.33	0.27	0.21	0.19	0.20	0.20	0.18
Textiles, clothing, leather & footwear	17-19	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01
Wood & wood products	20	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02
Pulp, paper & print production	21-22	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02
Chemical production	24	0.17	0.18	0.17	0.18	0.15	0.15	0.12	0.12	0.13	0.10
Rubber & plastic production	25	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Non-metallic mineral production	26	0.10	0.10	0.11	0.10	0.12	0.14	0.18	0.19	0.18	0.19
Metal prod. excl. machinery & transport equip.	27-28	0.22	0.24	0.24	0.22	0.20	0.20	0.21	0.21	0.20	0.19
Agriculture & industrial machinery	29	0.13	0.13	0.13	0.17	0.15	0.11	0.09	0.10	0.11	0.09
Office and data process machines	30	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-
Electrical goods	31-33	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05
Transport equipment	34-35	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Other manufacturing	36-37,23	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.03
Construction	45	0.01	0.01	0.01	0.01	0.01	-	-	-	-	-
INDUSTRY excl. Fuel, Power, Water		1.29	1.35	1.34	1.36	1.20	1.04	1.04	1.08	1.07	0.96
TRANSPORT*		0.62	0.65	0.70	0.72	0.67	0.64	0.66	0.68	0.67	0.66
SERVICES excl Transport		1.25	1.33	1.35	1.36	1.31	1.30	1.29	1.29	1.21	1.17
RESIDENTIAL		1.25	1.31	1.28	1.33	1.20	1.09	1.16	1.20	1.16	1.07
Total		33.93	34.12	32.57	30.91	29.34	28.82	28.30	28.08	27.34	26.04

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 3: Methane (CH₄) Emissions

	NACE REV 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGRICULTURE, FORESTRY, FISHING	1,2,5	607.68	591.16	562.63	558.10	554.80	549.33	547.86	544.65	542.32	524.40
FUEL,POWER,WATER	40-41	2.58	2.55	2.46	2.65	2.08	1.85	1.98	1.64	3.00	1.85
Coal, peat, petroleum, metal ores, quarrying	10-14	0.10	0.10	0.10	0.09	0.07	27.06	0.07	0.10	0.10	0.09
Food, beverage, tobacco	15-16	0.41	0.37	0.42	0.38	0.29	0.25	0.30	0.28	0.33	0.24
Textiles, clothing, leather & footwear	17-19	0.04	0.04	0.05	0.04	0.04	0.04	0.03	0.04	0.03	0.03
Wood & wood products	20	-	-	-	-	-	-	-	0.01	0.01	0.01
Pulp, paper & print production	21-22	0.06	0.05	0.05	0.05	0.05	0.03	0.02	0.03	0.03	0.02
Chemical production	24	0.19	0.17	0.17	0.19	0.14	0.12	0.16	0.14	0.18	0.12
Rubber & plastic production	25	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Non-metallic mineral production	26	0.30	0.25	0.39	0.48	0.48	0.53	0.66	0.70	0.61	0.62
Metal prod. excl. machinery & transport equip.	27-28	0.10	0.11	0.11	0.09	0.09	0.10	0.11	0.11	0.29	0.22
Agriculture & industrial machinery	29	0.03	0.03	0.03	0.04	0.03	0.02	0.02	0.02	0.02	0.01
Office and data process machines	30	-	-	-	-	-	-	-	-	-	-
Electrical goods	31-33	0.09	0.08	0.09	0.09	0.07	0.05	0.05	0.05	0.06	0.04
Transport equipment	34-35	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Other manufacturing	36-37,23	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Construction	45	-	-	-	-	-	-	-	-	-	-
INDUSTRY excl. Fuel, Power, Water											
TRANSPORT*		2.27	2.36	2.59	2.58	2.47	2.33	2.24	2.15	1.32	1.33
SERVICES excl Transport**		66.89	68.65	72.80	65.21	73.06	79.84	79.60	78.58	81.39	86.09
RESIDENTIAL		3.18	2.69	2.69	2.70	2.45	2.32	2.40	2.44	2.65	2.19
Total		683.97	668.66	644.62	632.74	636.13	663.89	635.55	630.97	632.38	617.29

* Includes both the Transport sector and road transport activities carried out in all other sectors.

** Due mainly to Solid Waste disposal on land

Table 4: Greenhouse Gas Emissions (CO₂, N₂O, CH₄)

	NACE REV 1	Thousand tonnes CO ₂ equivalent					
		1998	1999	2000	2001	2002	2003
AGRICULTURE, FORESTRY, FISHING	1,2,5	23,311	23,033	22,021	21,408	20,815	20,730
FUEL,POWER,WATER	40-41	1,308	1,234	1,372	1,581	1,307	1,097
Coal, peat, petroleum, metal ores, quarrying	10-14	901	1,031	1,058	1,125	1,124	1,656
Food, beverage, tobacco	15-16	2,556	2,597	2,695	2,824	2,616	2,381
Textiles, clothing, leather & footwear	17-19	201	211	221	215	190	160
Wood & wood products	20	263	271	275	281	263	234
Pulp, paper & print production	21-22	271	283	294	309	286	252
Chemical production	24	1,270	1,323	1,368	1,453	1,384	1,241
Rubber & plastic production	25	131	135	138	103	100	100
Non-metallic mineral production	26	4,919	4,956	5,668	5,862	5,640	4,881
Metal prod. excl. machinery & transport equip.	27-28	1,804	1,721	1,809	1,706	1,695	1,657
Agriculture & industrial machinery	29	836	856	872	1,068	1,056	898
Office and data process machines	30	64	72	76	106	96	87
Electrical goods	31-33	306	333	369	381	352	335
Transport equipment	34-35	98	105	111	117	107	93
Other manufacturing	36-37,23	295	304	312	311	292	261
Construction	45	42	42	43	45	57	45
INDUSTRY excl. Fuel, Power, Water	13,958	14,240	15,308	15,906	15,258	14,281	13,453
TRANSPORT*		8,717	9,617	10,359	11,095	11,152	11,340
SERVICES excl Transport		7,386	7,918	8,332	8,537	8,789	9,546
RESIDENTIAL		10,722	10,779	10,990	11,535	10,910	10,919
Total		65,401	66,821	68,382	70,063	68,231	67,914
							68,005
							69,593
							68,992
							68,537

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 5: Sulphur Dioxide (SO₂) Emissions

	NACE REV 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Thousands tonnes
AGRICULTURE, FORESTRY, FISHING	1,2,5	4.73	3.93	3.36	3.27	2.38	1.78	1.65	1.62	1.36	1.14	
FUEL,POWER,WATER	40-41	10.17	8.71	7.65	7.84	5.04	3.05	2.83	3.23	2.30	1.92	
Coal, peat, petroleum, metal ores, quarrying	10-14	3.32	3.39	2.80	2.49	1.94	1.38	1.28	1.27	1.61	1.26	
Food, beverage, tobacco	15-16	12.45	11.71	9.90	9.53	7.10	4.93	4.21	4.02	4.13	3.55	
Textiles, clothing, leather & footwear	17-19	1.22	1.17	0.98	0.84	0.60	0.38	0.31	0.31	0.16	0.11	
Wood & wood products	20	2.04	1.91	1.55	1.42	1.03	0.67	0.60	0.61	0.53	0.42	
Pulp, paper & print production	21-22	1.84	1.71	1.36	1.26	0.91	0.57	0.51	0.50	0.52	0.40	
Chemical production	24	8.02	7.50	6.08	5.78	4.21	2.71	2.39	2.22	1.81	1.51	
Rubber & plastic production	25	0.92	0.86	0.69	0.43	0.32	0.22	0.17	0.18	0.16	0.14	
Non-metallic mineral production	26	14.02	13.78	13.89	12.85	11.48	9.40	8.61	7.38	7.07	7.22	
Metal prod. excl. machinery & transport equip.	27-28	9.38	8.67	8.66	7.94	6.99	6.20	5.77	7.12	5.15	4.94	
Agriculture & industrial machinery	29	6.34	5.87	4.67	5.11	3.99	2.47	2.17	2.14	2.06	1.66	
Office and data process machines	30	0.36	0.34	0.28	0.39	0.29	0.20	0.14	0.10	0.09	0.07	
Electrical goods	31-33	1.90	1.83	1.54	1.35	1.01	0.74	0.59	0.77	0.81	0.44	
Transport equipment	34-35	0.71	0.66	0.52	0.47	0.33	0.21	0.18	0.19	0.15	0.13	
Other manufacturing	36-37,23	2.28	2.12	1.69	1.49	1.10	0.73	0.65	1.50	1.18	1.12	
Construction	45	0.34	0.31	0.25	0.23	0.23	0.13	0.12	0.11	0.09	0.07	
INDUSTRY excl. Fuel, Power, Water	65.14	61.81	54.84	51.57	41.51	30.93	27.70	28.40	25.50	23.04		
TRANSPORT*		11.12	3.26	3.60	3.39	2.10	1.96	1.80	1.02	0.67	0.49	
SERVICES excl Transport		31.89	31.25	26.38	25.32	20.07	17.19	15.38	14.33	11.44	10.51	
RESIDENTIAL		55.34	50.59	44.65	44.07	31.13	24.45	22.35	21.80	19.09	17.64	
Total		178.38	159.54	140.48	135.46	102.23	79.35	71.70	70.39	60.34	54.73	

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 6: Oxides of Nitrogen (NO_x) Emissions

	NACE REV 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Thousands tonnes
AGRICULTURE, FORESTRY, FISHING	1,2,5	10.85	11.14	11.60	11.76	11.68	11.83	11.73	12.65	11.88	11.35	
FUEL,POWER,WATER	40-41	3.01	2.65	2.98	3.33	2.71	2.18	2.15	2.61	2.00	1.81	
Coal, peat, petroleum, metal ores, quarrying	10-14	2.88	2.75	2.50	2.20	2.09	1.96	1.94	2.48	3.53	1.91	
Food, beverage, tobacco	15-16	10.61	10.83	11.51	12.16	10.94	9.78	8.57	9.02	10.05	9.89	
Textiles, clothing, leather & footwear	17-19	0.70	0.88	1.09	1.25	1.01	0.77	0.55	0.55	0.30	0.21	
Wood & wood products	20	0.69	0.69	0.74	0.77	0.72	0.64	0.64	0.59	0.55	0.60	
Pulp, paper & print production	21-22	0.70	0.70	0.74	0.78	0.76	0.71	0.73	0.68	0.69	0.59	
Chemical production	24	4.33	4.55	4.94	5.33	4.99	4.47	4.23	3.71	2.90	3.28	
Rubber & plastic production	25	0.64	0.53	0.44	0.26	0.25	0.24	0.22	0.26	0.28	0.22	
Non-metallic mineral production	26	7.96	8.32	8.97	8.96	8.76	7.88	7.67	7.54	6.33	7.02	
Metal prod. excl. machinery & transport equip.	27-28	6.47	6.28	6.69	6.60	6.18	5.73	5.42	4.84	5.37	6.14	
Agriculture & industrial machinery	29	2.04	2.03	2.14	2.58	2.50	2.07	1.92	2.00	1.94	1.79	
Office and data process machines	30	0.11	0.14	0.16	0.24	0.24	0.24	0.22	0.21	0.15	0.15	
Electrical goods	31-33	0.96	1.01	1.14	1.20	1.04	0.91	0.77	0.77	2.10	0.84	
Transport equipment	34-35	0.37	0.35	0.34	0.32	0.28	0.24	0.21	0.27	0.24	0.34	
Other manufacturing	36-37,23	0.82	0.81	0.86	0.86	0.95	1.03	1.17	0.87	1.05	1.17	
Construction	45	0.10	0.09	0.10	0.10	0.12	0.09	0.09	0.09	0.08	0.07	
INDUSTRY excl. Fuel, Power, Water	39.36	39.95	42.34	43.59	40.81	36.76	34.35	35.19	35.55	34.22		
TRANSPORT*		61.47	61.38	59.20	58.19	53.14	52.67	54.29	53.90	52.51	54.04	
SERVICES excl Transport		9.97	10.30	10.90	11.37	11.49	12.20	12.04	11.97	10.24	10.24	
RESIDENTIAL		15.03	14.75	14.94	15.64	14.17	13.65	14.31	14.26	13.58	12.94	
Total		139.69	140.17	141.96	143.89	133.99	129.29	128.86	130.59	125.76	124.60	

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 7: Ammonia (NH₃) Emissions

	NACE REV 1	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Thousands tonnes
AGRICULTURE, FORESTRY, FISHING	1,2,5	123.55	124.00	119.47	113.33	110.90	109.70	108.49	107.54	107.18	103.04	
FUEL,POWER,WATER	40-41	-	-	-	-	-	-	-	-	-	-	
Coal, peat, petroleum, metal ores, quarrying	10-14	-	-	-	-	-	-	-	-	-	-	
Food, beverage, tobacco	15-16	-	-	-	-	-	-	-	-	-	-	
Textiles, clothing, leather & footwear	17-19	-	-	-	-	-	-	-	-	-	-	
Wood & wood products	20	-	-	-	-	-	-	-	-	-	-	
Pulp, paper & print production	21-22	-	-	-	-	-	-	-	-	-	-	
Chemical production	24	-	-	-	-	-	-	-	-	-	-	
Rubber & plastic production	25	-	-	-	-	-	-	-	-	-	-	
Non-metallic mineral production	26	-	-	-	-	-	-	-	-	-	-	
Metal prod. excl. machinery & transport equip.	27-28	-	-	-	-	-	-	-	-	-	-	
Agriculture & industrial machinery	29	-	-	-	-	-	-	-	-	-	-	
Office and data process machines	30	-	-	-	-	-	-	-	-	-	-	
Electrical goods	31-33	-	-	-	-	-	-	-	-	-	-	
Transport equipment	34-35	-	-	-	-	-	-	-	-	-	-	
Other manufacturing	36-37,23	-	-	-	-	-	-	-	-	-	-	
Construction	45	-	-	-	-	-	-	-	-	-	-	
INDUSTRY excl. Fuel, Power, Water	-	-	-	-	-	-	-	-	-	-	-	
TRANSPORT*	1.09	1.54	2.04	2.30	2.31	2.24	2.23	2.81	2.69	2.53	-	
SERVICES excl Transport	-	-	-	-	-	-	-	-	-	-	-	
RESIDENTIAL	-	-	-	-	-	-	-	-	-	-	-	
Total	124.63	125.54	121.50	115.62	113.20	111.93	110.72	110.35	109.87	105.57	-	

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 8: Acid Rain Precursor Emissions (SO₂, NO_x, NH₃)

	NACE REV 1	Thousand tonnes SO ₂ equivalents					
		1998	1999	2000	2001	2002	2003
AGRICULTURE, FORESTRY, FISHING	1,2,5	244.84	245.09	236.32	224.78	219.26	216.51
FUEL,POWER,WATER	40-41	12.27	10.55	9.72	10.16	6.93	4.56
Coal, peat, petroleum, metal ores, quarrying	10-14	5.33	5.30	4.53	4.02	3.39	2.74
Food, beverage, tobacco	15-16	19.83	19.24	17.90	17.99	14.72	11.74
Textiles, clothing, leather & footwear	17-19	1.71	1.78	1.73	1.71	1.30	0.91
Wood & wood products	20	2.52	2.39	2.06	1.95	1.53	1.12
Pulp, paper & print production	21-22	2.32	2.19	1.88	1.80	1.43	1.07
Chemical production	24	11.03	10.66	9.52	9.49	7.68	5.82
Rubber & plastic production	25	1.37	1.23	1.00	0.61	0.49	0.39
Non-metallic mineral production	26	19.55	19.56	20.13	19.08	17.58	14.88
Metal prod. excl. machinery & transport equip.	27-28	13.88	13.03	13.31	12.53	11.29	10.19
Agriculture & industrial machinery	29	7.75	7.28	6.16	6.91	5.72	3.91
Office and data process machines	30	0.44	0.44	0.39	0.56	0.45	0.37
Electrical goods	31-33	2.56	2.53	2.33	2.19	1.73	1.37
Transport equipment	34-35	0.97	0.90	0.75	0.69	0.53	0.37
Other manufacturing	36-37,23	2.85	2.69	2.29	2.09	1.76	1.45
Construction	45	0.41	0.38	0.32	0.30	0.31	0.19
INDUSTRY excl. Fuel, Power, Water	92.52	89.61	84.30	81.89	69.90	56.50	51.59
TRANSPORT*	55.93	48.86	48.62	48.19	43.41	42.81	43.76
SERVICES excl Transport	38.83	38.41	33.96	33.23	28.06	25.67	23.75
RESIDENTIAL	65.80	60.85	55.05	54.95	40.98	33.95	32.30
Total	510.18	493.36	467.96	453.20	408.54	380.00	369.76
							368.96
							354.66
							340.14

* Includes both the Transport sector and road transport activities carried out in all other sectors.

Table 9: Gross Value Added at Basic Prices *

	NACE REV 1	€ million									
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGRICULTURE, FORESTRY, FISHING	1,22,5	3,142.6	2,918.8	3,009.0	2,966.1	2,816.6	2,918.0	3,040.6	2,540.1	2,294.1	2,613.1
FUEL,POWER,WATER	40-41	978.5	777.7	979.9	1,273.4	1,281.1	1,535.6	1,452.3	1,652.1	1,918.3	2,268.3
Coal, peat, petroleum, metal ores, quarrying	10-14	375.5	368.2	475.7	559.4	490.4	617.9	483.2	582.1	810.6	1,016.2
Food, beverage, tobacco	15-16	3,602.4	4,087.3	3,855.1	4,618.6	5,202.0	6,024.9	5,892.5	6,091.6	6,350.1	6,561.1
Textiles, clothing, leather & footwear	17-19	451.3	379.6	368.8	388.5	350.9	332.3	307.8	293.4	269.5	303.3
Wood & wood products	20	242.3	294.3	325.4	307.4	326.3	364.0	400.5	435.5	431.0	475.4
Pulp, paper & print production	21-22	3,290.8	4,363.1	4,147.6	3,704.5	3,676.4	3,934.7	4,163.0	4,456.8	4,349.7	4,678.0
Chemical production	24	8,410.1	8,665.4	10,182.0	12,572.4	17,100.2	13,862.7	12,251.6	10,743.8	11,424.3	12,531.0
Rubber & plastic production	25	410.8	415.5	493.2	514.0	514.8	550.3	603.3	599.3	632.8	722.1
Non-metallic mineral production	26	756.4	880.7	987.9	937.0	847.8	887.3	865.4	978.3	1,093.0	1,227.9
Metal prod. excl. machinery & transport equip.	27-28	748.9	850.7	1,037.9	972.1	953.8	991.3	1,060.2	1,116.4	1,301.5	1,295.5
Agriculture & industrial machinery	29	676.7	722.4	738.3	779.7	825.9	818.8	744.3	861.0	879.4	1,019.4
Electrical goods	30-33	4,059.2	6,326.6	7,597.8	7,406.1	6,944.2	6,494.5	6,604.8	6,834.9	7,229.6	6,634.0
Transport equipment	34-35	364.7	378.7	482.8	491.7	541.4	553.7	540.9	578.8	606.9	762.3
Other manufacturing	36-37,23	384.6	357.4	363.3	409.6	407.5	436.6	466.2	485.1	504.1	602.2
Construction	45	4,276.2	5,365.9	6,992.1	8,158.2	8,980.8	10,043.1	11,786.8	14,216.8	15,894.7	16,203.9
INDUSTRY excl. Fuel, Power, Water		28,049.9	33,456.0	38,048.2	41,819.4	47,162.3	45,912.0	46,170.5	48,273.8	51,777.3	54,032.1

*Source: CSO National Income and Expenditure Accounts

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Appendix

Air Emission Conversion Factors

	TOE per tonne	TOE per 1000 litres	Tonnes CO ₂ /TJ	Tonnes SO ₂ /TJ	Tonnes NO _x /TJ	Tonnes CH ₄ /TJ
1 TOE (Tonne of Oil Equivalent) = 41.868×10^{-3} TJ and TJ (Tera Joule) = 10^{12} Joules						
Briquettes	0.443		98.860	0.280	0.100	0.050
Milled Peat	0.186		113.262	0.270	0.160	0.050
Sod Peat	0.313		104.000	0.300	0.100	0.050
Coal	0.665		94.600	0.323	0.050	0.100
Gas/Diesel Oil	1.034	0.869	73.247	0.074	0.100	
Kerosene	1.056	0.845	71.342	0.034	0.100	0.005
Residual Fuel Oil	0.985		75.959	0.485	0.200	
LPG	1.126	0.579	63.647	0.000	0.100	
Natural Gas			54.890	0.000	0.100	0.005

Sources: Environmental Protection Agency, Sustainable Energy Ireland

Global Warming Potential

Emitted Gas	Global warming potential over 100 years (CO ₂ equivalents per tonne of gas emitted)
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous Oxide (N ₂ O)	310
Acid rain precursors (SO₂ equivalents per tonne of gas emitted)	
Sulphur dioxide (SO ₂)	1
Oxides of Nitrogen (NO _x)	0.6957
Ammonia (NH ₃)	1.8824