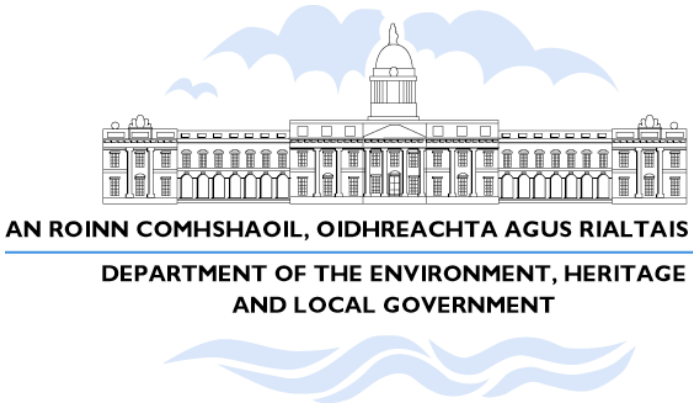

IRELAND'S
FOURTH NATIONAL COMMUNICATION

UNDER THE

UNITED NATIONS
FRAMEWORK CONVENTION
ON CLIMATE CHANGE

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EXECUTIVE SUMMARY

This report is Ireland's fourth national communication under the United Nations Framework Convention on Climate Change (FCCC). Ireland ratified the FCCC on 20 April 1994. Ireland ratified the Kyoto Protocol on 31 May 2002 and became a Party when it entered into force on 16 February 2005. This report covers principally information on activities during the period 2003-2005 and is based largely on data available up to and including early 2006, including final emissions inventory data for 2004.

The European Union (EU) has been to the forefront in promoting international cooperation to tackle climate change through mitigation efforts to control greenhouse gas emissions, and through promoting adaptation measures to counter the adverse effects of climate change that are inevitable due to historic and present emissions. Ireland is committed to meeting its greenhouse gas limitation target for the purposes of the Kyoto Protocol. This will be achieved through the continued implementation of domestic policies and measures and the use of the Protocol's flexibility mechanisms.

National Circumstances

Ireland is situated off the north-west coast of the continent of Europe. The country enjoys a relatively mild temperate oceanic climate, influenced by the relatively warm waters of the Gulf Stream and the prevailing south-westerly winds from the Atlantic. By 2006, the population of Ireland was estimated to be approximately 4.2 million, a growth of 20% on the 1991 population. Compared with the rest of Europe, Ireland has a markedly younger population profile with over one-third of the population aged under 25. Almost 40% of the population is concentrated in Dublin and the Eastern Region. However, outside this region, the State has a highly dispersed and low-density population.

Ireland is a small, dynamic, globalised economy that experienced an unprecedented level of growth during the latter half of the 1990s. The Irish economy is heavily dependant on external trade and investment. GDP grew by approximately 140% over the period 1990-2004. Ireland's period of unprecedented economic growth began in the early 1990s. Between 1995 and 2000, the economy grew at an average annual rate of 9.5%. Although the growth rate declined after 2000, it still remained high by EU standards with an average GDP growth rate of 6.1% from 2000-2004. Economic development over the past decade include:

- a doubling of national income;
- a reduction in unemployment levels by two-thirds; and,
- an increase in the number of people at work by more than one-half.

This economic growth has a direct bearing on the increase in greenhouse gas emissions, namely through:

- increased energy consumption by businesses, industries and households;
- increased population and household formation;
- increased use of private transport; and,
- increased waste production.

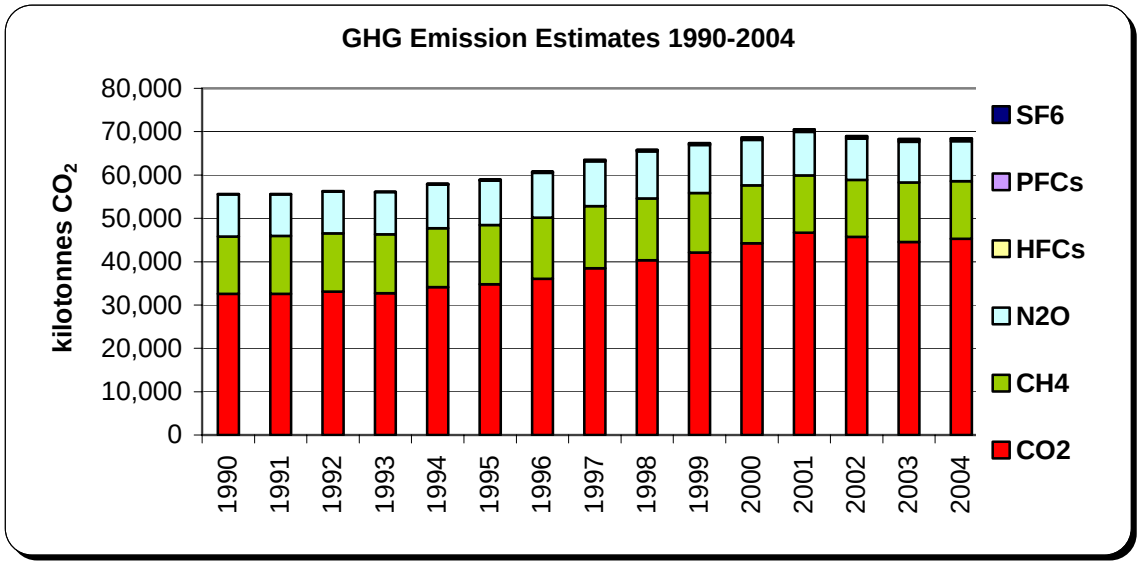
Greenhouse Gas Inventory Information

The national greenhouse gas inventory is compiled by the Environmental Protection Agency (EPA) using the guidelines of the Intergovernmental Panel on Climate Change (IPCC). The inventory is compiled on an annual basis and submitted by year-end in draft form to the European Commission to facilitate EU reporting, and in final form to the Secretariat by the April 15th deadline. The 2006 National Inventory Report (NIR) which contains the inventory data in the Common Reporting Format (CRF) along with full documentation of the assumptions underpinning the inventory has been submitted to the UNFCCC secretariat for the years 1990 to 2004.

The complete inventory currently comprises a time series from 1990 to 2004 for carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O) and for the fluorinated or F-gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). The year 1995 has been chosen as the base year for the fluorinated gases for obligations under the Kyoto Protocol.

In recent years, greenhouse gas emissions have fallen from a peak of 26.9% above 1990 levels in 2001 to 23.1% above 1990 levels in 2004, mainly due to:

- increasing use of natural gas in the power generation sector;
- the closure of ammonia and nitric acid production plants in 2002; and,
- reduction in the size of the national livestock herd.



Total emissions of the six greenhouse gases in Ireland (excluding net CO_2 from Land Use Change and Forestry) increased steadily from 55.6 million tonnes CO_2-equivalent in 1990 to 70.6 million tonnes CO_2-equivalent in 2001 and then decreased slightly to 68.5 million tonnes CO_2-equivalent in 2004. Total emissions in 2004 were 23% higher than in 1990 and 3% lower than the peak level of 2001. The estimated total for 2004 is 100 kilotonnes CO_2-equivalent higher than that for 2003.

In 2004, energy accounted for 64.9% of total emissions. Agriculture contributed 27.7%, while a further 4.6% emanated from industrial processes and 2.7% was due to waste. Emissions of CO_2 accounted for 66% of total emissions in 2004, with CH_4 and N_2O contributing 19.4% and 13.5%, respectively. The combined emissions of HFC, PFC and SF_6 accounted for approximately 1% of total emissions in 2004.

Policies and Measures

The National Climate Change Strategy (NCCS), which was published in 2000, forms the basis for Government policy in relation to climate change. Since the Third National Communication was published, the policy context for the principal greenhouse gas emitting sectors has continued to evolve. New policies and measures have been introduced, some of which were envisaged by the NCCS, while others derive from measures agreed at European Union level.

Other proposals in the Strategy have not been implemented in light of further analysis as to their suitability in an Irish context. The Climate Change Strategy will be reviewed during 2006, with the objective of updating its provisions to reflect the current policy context, and to clearly identify Ireland's pathway to Kyoto compliance.

A significant contribution to the achievement of Ireland's Kyoto target will be made by firms from the energy and industry sectors that are covered by the EU Emissions Trading Scheme (ETS). Collectively these firms account for some 33% of Ireland's total greenhouse gas emissions. A three-year pilot phase of the scheme commenced in 2005. The first full period of emissions trading will begin in 2008 and will operate over the duration of the Kyoto commitment period from 2008 – 2012.

A range of other measures are targeted at the energy, transport, residential, commercial, industry, services, agriculture and forestry sectors, which are detailed in Chapter 3.

Projections and the Total Effect of Policies and Measures

The projections are a 'with measures' scenario based on currently implemented and adopted policies and measures. Overall emissions are projected to rise up to 2005 before falling in 2006 and stabilising for 2007, resuming upward growth from 2008 onwards. The fall from 2005 is largely due to a fall in the energy sector resulting from the introduction of cleaner generating plant to meet electricity demand.

The largest single sectoral source of emissions in 2003 was from agriculture. However, by 2010, energy is projected to be the largest source with almost 27%; and this is projected to remain the case for 2015 and 2020.

Agriculture is the second largest source in 2010 with 25% of emissions and its share is projected to fall slightly to around 24% for 2015 and 2020.

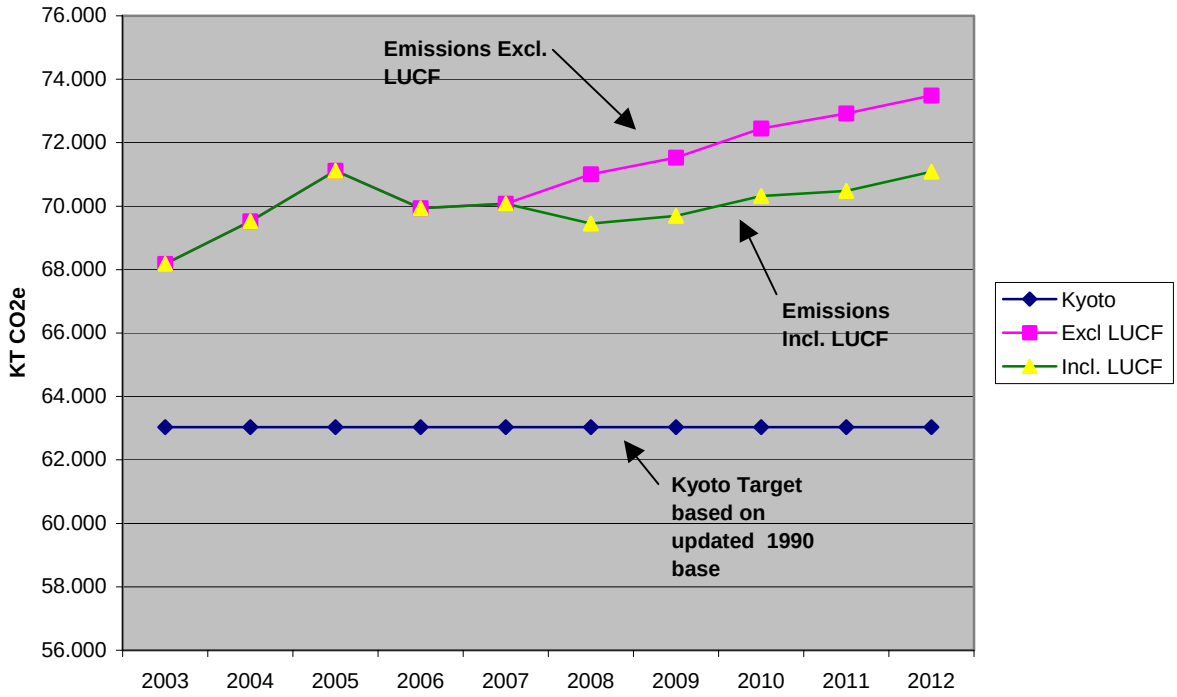
Industry is the third largest source with 19% of emissions in 2010, rising to 21% and 22% in 2015 and 2020 respectively.

The transport sector is responsible for over 18% of emissions in 2010 rising to 20% and 21% of emissions respectively in 2015 and 2020 respectively.

The share of emissions from the residential sector is set to remain stable between 2010 and 2020 at a little over 9%.

Finally the share of emissions from the waste sector is projected to fall from 2.6% in 2010 to 2.1% in 2015 and 1.2% in 2020.

'With Measures' Scenario - GHG Emissions Projections 2003-2012



Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

The Third Assessment Report (TAR) of the IPCC represents the most authoritative scientific assessment of climate change by several hundred scientists. Ireland, as an island mid-latitude country, can be expected to be faced with the effects of global trends, identified in the TAR, which have implications for the future course of Irish climate, and with it for a range of impacts that it is prudent to anticipate.

The Environmental Protection Agency, through the Environmental Research, Technological Development and Innovation (ERTDI) research programme, has provided some €6.4m towards climate change research in Ireland in the areas of mitigation, adaptation, basic science and observations. Specific objectives for the investment in climate change adaptation research include the provision of analyses of projected climate change and its impacts for Ireland and development of analytical capacity in this area. Reports published to date include *Climate Change: Scenarios and impacts for Ireland*, *Climate Change Indicators for Ireland* and *Climate Change: Regional climate model predictions for Ireland*.

A study published in 2005 *Climate Change: Regional climate model predictions for Ireland* prepared by the Community Climate Change Consortium for Ireland (c4i), provides an analysis of future Irish climate conditions for the period 2012-2060 using a regional climate model. The study applies data from this model to assess the impact of climate change on river discharge and local flooding in the River Suir catchment area. One of the conclusions of applying the model in this way is that a predicted increase in winter rainfall was found to increase the risk of future flooding in the area. Other conclusions from the study include the following general scenarios:

- General warming with mean monthly temperature increasing by between 1.25º and 1.5º. The largest increase will occur in the South East and East, with the greatest warming occurring in July.
- Rainfall in June will decrease by about 10% compared to the present while December values show increases ranging between 10% in the south-east and 25% in the north-west.
- Increased frequency of storms over the North Atlantic in the vicinity of Ireland by about 15% compared to current conditions.

Further analyses of climate scenarios are being conducted under the auspices of C4i, which will examine the impacts for agriculture and water management, focusing on river basin districts.

The potential for climate change impacts are already being addressed in a number of policy-making areas. On foot of the 2004 report of the Flood Policy Review Group, climate change is identified as one of the key elements that need to be addressed when assessing future flood relief measures in Ireland. In addition, the Government appointed the Office of Public Works (OPW) as the lead agency to implement flooding policy in Ireland and the OPW is developing a strategy to manage flood risk in conjunction with other relevant State agencies.

Local Authorities now have the power to consider adaptation initiatives in relation to their development plans. The Planning and Development Act, 2000, empowers planning authorities to provide, in their development plans, that development in areas at risk of flooding may be regulated, restricted or controlled. If development is proposed in a flood-risk area, the risk of flooding can be carefully evaluated and planning permission refused, if necessary. Integrated costal zone management is supported by the planning system. Under the 2000 Act, each local planning authority must prepare a development plan setting out an overall strategy for the proper planning and sustainable development of the area, which includes regulating, restricting or controlling development in areas at risk of flooding and regulating the development of coastal and inland waterway areas.

Financial Resources and Transfer of Technology

Ireland's Official Development Assistance (ODA) has continued to increase since the publication of Ireland's Third National Communication in 2003. In 2003, total ODA stood at €446 million, in 2004 it had increased to €489 million and by 2005 had reached €578.46 million. This represents 0.43% of GNP. At the Millennium Review Summit in 2005, Ireland committed to reaching the UN target of 0.7% ODA by 2012.

Ireland's development assistance is focused on the Least Developed Countries, particularly those in sub-Saharan Africa. Ireland has bilateral development programmes with Lesotho, Ethiopia, Mozambique, Tanzania, Uganda and Zambia. Irish Aid also has a programme in South Africa and in Timor Leste and Vietnam.

The bulk of Ireland's assistance to developing countries is administered by Irish Aid, located in the Department of Foreign Affairs. The Departments of Agriculture and Food, Environment, Heritage and Local Government, and Enterprise Trade and Employment also contribute to Ireland's ODA. In the last number of years since the publication of Ireland's Third National Communication, Ireland, like a number of other donors, has been working towards a more programmatic and harmonised approach to development cooperation. Ireland's assistance programme supports a wide range of activities, programmes and sectors which have benefits for countries addressing climate change. Many activities related to agriculture, health, infrastructure, water resource management and disaster prevention have positive impacts in terms of adaptation to climate change.

Ireland also supports climate change activities through multilateral programmes and through support to international agencies. Funding administered through these channels has continued to rise on an annual basis since the Third National Communication. Ireland continues to provide funds to the GEF and in 2005 it also contributed to the Least Developed Countries Fund and the Special Climate Change Fund. Ireland is committed to the Bonn Declaration and has committed funds towards the US$410 million from 2005 to 2008.

Research and Systematic Observation

Funding for climate change research, systematic observations and related activities is provided on a national level though a number of thematic agencies and organisations. The budgetary allocations are provided via relevant Government Departments. Since 2000 research funding has been provided through the National Development Plan (NDP) 2000-2006.

Under the NDP direct funding for environmental research is the responsibility of the Department of Environment, Heritage and Local Government who have requested that the Environmental Protection Agency (EPA) undertake the task of management of this research allocation. The EPA has given a high priority to climate change research and is funding several large-scale projects in this area. Other Government Departments have similarly devolved direct responsibility for research funding. Climate change related studies have thereby received funding from a number of such bodies such as the Higher Education Authority and the National Council for Forest Research and Development. The national meteorological service, Met Éireann, operates a climate analysis section from within its own budget and has primary responsibility for systematic observations of meteorological parameters. Sustainable Energy Ireland has responsibility for the development of research in relation to energy, energy management and education on energy usage. Climate change research has developed significantly under the NDP 2000-2006. The EPA investment in climate research is of the order of €7m over the NDP period. Linked infrastructure development, investments for other state agencies, as well as input from European and bilateral projects, are estimated to be of a similar order.

The Irish Committee on Climate Change coordinates activities in relation to international bodies such as the International Geosphere -Biosphere Programme. Ireland supports the European Union/European Space Agency Global Monitoring for the Environment and Security activities and influences its development through the GMES Advisory Council. Ireland is a member of the Intergovernmental Group on Earth Observations and supports its development.

A number of national bodies/organisations are engaged in systematic observations including Global Atmospheric Observing Systems (GCOS). Met Éireann has primary responsibility for meteorological/climatological observations listed below. Responsibility for terrestrial and oceanographic observations is divided among a number of State agencies including the EPA, Marine Institute, universities and other academic institutions. The EPA, Met Éireann and the Marine Institute have established a process to develop a national GCOS plan in response to the GCOS 10 year implementation plan.

Education, Training and Public Awareness

ENFO, the Environment Information Service of the Department of the Environment, Heritage and Local Government has been involved in raising public awareness of climate change issues through climate change-related activities. In view of the need to heighten awareness of climate change among the general public, a National Environmental Awareness Campaign included a significant climate change element.

1. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

1.1 Government Structure

Ireland is a parliamentary democracy. The national parliament is called the Oireachtas and consists of the President, and two houses - the Dáil (the lower house), and the Seanad (the upper house). Bunreacht na hÉireann, the written Constitution of Ireland, sets out the administrative structure of the Government and defines the structure and principles of legal and social policy to guide the Oireachtas. The rights of every citizen are also enshrined in the Constitution. The power of the two houses of the Oireachtas derive from Bunreacht na hÉireann and law. The Dáil is the primary House and the Government is answerable to the Dáil only. The Irish Government consists of not less than seven and not more than fifteen members. The Head of the Government is the Taoiseach, who is appointed by the President on the nomination of the Dáil. Departments of State are assigned to members of the Government, with a Minister occasionally being responsible for more than one Department. The Irish Government, in exercising the executive powers of the State and delivery of its policy, retains overall responsibility for ensuring delivery of Ireland's obligations under the UNFCCC and the Kyoto Protocol. The Department of Environment, Heritage and Local Government is responsible for Ireland's policy on climate change and has an overarching role in the delivery of this policy.

1.2 Geographic and Climate Profile

Ireland is situated off the north-west coast of the continent of Europe between longitude 5.5^{o} and 10.5^{o} West and latitude 51.5^{o} and 55.5^{o} North. The total area of the island of Ireland is 84,421 square kilometres. The Republic of Ireland comprises 70,282 square kilometres. The greatest length of the island from the north to the south is 486 kilometres and the greatest width, from east to west, is 275 kilometres. There are 3,172 kilometres of coastline. The island comprises a large central lowland of limestone with a relief of hills and a number of coastal mountains, the highest of which, Carrantouhill, is 1,040m and the longest river, the Shannon, is 340km. Ireland's National Parks are home to some of the most unique and spectacular scenery in the country while wild boglands occur in mountain and lowland areas and are among the most distinctive natural habitats in the country. The bio-diversity of wildlife is comparatively low due to Ireland's isolation from mainland Europe with many species present on the continent being absent. Many other common animals and plants have, in fact, been introduced by human settlers.

The country enjoys a relatively mild temperate oceanic climate, influenced by the relatively warm waters of the Gulf Stream and the prevailing south-westerly winds from the Atlantic. The coldest months are January and February, with mean daily air temperatures of between 4^{o}C and 7^{o}C while the warmest are July and August, with mean temperatures of between 14^{o}C and 16^{o}C. May and June are the sunniest, averaging 5 to 7 hours sunshine per day. Rainfall is well distributed throughout the year. In low-lying areas average annual rainfall is mostly between 800 and 1200 millimetres but ranges from less than 750mm in some eastern areas to 1500mm in parts of the west. In mountainous areas annual rainfall may exceed 2000mm.

1.3 Population Distribution Profile

By 2006, the population of Ireland was approximately 4.2 million, a growth of over 20% on 1991 levels. On the basis of the 2006 census, Ireland had the largest population growth within the European Union over the previous decade. This is being driven by high levels of immigration and natural increase. Compared with the rest of Europe, Ireland has a markedly younger population profile with a high proportion of the population concentrated in the younger age-groups - over one-third of people are aged under 25. Population density of 60 persons per square kilometre remains relatively low compared to other countries in Europe. However, almost 40% of the population is concentrated in Dublin and the Eastern Region. Outside this region, the State has a highly dispersed and low-density population.

Housing is generally one or two storey, detached or semi-detached, and in urban areas is mostly in low density suburbs (15 to 30 houses per hectare). Flats or apartments are now becoming more common, and prior to the coming into force of the Building Regulations in 1992 for new construction, insulation standards for housing were generally low. Only 31% of the population live in population settlements in excess of 100,000, as opposed to 35% of the population living in dispersed settlement patterns in rural areas. Comparative EU data shows that Ireland has the lowest population share living in settlements of between 2,000 and 100,000. The National Sustainable Development Strategy (1997) sets out Government policy of encouraging more sustainable residential development by the avoidance of excessive suburbanisation and the promotion of higher residential densities in appropriate locations in conjunction with improved public transport systems. The 2002 National Spatial Strategy is a twenty-year planning framework designed to achieve a better balance of social, economic, physical development and population growth between regions. Its focus is on people, on places and on building communities. Through closer matching of where people live with where they work, different parts of Ireland will for the future be able to sustain a better quality of life for people, a strong, competitive economic position, and an environment of the highest quality.

1.4 Economic Profile

The Irish economy is a small, dynamic, globalised economy that experienced an unprecedented level of growth during the latter half of the 1990s. The Irish economy is heavily dependant on external trade and investment. GDP grew by approximately 130% over the period 1990-2005. Sustained growth has moved Ireland to a more favourable position among its EU partners with a GDP per capita equivalent to €36,000 – approximately 20% higher than the EU average. Ireland's period of unprecedented economic growth began in the early 1990s. Between 1995 and 2000, the economy grew at an average annual rate of 9.5%. Although the growth rate declined after 2000, it still remained high by EU standards with an average GDP growth rate of 6.1% from 2000-2004. Economic achievements over the past decade include:

- a doubling of national income;
- a reduction in unemployment levels by two-thirds; and,
- an increase in the number of people at work by more than one-half.

1.5 Industrial Profile

Current world economic trends have seen a falling share of manufacturing as a percentage of GDP and conversely, the share of the services sector rising. However, Ireland has of late developed contrary to this trend with significant increases in the share of manufacturing. This temporary, albeit significant phenomenon, is primarily due to the Government's policy orientation and the level of foreign direct investment attracted here through low corporate tax rates, a skilled workforce and easy access to the EU market. Since 1990, industry's share of Irish GDP has increased from 33% to over 40%. While much of the industrialisation in recent years has been in large measure due to foreign owned firms, the share of Irish owned industries has also been growing quickly in recent years. In 2004, 20% of exports were destined for the US market; 18% of exports went to the UK; and 45% of exports went to the rest of the EU. Total merchandise exports are equivalent to 57% of GDP.

The ICT, chemical/pharmaceuticals and food/agricultural products continue to be the most important sectors in terms of exports and their contribution to GDP. The ICT sector alone employs over 45,000 people and accounts for about 10% of Irish GDP. Approximately 35,000 are also employed in pharmaceutical/chemical and medical companies. The highest growth rates in Irish industry over recent years have been in the high-technology sectors of computer equipment, pharmaceuticals and engineering, where overseas investment in Ireland has played a vital role. Overseas-owned companies continue to account for the majority of total manufactured exports.

The services sector in Ireland accounts for half of GDP and for two-thirds of employment. In 2004, Ireland was one of the biggest exporters of internationally traded services on a per capita basis. The most important service industries are computer services, tourism and financial services.

In 2004, the total labour force was reported to be approximately 1.9 million, representing about 60% of all persons aged 15 or over. The overall participation rate has generally been increasing gradually over the last few years, though the level of female participation is still below European averages. The level of unemployment remains low at 4.4% (March 2004), representing almost full employment

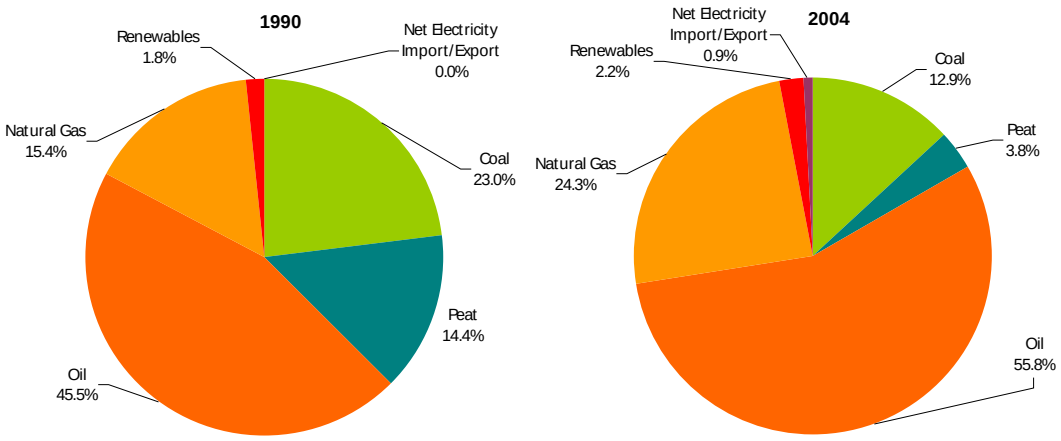
1.6 Energy Profile

The use of energy in Ireland continues to grow. Between 1990 and 2004, the total primary energy requirement grew by 60%. The amount of energy consumed per capita is also increasing, and this trend is projected to continue. There has been significant growth in the transport sector that has seen energy consumption more than double since 1990.

Electricity generation accounted for 96% of total emissions from the sector in 2004, with CO_2 from power generation making up 93% of total energy sector emissions. Electricity demand and therefore emissions have risen in line with economic growth since 1990, with total emissions for the energy sector increasing by 35% between 1990 and 2004. Despite the increased electricity demand over the period since 1990, in recent years there has been a degree of decoupling between electricity demand and emissions growth, due to the increased contribution of high efficiency electricity generation such as natural gas powered plants and of

renewables to electricity generation. The downward trend in the CO_2 intensity of electricity generation continued in 2004 arising from the closure of the older, less efficient, Shannonbridge and Lanesboro peat-fired power plants and the increased contribution of wind to electricity generation.

Final Energy Consumption by Energy in Ireland 1990 vs 2004[1]



A report prepared by Sustainable Energy Ireland (SEI) entitled *"Energy in Ireland 1990-2004"* highlighted the following indicators in relation to Irish Energy consumption:

- Energy use in Ireland increased by 1.4% in 2004 while energy-related carbon dioxide (CO_2) emissions increased by 1.1%. Driving these increases was a 4.4% increase in economic growth, as measured by Gross Domestic Product (GDP).
- The factors contributing to this decoupling include:
    - reduction in peat consumption in electricity generation;
    - increased production of renewable energy, in particular wind;
    - increased electricity imports;
    - reduced industrial and services sectors' energy use; and,
    - reduced peat consumption in the residential sector.
- Compared with the other fuels, renewable energy experienced the highest growth in 2004 increasing by 18%. This meant renewable growth outpaced the growth in primary energy consumption and thus increased its share from 1.8% in 2003 to 2.2% in 2004, the highest share since 1990. Since 1990 renewable energy has grown by 92% (4.8% per annum on average) in absolute terms.
- Wind generation experienced a growth of 44% in 2004 and for the first time exceeded the amount of electricity generated by hydro.
- The share of oil in primary energy requirement was almost 56% in 2004 up from 54% by 2003. Oil consumption increased by 4.8% in 2004.
- The share of oil accounted for by transport in 2004 was 56%.
- Consumption of peat decreased significantly (31%) in 2004 compared with 2003, primarily due to the closure of old peat fired electricity generation plants.
- Final consumption of electricity grew by 2.1% in 2004. This was achieved with just a 0.4% increase in the fuel inputs into electricity generation.
- The efficiency of electricity supply increased by 1% point in 2004 to 41%.

[1] Energy in Ireland 1990-2004, Sustainable Energy Ireland

- In 2004, electricity generated from wind exceeded that from hydro for the first time. This made it the dominant renewable energy input into electricity generation.
- The renewable energy share of gross electricity consumption was 5.2% in 2004, increasing from 4.3% in 2003.
- The carbon intensity of electricity continued to fall in 2004 reducing by 4.1% to 624g CO_2 /kWh.

An analysis of the figures of final energy consumption in 1990 and 2004 is outlined below.

Subsequently, the Government published a Green Paper on energy policy, which sets out a policy framework for the long-term development of the energy sector in Ireland, including the development of an all-island energy market, having regard to an overarching requirement to, inter alia, maintain security of electricity supply in the context of Ireland's continually rising demand for energy.

Projections by Sustainable Energy Ireland show Ireland's total energy needs growing by an estimated 38% between now and 2020, and total electricity generation growing by 27.5%. Ireland's high dependency on fossil fuel imports, particularly oil and natural gas, is expected to continue with oil and natural gas contributing almost 87% to total energy supply in 2020 and gas contributing 71% to fuel used in electricity generation by 2020. The contribution of more CO_2-intensive fuels such as peat and coal to Ireland's total energy requirements is expected to decline to just under 7% by 2020.
A key component of Ireland's energy policy in the years ahead will therefore be the need to place increasing emphasis on the measures to further encourage energy consumption using renewable sources and less CO_2-intensive fuels. Equally, it will be important to strengthen energy efficiency measures in order to reduce overall energy consumption and to ensure that Ireland's demand for electricity does not exceed the available generation capacity. These issues are also being informed by wider international developments in energy policy including the recent publication of EU green papers on energy efficiency and on a European strategy for sustainable, competitive and secure energy.

1.7 Transportation

In Ireland, roads are the dominant mode of internal transport, accounting for about 90% of freight traffic and over 95% of passenger traffic, and are, therefore, vital for future economic and social development at both national and local level. At the end of 2004, there were almost 1.6 million private cars on Irish roads, compared to approximately 800,000 in 1990. These account for approximately 80% of the two million vehicles on the road. Some 270,000 freight vehicles are also registered, representing 13% of all vehicles.

As a result of strong economic growth, rapidly increasing levels of ownership and usage of private transport are evident with car ownership approaching the EU-15 average of 488, from 230 per 1,000 head of population in 1990, to 397 in 2004. Substantial traffic growth increases of up to 6% per annum has taken place on the national road network over the past number of years, and there is a need to manage further anticipated growth in a manner consistent with environmental sustainability. Consequently, road transport contributes the vast majority of

emissions from the transport sector in Ireland, accounting for 96% of the sector's CO_2 emissions for 2004.

The transport sector in Ireland is in a period of large-scale development and investment. Unprecedented levels of investment in transport infrastructure are being made which will significantly enhance conditions for the efficient movement of people and goods throughout Ireland and to destinations abroad. The Department of Transport has a major part to play in providing a supportive framework to the industry through its policy making and regulatory functions in the areas of air travel, airports, haulage transport and passenger transport, and through its role as shareholder in the commercial state transport companies.

1.8 Agricultural Profile

The land area of Ireland is almost 6.9 million hectares, of which 4.3 million hectares is used for agriculture or about 62% of total land area, and 709,262 hectares for forestry or about 10.3% of total land area. Some 79% of the agricultural land is devoted to grass (silage, hay and pasture), 11% to rough grazing (0.5 million hectares) and 10% to crop production (0.4 million hectares). Beef and milk production currently account for 55.2% of agricultural output at producer prices. The average farm size is now around 32.3 hectares. Primary agriculture accounts for some 2.7% of GDP, 5.7% of employment and 5.2% of exports[2]. Ireland's livestock numbers in December 2005 included 6.19 million cattle, 4.26 million sheep, and 1.68 million pigs.

1.9 Forestry Profile

Ireland will continue to increase its level of afforestation under the National Development Plan and its forest strategy *Growing for the Future* up to the end of the decade and beyond. Since 1990, some 244,000 hectares have been afforested, with deforestation of approximately 1,500 hectares (ha.) over the same period. Despite this rate of planting, however, Ireland remains one of the least forested countries in the EU. At the end of the year 2005, the national forest estate stood at 709,262 ha. This represents about 10.29% of the area of the country, compared to the 35% average throughout the other EU Member States.

Afforestation Programme

A long-term forestry strategic plan provides for 20,000 hectares of new afforestation per annum up to 2030. If achieved these proposals will increase forest area to 860,000 hectares by 2010 and to over 1.2 million hectares by 2030, almost doubling the area under forest in the State from approximately 9% to 17%. Afforestation rates in the period 2003-2005 averaged 9,644 ha. per annum. While conifers, mainly Sitka spruce, still represent a considerable part of the estate there has been a marked increase in the planting of broadleaves, including native species, between 1995 and 2000. By the end of 2005, broadleaf planting had risen to 29.73% of total afforestation.

The Irish wood harvest in 2004 was 2.5 million cubic metres, comprised in the main of conifers (97%) and predominantly Sitka spruce. The wood is used in wide range of products from structural sawnwood to fencing products, pallet products and panel products including

[2] 8.6% of GDP, 8.5% of employment and 8.5% of exports if agri-food sector is included – this covers agriculture, food, drinks and tobacco.

OSB (oriented strand board) MDF and door panels. COFORD, the National Council for Forest Research and Development, has recently forecast a potential doubling of wood production to 5 million cubic metres per annum by 2015. There is also close liaison between the Forest Service and environmental and planning agencies on forest development, especially in the area of forest establishment.

Carbon Sequestration

The Irish afforestation programme will play an important role in carbon sequestration during the first and any subsequent Kyoto carbon reporting periods. While the National Climate Change Strategy (NCCS) envisaged that sequestration as result of Article 3.3 would account for a total of 1.0 Mt CO_2 per annum between 2008 and 2012, it is now forecast that, with the levels of afforestation that have occurred since 1990, the average rate of sequestration in qualifying forests over the Kyoto first commitment period will be 2.074 Mt CO_2 per annum. This revised forecast is based on approaches and methodologies for accounting of sequestration agreed to by Kyoto Protocol parties, particularly in the Marrakech Accords, the Good Practice Guidance of the Intergovernmental Panel on Climate Change, and on research and modelling of carbon sequestration in Irish forests undertaken by COFORD, the National Council for Forest Research and Development. Current afforestation will have little effect on levels of sequestration during the first commitment period, as forests grow relatively slowly as they establish themselves over the first five years or so. However, in the period after 2012, they will make a substantial contribution to climate change mitigation.

The total carbon stock in forest biomass (excluding soil carbon) is estimated to be circa 18 million tonnes for the year 2000, with an annual storage of 0.9 million tonnes before harvest and 0.28 million tonnes after harvest. Forest soils represent a very significant carbon pool; current estimates are that the pool is in the region of 300 million tonnes of carbon.

1.10 Waste Management Profile

Ireland, as with other European countries, continues to show a steady increase in waste production in line with economic growth. Municipal solid waste arisings have doubled over the past fourteen years, and the bulk of this waste is being consigned to landfill. The most recent figures available in the EPA's *National Waste Report 2004* indicate that more than 67% of municipal waste was sent to landfill in 2004.

The foundation for a modern waste management culture in Ireland was laid down in the 1996 Waste Management Act. This was followed in 1998 by the Policy Statement *Changing Our Ways*, which provided a national policy framework for the adoption and implementation of local and regional waste management plans. *Changing Our Ways* set down broad, ambitious national objectives and targets over a 15-year timescale. While successes have been recorded in some areas, such as recovery of packaging waste and farm plastics, considerable progress remains to be achieved in the areas of waste prevention, minimisation and recycling. The Policy Statement *Preventing and Recycling Waste: Delivering Change,* was published by the Government in March 2002 in recognition of the need to accelerate and drive change in a more systematic manner.

2. GREENHOUSE GAS INVENTORY INFORMATION

2.1 Introduction.

The national greenhouse gas inventory is compiled by the Environmental Protection Agency (EPA) using the guidelines of the Intergovernmental Panel on Climate Change (IPCC). The inventory is compiled on an annual basis and submitted by year-end in draft form to the European Commission to facilitate EU reporting, and in final form to the Secretariat by the April 15th deadline. The 2006 National Inventory Report (NIR) which contains the inventory data in the Common Reporting Format (CRF) along with full documentation of the assumptions underpinning the inventory has been submitted to the UNFCCC secretariat for the years 1990 to 2004.

The complete inventory currently comprises a time series from 1990 to 2004 for carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O) and for the fluorinated or F-gases (HFCs, PFCs, and SF_6) – the year 1995 has been chosen as the base year for the fluorinated gases for obligations under the Kyoto Protocol. Summary tables showing emissions by gases and sector for the full time series are presented in Annex 1.

A schematic diagram setting out the national institutional arrangements for the compilation of the inventory is contained in Annex 2.

2.2 General Summary.

In recent years, emissions have fallen from a peak of 26.9% above 1990 levels in 2001 to 23.1% above 1990 levels in 2004, mainly due to:

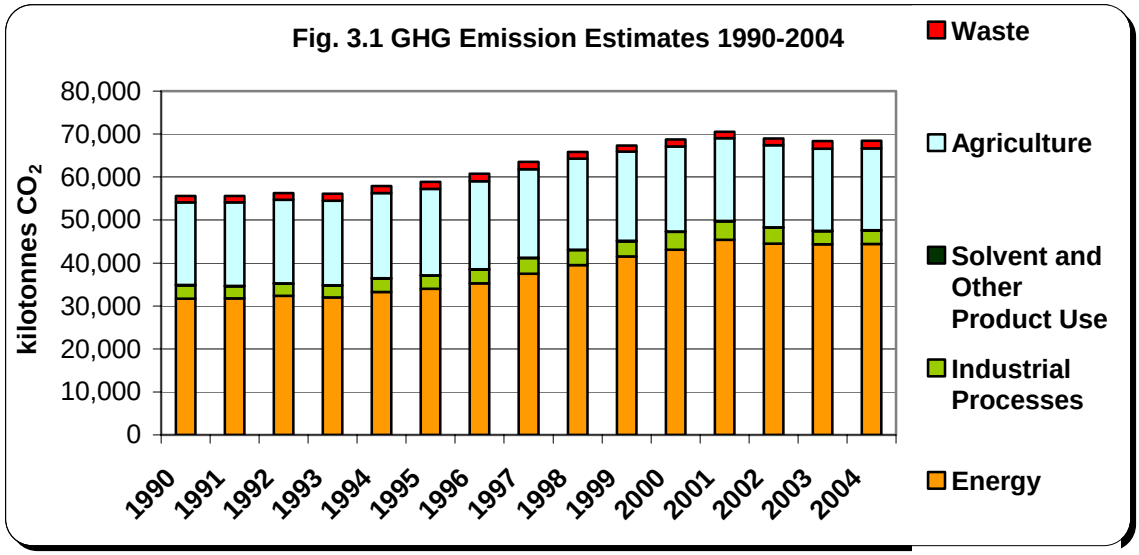
- increasing use of natural gas in the power generation sector;
- the closure of ammonia and nitric acid production plants in 2002; and,
- reduction in the size of the national livestock herd.

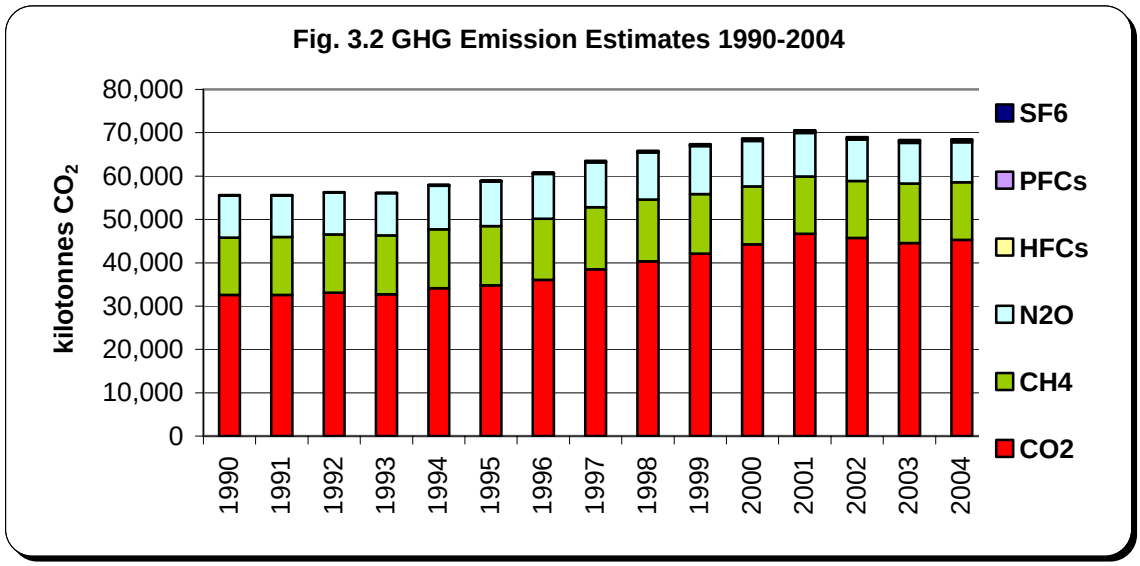
Total emissions of the six greenhouse gases in Ireland (excluding net CO_2 from Land Use Change and Forestry) increased steadily from 55.614 million tonnes CO_2-equivalent in 1990 to 70.55 million tonnes CO_2-equivalent in 2001 and then decreased slightly to 68.46 million tonnes CO_2-equivalent in 2004. Total emissions in 2004 were 23.1 percent higher than in 1990 and three percent lower than the peak level of 2001. The estimated total for 2004 is 100 kilotonnes CO_2-equivalent higher than that for 2003.

In 2004, the Energy sector accounted for 64.9 percent of total emissions. Agriculture contributed 27.7 percent while a further 4.6 percent emanated from Industrial Processes and 2.7 percent was due to Waste. Emissions of CO_2 accounted for 66 percent of the total of 68.46 million tonnes CO_2 equivalent in 2004, with CH_4 and N_2O contributing 19.4 percent and 13.5 percent, respectively. The combined emissions of HFC, PFC and SF_6 accounted for approximately 1 percent of total emissions in 2004. The Energy and Industrial Processes sectors account for the bulk of the CO_2 emissions, CH_4 emissions are produced mainly in the Agriculture and Waste sectors and most of the N_2O emissions are generated in Agriculture.

The large increase in emissions during the period 1990-2001 was clearly driven by the growth in CO_2 emissions from energy use. The increase in CO_2 amounted to 43% over these 12

years. The bulk of this increase occurred in the years between 1995 and 2000, during which Ireland experienced a period of unprecedented economic growth and emissions grew by around 3 percent annually. The rate of economic growth slowed down from 2000 to 2004, which together with the closure of some major industrial plants and continued decline in cattle populations and fertilizer use, resulted in some reduction in the emission levels in 2002 and 2003.





2.3 Carbon Dioxide CO_2.

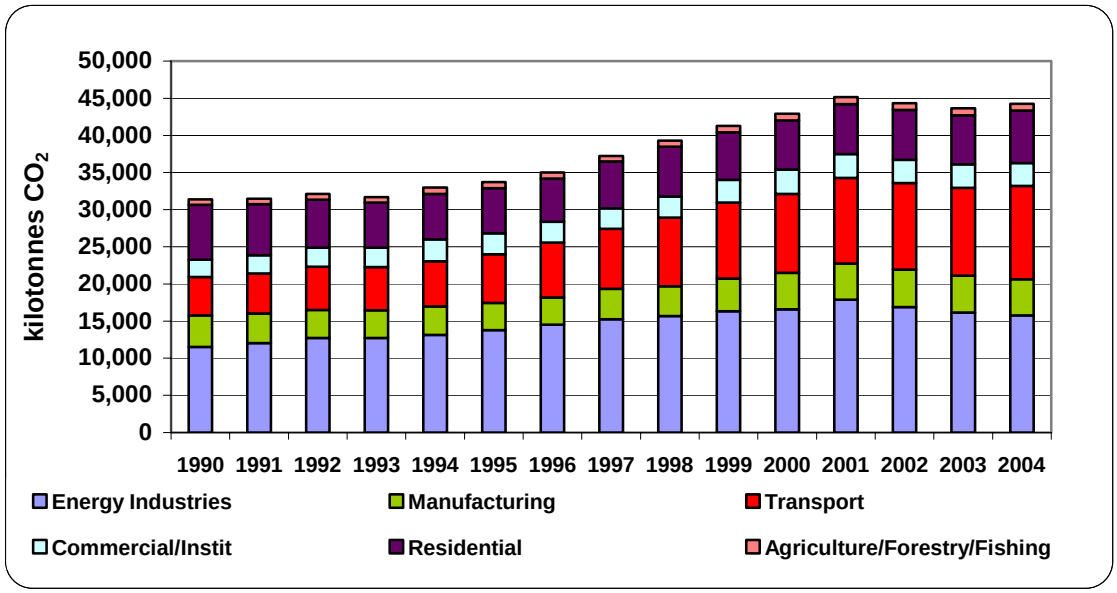
Emissions of CO_2 accounted for 65% of the total 68.46 million tonnes CO_2-equivalent in 2004, with 94% of this from the energy sector and the remainder coming largely from industrial processes. The largest increases in CO_2 emissions have taken place in energy industries and in the transport sector.

There continues to be heavy reliance on carbon intensive fuel for electricity generation and as electricity demand increased steadily during the 1990s, the associated CO_2 emissions from

energy industries increased by 55% between 1990-2001. Some gains were achieved from energy efficiency and fuel switching as some new electricity producers entered the market in 2002 and 2003, with the result that CO_2 emissions from energy industries reduced in 2004, which is approximately 25 percent higher than in 1990.

The increase in CO_2 from transport sources was 144 percent between 1990 and 2004, which was largely accounted for by road traffic due to sustained growth in vehicle numbers and road travel. This trend is exaggerated by the phenomenon of 'fuel tourism' whereby a significant proportion of automotive fuel purchased in Ireland is consumed by vehicles in Northern Ireland and Britain due of favourable retail prices in Ireland. The proportion of apparent national consumption which results from 'fuel tourism' was estimated to be approximately 12 percent for petrol in 2000-2004 and averaged 25 percent in the case of diesel in the same period. The apparent increase in transport emissions between the 1990 base year and 2001 is exaggerated further by the fact that 'fuel tourism' occurred in the opposite direction in 1990 and there was significant cross-border movement of automotive fuels into Ireland as a result of Irish fuel prices being higher then than in Northern Ireland.

Fig. 3.4 CO_2 Emissions from Fuel Combustion



Ireland has only a small number of energy intensive industries. Nevertheless, CO_2 emissions in the industrial sector grew by approximately 20% between 1990 and 2004.

In the residential sector, while total energy consumption (including electricity consumption) has been increasing, direct emissions, which excluded electricity consumption, have fallen by 10% between 1990 and 2004. This fall is a result of shifting fuel consumption from solid fuel towards cleaner fuels such as natural gas, as well as the adoption of strengthened energy efficient standards for new buildings.

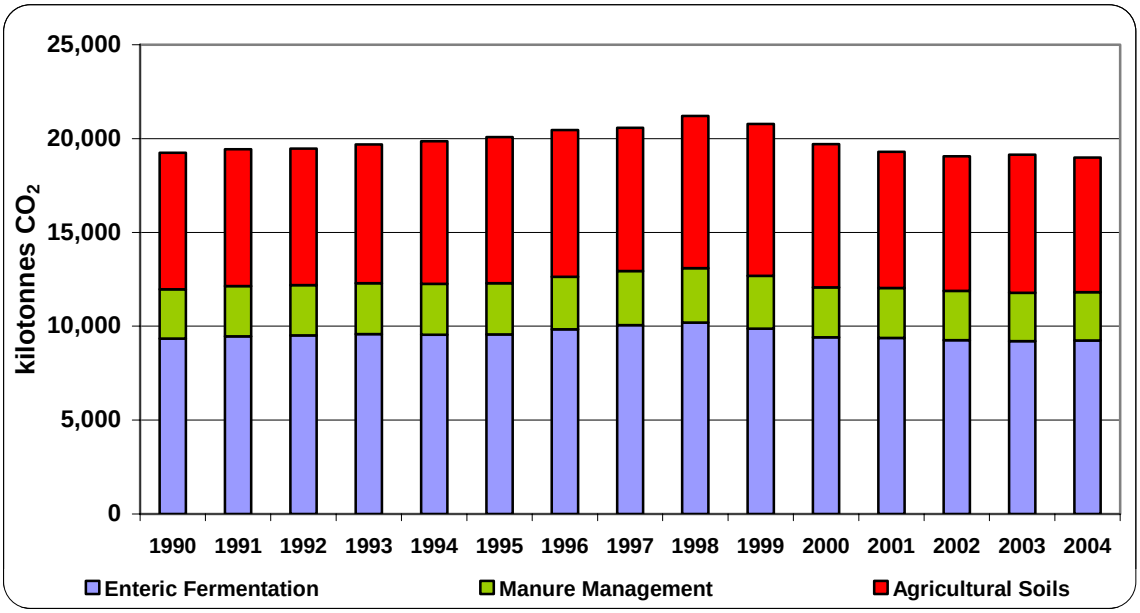
2.4 Methane (CH_4).

Emissions of CH_4 accounted for 19% of the total 68.46 million tonnes CO_2-equivalent in 2004, with 86% of this from the agriculture sector and a further 13% from waste disposal and the remainder from the energy sector.

Large livestock populations produce about 0.55m tonnes of CH_4 annually through enteric fermentation and manure management. Methane emissions from agriculture have shown a small decrease between 1990 and 2004. However, it is likely there will be reduction from this source category as herd numbers fall following the Irish Government's decision to fully decouple farm payments after 1999. Total emissions from agriculture show a slight downturn after 1999, reflecting a decrease in cattle populations and some reduction in fertiliser use.

The waste sector is an important source of CH_4 emissions, the contribution of which is increasing steadily due to the continued dominance of landfill as a means of solid waste disposal in Ireland. The downward shift in the level of emissions after 1997 reflects the effect of landfill gas utilisation at a number of sites since 1997 and flaring since 2001 but nevertheless emissions in 2003 and 2004 had exceeded earlier levels.

Fig. 3.3 Emissions from Agriculture



2.5 Nitrous Oxide N_2O.

Emissions of N_2O accounted for 13.5% of the total 68.46 million tonnes CO_2-equivalent in 2004, with 82% of this from the agriculture sector (of which 95% from agricultural soils) and a further 17% from the energy sector and the remainder from industrial process and the waste source categories.

The largest single agricultural 'crop' in Ireland is grassland to feed the national cattle herd and this is maintained by the sustained application of large amounts of chemical and organic nitrogen to soils which results in the emissions of approximately 25,000 tonnes N_20 per year. N_2O emissions from agriculture have shown a small increase between 1990 and 2004.

There has been a decrease in N_2O emissions from the chemical industry and this reflects the commissioning of a new technology plant for the production of nitric acid in the early 1990s. Emissions from transport, though a relatively small component of overall N_2O emissions, have increased significantly reflecting the increases penetration of vehicle fitted with catalytic converters between 1990 and 2004.

2.6 F-gases (HFC, PFC, and SF_6).

Emissions of the F-gases accounted for only 1% of the total 68.46 million tonnes CO_2-equivalent in 2004, with 60% of these emissions from HFCs, 30% from PFCs and 10% from SF_6. There has been an almost nine fold increase in emissions of HFCs between 1995 and 2004, the largest single use of which is HFC 134a for refrigeration and air conditioning. Over the same period, PFC emissions have increased by almost a factor of about two and one half, driven by the growth in semi-conductor manufacture. However, emissions of SF_6 have declined by over 15% over the period 1995-2004. Despite increases in the F-gases overall between 1995 and 2004, they still only account for 1% of overall emissions.

3. POLICIES AND MEASURES

3.1 CLIMATE CHANGE STRATEGY

Since the Third National Communication was published, the policy context for the principal greenhouse gas emitting sectors has continued to evolve. New policies and measures have been introduced, some of which were envisaged by the 2000 National Climate Change Strategy, while others derive from measures agreed at European Union level.

Other proposals in the Strategy have not been implemented in light of further analysis as to their suitability in an Irish context. The Climate Change Strategy is currently undergoing a review, with the objective of updating its provisions to reflect the current policy context, and to clearly identify Ireland's pathway to Kyoto compliance.

Table 1 – Annual Reduction of Adopted Measures on Full Implementation

Measure	Average annual Reduction 2008-2012
CAP Reform – full decoupling	2.40
Afforestation	2.08
RES-E Directive[3]	1.30
Landfill Gas power generation or flaring	0.70
EU/ carmakers voluntary agreement	0.48
Building Regulations Part L & EPBD[4]	0.30
Dublin traffic measures (e.g. Port Tunnel)	0.27
Biofuel excise relief	0.25
Implementation of Landfill Directive	0.06
Modernisation of natural gas network	0.06
Motor taxation / fuel labelling	0.05
Total	**7.95**

Table 1 sets out the contribution of significant policies and measures implemented by end-2005/early-2006. The estimates of emissions reductions from these measures are based on revised projections of greenhouse gas emissions to 2012 across all sectors included in the National Climate Change Strategy, which were completed in March 2006 and are published in 'Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012', by ICF Consulting & Byrne Ó Cléirigh. A more detailed description of

[3] Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, which requires Ireland to generate 13.2% of its electricity from renewable sources by 2012.
[4] Directive 2002/91/EC on the energy performance of buildings

sector specific policies and measures, and their impact on overall emissions are outlined in Chapter 3.3.

3.2 CROSS-SECTORAL MEASURES

Cross-sectoral measures will be used to provide an across-the-board incentive for a wide range of actions to reduce emissions. The Kyoto target cannot be met by actions in one, or indeed in a limited number of sectors; action is required to be taken across all sectors. Economic instruments comprise a variety of measures, which use market processes to achieve objectives. These include measures to change prices of goods or services, and the development of markets (in carbon or greenhouse gas emissions) where they do not currently exist.

3.2.1 Emissions Trading In Ireland

A significant contribution to the achievement of Ireland's Kyoto target will be made by firms from the energy and industry sectors that are covered by the EU Emissions Trading Scheme (ETS). Collectively these firms account for some 33% of Ireland's total greenhouse gas emissions. A three-year pilot phase of the scheme commenced in 2005. The first full period of emissions trading will begin in 2008 and will operate over the duration of the Kyoto commitment period from 2008 – 2012.

Under the Scheme, responsibility for a portion of each EU Member State's national emissions reduction targets is placed on individual emitters of greenhouse gases, primarily large industrial and power generation facilities. The Scheme provides an incentive for individual installations to reduce their emissions through having the amount of carbon dioxide they can emit capped. Installations that succeed in reducing their emissions below the capped level can sell surplus allowances. For some, it may be more cost-effective to purchase allowances arising from emissions reductions by other firms than to reduce their own emissions. The key rationale behind emissions trading, therefore, is to achieve emissions reductions at least cost through a market mechanism.

Since November 2005, firms in the ETS have been able to purchase credits, with some exceptions, from the Kyoto Protocol's project-based mechanisms – Joint Implementation (JI) and the Clean Development Mechanism (CDM) - to provide a cost-effective way of achieving compliance with their target under the scheme. As well as being able to purchase credits, firms can now invest in projects to reduce emissions inside or outside the EU through JI or CDM and convert the credits they earn from those projects into allowances that can be used for compliance under the EU scheme. Only credits earned from CDM projects can be used for compliance during the first trading period (2005-2007). Credits from both JI and CDM projects may be used by firms in the Scheme once the Kyoto commitment period commences in 2008.

In 2006, the Government set directions for the next period (2008-2012) of the EU Emissions Trading Scheme and a National Allocation Plan for this period was prepared by the Environmental Protection Agency and submitted to the European Commission.

3.2.2 Government use of the Kyoto Protocol Flexible Mechanisms

The flexible mechanisms available under the Kyoto Protocol allow the Government to acquire allowances arising from emission reduction initiatives elsewhere in the world. The Government recognises that greenhouse gas emissions are not limited by national boundaries; the effect is global rather than local. A tonne of carbon dioxide released or reduced anywhere in the world will have the same effect on the climate system. The mechanisms included in the Kyoto Protocol are designed to ensure that a global problem can be addressed in a global manner. The Government will use this option as an element of its overall response to meeting its emissions target.

The National Treasury Management Agency (NTMA) has been designated as purchasing agent on behalf of the State and it is intended that the purchasing activities of the Agency will be underpinned by Exchequer funding provided through a National Carbon Fund.

The Government does not propose to stipulate the type of credit or allowance that the NTMA should purchase or to direct the NTMA to purchase credits from a particular type of project or particular host countries. It is envisaged, however, that the activities of the Agency in its role as the purchasing agent for the State will be directed by a number of guiding principles. The primary objective will be to provide for the timely purchase of sufficient carbon credits to allow Ireland to meet its target for the purposes of the Kyoto Protocol in the commitment period 2008-2012.

3.2.3 European Climate Change Programme

The European Climate Change Programme (ECCP) is the European Union's strategy to implement the Kyoto Protocol, complementing the efforts of Member States. Effective common and co-ordinated policies and measures under the ECCP, as well as being an important avenue for the EU to meet its overall commitment, are also an important element of Member States' strategies to achieve the required emission reductions. In October 2005, the European Commission launched a new phase of the ECCP, to explore further opportunities to exploit cost-effective emissions reduction options, building on existing initiatives, but also examining the potential contribution of carbon capture and storage, controlling emissions from aviation and an integrated approach to reducing CO_2 emissions from light vehicles.

3.2.4 Meeting Ireland's Kyoto Commitments

Even with existing policies and measures already implemented or expected to be implemented up to 2012, projections show that Ireland will continue to face an average annual shortfall in its Kyoto target of some 7.174 million tonnes of CO_2-equivalent in the 2008-2012 period. In summary, this shortfall (which is referred to as the distance to target) is capable of being met through:

- further measures to be decided on by the Government, over and above those in Table 1,
- emissions reductions, or purchase of carbon allowances in lieu of reductions, by installations participating in the EU Emissions Trading Scheme; and
- use of the Kyoto Protocol flexible mechanisms by Government to purchase carbon allowances.

In March 2006, the Government decided on the proportion of Ireland's distance to target that will be borne by participants in the EU Emissions Trading Scheme. This decision was required so that the National Allocation Plan (the distribution of emission allowances among the participants) could be finalised by the mid-year deadline for submission to the European Commission. As shown in Table 2 below, this sector will be responsible for 3.02 million tonnes per annum of the national distance to target, through a combination of internal emissions reductions or the purchase of allowances.

The Table shows that the balance of the distance to target, i.e. 4.154 million tonnes per annum, is to be addressed across the whole economy. Any emission-reducing measures that are adopted over and above those set out in Table 1, will count under this heading. Whatever balance remains will be met by Government purchases of carbon credits. The flexible mechanisms of the Kyoto Protocol enable Governments to make rational economic choices between domestic emission reductions or purchases of credits for reductions elsewhere in the world.

Table 2: Approach to meeting Ireland's Kyoto Protocol target

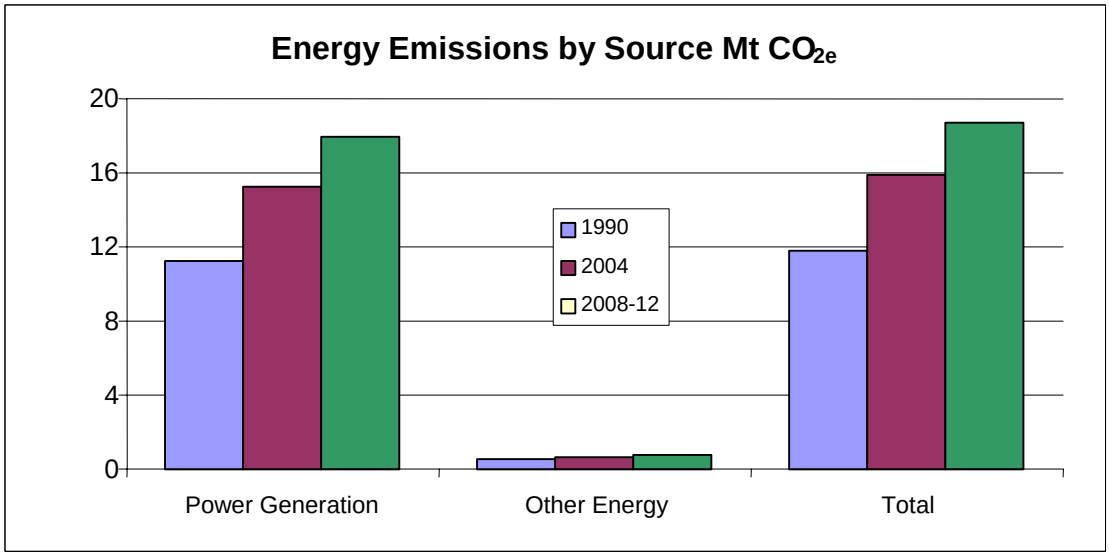
Million tonnes per annum	***Emissions Trading Sector***	***Rest of Economy***	***TOTAL***
Average annual emissions 2008-2012 without any action	*25.658*	*44.548*	*70.206*
Share of reduction	*3.020*	*4.540*	*7.174*
Target	*22.638*	*40.394*	*63.032*

3.3 SECTOR SPECIFIC MEASURES

3.3.1 ENERGY SECTOR

Emissions from this sector arise from electricity generation, oil refining, gas production and distribution and solid fuel production. Of these, electricity generation accounted for 96% of total emissions from the sector in 2004, with CO_2 from power generation making up 93% of total energy sector emissions. Electricity demand and therefore emissions have risen rapidly in line with economic growth since 1990, with total emissions for the energy sector increasing by 35% between 1990 and 2004. Based on latest available projections, greenhouse gas emissions from the sector are forecast to increase from 11.81 Mt CO_2-equivalent (CO_2e) in 1990 to an average of 18.75Mt CO_2e during the period 2008 – 2012. While these projections include all adopted and implemented policies, including national targets for the contribution of renewables to electricity supply, the effect of the Emissions Trading Scheme is not included in these projections.

Figure 1: Energy Emissions in Ireland 1990 – 2008/2012

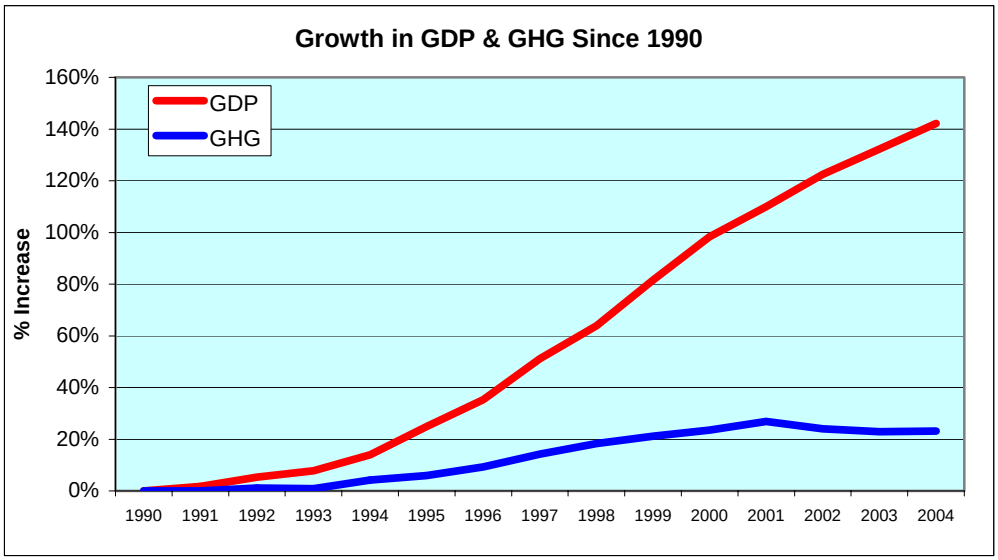


CO_2 Intensity of Electricity

Despite the increased electricity demand over the period since 1990, in recent years there has been a degree of decoupling between electricity production and emissions growth, due to the increased contribution of high efficiency electricity generation such as natural gas powered plants and of renewables to electricity generation.

According to the SEI report *Energy in Ireland 1990*-2004, the downward trend in the CO_2 intensity continued in 2004 arising from the closure of the older, less efficient, Shannonbridge and Lanesboro peat-fired power plants and the increased contribution of wind to electricity generation. A 21% increase in the renewables contribution to electricity generation between 2003-2004, which brought its overall share to 5.2%, was primarily due to the new connections of wind farms to the national grid.

Figure 2.5: Relationship between Economic Growth and GHG Emissions



The carbon intensity of electricity has therefore fallen (particularly since 1994) from 925g CO_2/kWh in 1990 to 624g CO_2/kWh in 2004, reflecting the increase in the efficiency of electricity supply. Figure 2 illustrates the broad decoupling achieved between economic activity and greenhouse gas emissions.

3.3.1.1 Fuel switching

This includes a broad set of measures aimed at using less carbon intensive fuels throughout the economy including power generation, such as substituting for coal, peat and oil; expansion of combined heat and power and renewables; and expansion of the gas supply network. Emissions from the energy sector are influenced by the Government's policy of ensuring fuel security in electricity generation through fuel diversity. This has led the Government to decide to continue coal-fired electricity generation at Moneypoint and to approve the commissioning of three new peat-fired power plants supported by a Public Service Obligation (PSO) levy. The replacement of the last of the remaining older peat-fired power stations with three new peat power stations by December 2005 provided about 350Mw of generating capacity. While peat burning contributes about 10% of greenhouse gas emissions arising from electricity generation, the existence of new plant means that peat is currently being burned in the most efficient way possible.

3.3.1.2 Emissions Trading Scheme

All fossil fuel based electricity generation plants in Ireland are included in the EU Emissions Trading Scheme. When the industry sectors covered by the scheme are included, it will address approximately 3Mt CO_2 of Ireland's overall distance to its target for the purposes of the Kyoto Protocol during the 2008-2012 period. The Scheme provides flexibility to firms in meeting the caps placed on individual installations. If internal emission reductions are not cost-effective, firms may meet their obligations through the purchase of allowances that become available due to reduced emissions by other firms in the Scheme or allowances arising from the Kyoto Protocol's project-based mechanisms.

3.3.1.3 Gas production and distribution

The gas transmission network has continued to expand in Ireland with the completion of the Dublin-Galway-Limerick ring-main pipeline and a second interconnector with the United Kingdom. The pipeline from Belfast to Derry, serving the Coolkeeragh power plant and five towns along the route has also been completed. The Dublin-Belfast pipeline, which will also serve five towns in Northern Ireland en route, was under construction during 2004-2006. The Mayo-Galway pipeline, from the Bellinaboy Corrib Gas terminal in North Mayo to the gas network at Galway, is also planned.

Approximately 90% of the Bord Gáis Éireann distribution network comprises new polyethylene pipe. The network now extends to 9,316 kilometres, compared with the 3,000 kilometres when BGÉ took over from the former town gas companies.

Fugitive emissions from the network are expected to fall despite continued expansion of the network, due to the replacement of older cast-iron piping on the network. Total fugitive emissions are projected to be 0.046Mt of CO_2e by 2009 compared with 0.103 Mt in 2001.

The commencement of production in the Corrib gas field will increase the level of indigenous gas supplies, making a positive contribution to Ireland's security of supply. Emissions of 0.04 Mt CO_2e per annum in the period 2008-2012 are attributable to production at Corrib.

3.3.1.4 Renewable Energy

Ireland is required to ensure that 13.2% of gross national electricity consumption comes from renewable sources by 2010. Achieving this target will play an important role in Ireland's pathway to Kyoto compliance, although this contribution must be viewed in the context of continued growth in the overall demand for electricity over the Kyoto commitment period. When achieved, the target will represent about 1450Mw of installed capacity, of which 846Mw is currently in place, including 574 Mw of wind capacity, and a further 630Mw with grid connection agreements. The Government's decision in 2006 to move to a new Renewable Energy Feed in Tariff (REFIT), which replaces the previous competitive tendering programme, will help to stimulate further development of the renewables market, not just for wind energy, but for a range of other technologies, including biomass and biomass-powered CHP. This new support structure complements initiatives such as the new grid code connection conditions and enhanced technical grid control to accommodate the increased number of wind-generated electricity suppliers on the system. This support structure will be also complemented, for wind energy, by the publication of Wind Energy Development Guidelines, due in mid-2006. The Guidelines will provide a context within which planning authorities may consider the development of wind energy projects through the development plan process on a consistent basis throughout the country. Building on Ireland's existing EU target, the Government intends to set a new national target of 15% by 2010 and to build upon this with more ambitious targets for 2020.

The development of an all-island electricity market will result in increased interconnection between the two jurisdictions, which will provide a stronger, larger grid to accommodate renewable energy development. As part of the development of an all-island electricity market, the relevant Ministers jointly published a 2020 Vision for Renewable Energy consultation paper in 2005 to inform the development an all-island renewable energy market. Separately, an all-island Grid Study is examining the system and economic effects of renewable electricity levels between 15% and 30% on an all island basis for 2020.

3.3.1.5 Wave / Ocean Energy

The Government plans to launch an Ocean Energy Development Strategy, to be led by Sustainable Energy Ireland and the Marine Institute, to promote the development of an ocean energy strategy in Ireland, including support for initial research and development through to full commercial application. The first phase of the strategy was the deployment of a scale model testing device at a test site at An Spidéil, County Galway. The ocean energy resource available to Ireland indicates a potential to supply 100% and 6% of the forecasted all-Ireland electricity demand from wave and tidal energy sources respectively. While it is not yet known how much of this could be exploited economically, it is estimated that some 84 MW of installed capacity could exist by 2020, displacing some 90,000 tonnes of CO_2.

3.3.1.6 Co-Firing in Power Generation

Co-firing at power stations has the potential to reduce CO_2 emissions from fossil fuel generation. Alternative fuels, such as biomass or meat and bone meal, result in less CO_2 emissions and, unlike fossil fuels, are renewable energy resources. It has been estimated that co-firing the three peat-burning stations with 24% wood biomass could reduce emissions by up to 500,000 tonnes per annum. A technical feasibility trial conducted in 2003 successfully burned wood biomass with peat at concentrations up to 32%, with no negative impact on boiler efficiency. As well as reduced CO_2 emissions, co-firing with biomass would also have a positive environmental impact in reducing emissions of the air pollutants sulphur dioxide (SOx) and nitrogen oxides (NOx).

3.3.1.7 Combined Heat and Power

There is currently 282Mw of installed Combined Heat and Power (CHP) capacity in Ireland. As a proportion of national electricity consumption, Ireland has one of the lowest rates of CHP deployment in the EU. In the absence of additional support to assist CHP penetration, capacity would be expected to continue to grow slowly and perhaps even contract, due to a range of factors including unfavourable fuel prices, high connection charges and investment uncertainty. Recognising this problem, the Government announced an €11 million scheme to promote the deployment of CHP in the industrial, commercial and public services sector, including CHP from both fossil-fuel and sources such as biomass. The programme will provide capital grant support for the installation of CHP units and metering technologies, and is designed to encourage fossil fuel-fed CHP up to 1 Mw in size and any size biomass fed CHP. It is intended that this scheme will be the primary instrument for promoting the development of CHP. Separate initiatives to promote more widespread deployment of CHP include an examination by the Commission for Energy Regulation of potential physical and regulatory barriers to becoming a CHP generator and work by SEI on a substantial information campaign on the benefits of CHP.

3.3.1.8 Efficiency of Electricity Supply

The efficiency of electricity supply is a measure of the amount of fuel inputs required to provide a unit of electricity for final consumption. In Ireland, electricity supply efficiency is at 41% (2005), meaning that 59% of the potential energy contribution from fuel input at the generation stage is lost. While a small proportion of this is as a result of the generating plants' own use, the majority of the energy potential is lost through transmission losses and electricity transformation. There has been a sharp increase in electricity generation efficiency since 2001, with a rise from 35% to 41% due to the replacement of older generating plant with more-efficient gas and peat plants, and the increasing contribution of renewables to electricity generation. Further efficiencies can be expected in the future as additional high efficiency gas-fired power plants come on line and continue to displace less efficient generating capacity. Three new plants in total are either planned or under construction. While some of this new capacity will meet forecasted increased demand for electricity, it will contribute greater overall efficiency in electricity generation.

3.3.1.9 Transmission and Distribution Losses

The remainder of losses in energy potential arising from electricity generation result from transmission and distribution losses. Transmission losses are incurred on the transmission

system as electricity is transported from generators across the electricity grid. The cost of transmission losses acts as an incentive for generators to locate where losses are low; transmission losses are paid for by the generators, based on estimated losses and on their location on the grid. This system therefore benefits distributed generation such as windfarms, which are located nearer to the electricity end user.

Due to the intermittent nature of wind power, however, there will continue to be a need to have power available to travel on the transmission lines into those areas when the wind is not blowing consistently so there is still a need for high voltage power lines, which enable large quantities of energy to be transported in bulk while minimising losses. In order to actively manage the level of losses on the transmission system, the Transmission System Operator has a preference for 220KV lines and operates the power system within all international standards. Where possible, the system utilises voltages at the upper band of those standards. Losses as a percentage of electricity distributed are forecast to reduce from current levels due to the planned changeover of rural medium voltage networks to 20kV operation, which will increase from just over 20% of the medium voltage network at present to around 70% by 2010. This is projected to result in savings of 132 GWh at the generation stage.

3.3.1.10 Demand Side Management

The establishment of Sustainable Energy Ireland (SEI) in 2002 means there is now a dedicated body to promote and assist environmentally and economically sustainable production, supply and use of energy across all sectors of the economy. SEI programmes include the Large Industry Energy Network (LIEN), a voluntary networking initiative of 85 of the largest commercial energy users in Ireland; the Energy Agreements Programme, which assists companies achieve certification to the Irish Standard on Energy Management; and the Public Sector Investment Programme.

3.3.1.11 Promotion of Efficient Energy Use by Energy Suppliers

The EU Directive on energy efficiency in end-use and energy services requires energy suppliers to offer electricity and other energy supplies to end-use consumers as part of a comprehensive package of energy services. The Directive includes targets to improve energy efficiency by 1% per annum from 2008. Measures covered by the directive include management of customer demand for electricity for inter alia, appliances and space and water heating, and promotion of lower consumption at peak times. With appropriate pricing, the Directive proposes that electricity consumers would be encouraged to reduce their energy consumption over time and the energy suppliers would also be incentivised to promote reduced energy consumption among their customers through competition between energy suppliers. Such a framework may also be extended through a system of tradable ‘white certificates’ issued for a given quantity of energy saved.

3.3.1.12 Electricity Supply Board (ESB) Customer Supply Energy Efficiency Programmes

ESB Customer Supply has been directly engaged in promoting the benefits of greater energy efficiency to its customer since 1991. It is estimated that between 1991 and 2005, the cumulative saving in direct costs to business, industry and residential customers (lifetime savings) has been in the region of 6,300 GWh. The Winter Peak Demand Reduction Scheme

(WPDRS) was introduced from Winter 2003/04 as an incentive to business customers to reduce electricity consumption during the power system's peak hours (5pm - 7pm) in winter months (November - February). The Scheme provides incentives for customers to reduce their electricity consumption and to establish stable patterns of energy consumption. The level of incentive increases with the amount of energy saved.

3.3.1.13 Regulation Targets

As part of the energy industry restructuring, the Commission for Energy Regulation sets measurable targets for ESB Customer Supply to achieve energy efficiency gains in end-use of electricity. These targets are agreed between ESB Customer Supply and CER at the beginning of each year and the performance against target is reported to CER at the end of each year. Residential targets are achieved through specific energy efficiency promotions, including promotional support for energy efficient products, targeted direct marketing and dedicated inserts with ESB Customer supply bills. Separate business targets are also agreed annually. In addition to the mechanisms geared towards residential customers, these targets are achieved through, inter alia, the provision of a range of energy management services for business customers.

3.3.1.14 Intelligent Energy Europe programme

The EU Intelligent Energy Europe (IEE) Programme is aimed at tackling mainly non-technological barriers to the market uptake of energy efficiency, renewable energy and more sustainable transport measures. It covers three thematic areas: energy efficiency (SAVE); renewable energy sources (ALTENER); and energy aspects of transport (STEER). Irish projects have received part funding for projects in all three fields, in partnership with organisations in other eligible Member States. Among the organisations which have received support is the Tipperary Energy Agency, for its projects to develop a standardised energy check for use by Small to Medium size Enterprises (SMEs) for quick identification of potential savings in energy use, and to develop a framework for encouraging the growth of markets for bio-fuels as a low carbon fuel for local authorities and other public sector transport fleets across the EU.

3.3.2 TRANSPORT SECTOR

The National Climate Change Strategy (2000) envisaged that greenhouse gas emissions in the transport sector would increase further both in absolute terms and as a proportion of total greenhouse gas emissions. Since 1990, the transport sector has been the fastest growing contributor to national greenhouse gas emission levels, with a growth rate of over 144% between 1990 and 2004. Transport is the third largest contributor to national greenhouse gas emissions, accounting for 18.4% of the total emissions in 2004.

Road transport contributes the vast majority of emissions from the transport sector in Ireland, accounting for 96% of the 12.58 Mt of CO_2e released in 2004. Smaller quantities of emissions arise from rail, domestic marine, domestic civil aviation and natural gas transmission.

The growth in transport emissions has primarily been caused by increased fuel consumption in the road transport sector. This can be attributed to a number of interlinking factors

associated with Ireland's significant economic growth in recent years, including growing population, increased demand for housing leading to urban sprawl, increased commuting, larger air passenger numbers through our airports and increased freight movements. More people are travelling more often, and there are more vehicles on our roads. People are buying larger private vehicles as disposable income increases, which is offsetting technological fuel efficiency improvements. Emissions in 2004 increased by 6.1% on the previous year, reflecting continuing growth in road traffic. The number of vehicles on our roads grew by 21% between 2000 and 2004 alone. The number of private cars increased by almost 20% in that period, with the number of goods vehicles increasing by over 30%. This upward trend in the national vehicle fleet, which is related to the link between transport demand and economic growth, is expected to continue: Irish car ownership levels, at 397 per 1000 population in 2004, are below the EU-15 average of 495 cars per 1000 (in 2003). Without any further measures to tackle emissions from transport, emissions are projected to continue to increase to an annual average of 13.03 Mt in the period 2008 – 2012.

The growth in emissions from the transport sector has been inflated by fuel bunkering, i.e. where fuel is bought by private motorists and hauliers within the State but consumed elsewhere, mostly in Northern Ireland and Britain. International reporting guidelines require that emissions be reported on the basis of domestic sales rather than domestic consumption. The Department of Environment, Heritage and Local Government estimates that in 2004 10% of petrol and 25% of diesel sold was consumed outside the State, equating to 2.2 Mt CO_2e of emissions. On this basis it is estimated that emissions from domestic consumption in road transport increased from 5.2 Mt CO_2e to 10.0 Mt CO_2e between 1990 and 2004, an increase of 92%.

The National Climate Change Strategy (2000) divided measures for the transport sector into three broad categories. These are:

- measures to improve the fuel efficiency of the fleet of private and commercial vehicles in Ireland, including the increased penetration of low carbon technologies;
- measures to influence behaviour to promote modal shift from private to public transport; and
- measures to maximise the efficiency of the existing and future transport network in Ireland.

3.3.2.1 Fuel Efficiency Measures

3.3.2.1.1 Technological Improvements

Improving the fuel efficiency of the passenger vehicle fleet is a key part of reducing emissions from the transport sector since private cars will remain an important means of personal mobility, particularly in rural and isolated areas. Technological advances within the automotive industry will be critically important in bringing more fuel efficient, novel and clean technologies to market. However, in the absence of an indigenous automotive industry, Ireland is a technology taker and has little ability to influence the development of cleaner vehicle technology on its own. Nevertheless, the Government recognises the key role of innovative technologies (such as alternative fuels and more fuel efficient engines) in reducing tail-pipe CO_2 and air pollutant emissions over the long term. In particular, the Government supports

the EU Voluntary Agreement between car manufacturers and the European Commission as a cost-effective and efficient means of increasing the fuel efficiency of passenger cars.

The EU strategy to reduce CO_2 emissions from passenger cars includes a commitment to reach - by 2010 at the latest - an average CO_2 emission figure of 120 g/km for all new passenger cars marketed in the Community. The EU is pursuing this target through, inter alia, voluntary agreements with car manufacturers; voluntary agreements were negotiated between the EU Commission and the European, Japanese and Korean car manufacturers to reduce CO_2 emissions to 140g/km by 2008-2009. The difference between the 140g/km target and the EU target of 120g/km is to be achieved by two other measures; the 1999 legislation on fuel economy labelling and fiscal measures. Major additional efforts are required to deliver the target of reducing CO_2 emissions to 140g/km by 2008–2009, to which the industry has committed itself.

Between 1995 and 2003, CO_2 emissions from new passenger vehicles are reported to have been reduced by on average of 12%. However, the contribution of technological improvements to reducing emissions from transport in Ireland has been lost due to a purchasing trend toward vehicles with larger engine sizes.

3.3.2.1.2 Fuel Economy Labelling

Since 2001, fuel economy and CO_2 information for new cars must be displayed in car salesrooms. This requirement enables consumers to make purchasing decisions informed by these particular environmental indicators. The Society of the Irish Motor Industry now publishes a Guide to Passenger Vehicles' Fuel Economy and CO_2 emissions, which contains fuel economy and CO_2 emissions information for all vehicles on sale in Ireland.

3.3.2.1.3 Alternative fuels

Alternative fuels such as biofuels offer the potential to reduce the environmental impact of the transport sector. In April 2005, the Government announced a scheme for the provision of excise relief on biofuels (which was extended in 2006). It is expected that the extended programme will result in Ireland achieving 2% market penetration of biofuels by 2008 and 5.75% by 2012 in accordance with the Biofuels Directive 2003/30/EC will bring about a reduction of over 0.5 Mt of CO_2e per annum post-2010. To complement this scheme, Transport 21 provides funding for pilot projects to make cleaner, more environmentally friendly vehicles available, embracing public transport, the haulage industry and taxis. These initiatives include pilot projects for biofuels and hybrid electric technologies. These pilot projects will be used to guide future policy development, particularly in relation to public transport investment.

3.3.2.1.4 Vehicle Registration Tax and Annual Motor Tax

Both Vehicle Registration Tax (VRT) and annual motor taxation for private vehicles are based on engine size, which is related to fuel consumption and CO_2 emissions. The National Climate Change Strategy proposed rebalancing VRT and motor tax so that they are more closely aligned to actual tailpipe CO_2 emissions. A 50% relief in VRT for hybrid-electric cars was introduced in 2001. This was augmented in the announcement of Budget 2006 with an extension of this relief to flexible fuel vehicles for a two-year period from January 2006. The

Government aims to introduce a rebalancing of VRT and motor tax to more closely reflect CO_2 emissions in January 2008, following public consultation in 2007.

3.3.2.1.5 National Car Test (NCT)

Car testing was introduced in Ireland in 2000 to improve road safety and environmental protection and to comply with EU legislation making car testing compulsory in all EU member states. The National Car Test (NCT) is conducted every two years on vehicles. This regular evaluation of cars is, inter alia, ensuring that vehicles are maintained and operated as fuel efficiently as possible. The number of cars to undergo a full NCT test has increased from 274,355 cars in 2000 to 624,619 cars in 2005. The nationwide first-time pass rate for full tests has averaged around 52%.

3.3.2.1.6 Fuel efficiency measures in public transport

Incorporating sustainability considerations into the day-to-day operations of Coras Iompar Éireann (CIÉ), the State-owned public transport operator, and its companies, is important in terms of improving performance and efficiency. The need to report on sustainability issues, and, in particular, on progress in testing the feasibility of alternative fuels such as biofuels, has been agreed between CIÉ and the Department of Transport.

A significant proportion of both the Dublin Bus and Bus Éireann fleets have been replaced in recent years as part of the public transport investment programme. This has delivered significant fuel efficiency gains by introducing newer and more fuel-efficient vehicles into the fleets.

Dublin Bus and Bus Éireann continuously review the use of alternative low-carbon fuels. Dublin Bus trialled the use of Liquid Petroleum Gas (LPG) and Compressed Natural Gas (CNG) fuelled buses in 1998 – 1999. It was concluded that it would not be commercially viable, because of the pricing structures and maintenance costs at the time, to proceed with these fuel options. However, both companies are currently piloting the use of biofuels in a number of buses in Dublin and Cork. The need to achieve reductions in greenhouse gas emissions and the increasing cost of fuel has led to a review by both companies of cleaner fuel alternatives. These pilot initiatives will complement the Transport 21 projects that aim to test the feasibility of a range of biofuels, hybrid-electric vehicles and eco-driving.

3.3.2.2 Modal Shift

3.3.2.2.1 Investment in and use of public transport

Significant investment in public transport under the National Development Plan (NDP) has already been made since the National Climate Change Strategy (2000) was published. This includes substantial investment in upgrading the public transport system and particularly in increasing the capacity of urban public transport. There has also been significant investment in improved traffic management, particularly bus priority measures. The current transport investment programme under the NDP, which is due to expire at the end of 2006, will be augmented by Transport 21, which provides for total capital funding of over €34 billion over the next ten years and represents a major rebalancing of investment in favour of public transport (about €16 billion of the total funding). This record level of investment in public

transport will provide choice and an alternative to the private car, particularly in the major urban areas, thereby encouraging a modal shift from the private car to less polluting and less energy-intensive forms of transport such as public transport.

Modelling of the impacts of Transport 21 in the Greater Dublin Area shows a reduction of almost 20% in fuel consumption and CO_2 emissions during rush-hour in 2016 compared to business as usual. This will be as a result of modal shift from private cars to public transport and includes the contribution of associated demand management measures. The reduction equates savings of around 0.016 Mt CO_2e per year from 2016 in the Greater Dublin Area. Emissions reductions nationally are estimated to be 0.51 Mt CO_2e.

3.3.2.2.2 Light Rail, DART and Suburban Rail

The two Luas light rail lines began operation in 2004. Luas carried almost 26 million passengers in 2006. A survey of Luas users, carried out in 2006 by the Rail Procurement Agency (RPA) and the Dublin Transportation Office (DTO) indicates that over 30% of those surveyed have switched from private modes of transport (e.g. cars, motorcycles and taxis).

The number of passengers carried by Iarnród Éireann (i.e. DART, Dublin outer suburban, the Cork-Cobh line and mainline services) increased by approximately 19% between 2000 and 2005.

Over the period of investment in Transport 21, Ireland's public transport system will be transformed with a particular emphasis on developing an integrated network. Public transport capacity will almost double in the Greater Dublin Area with seven new Luas (light-rail) projects, DART (suburban rail) extensions, two Metro lines and a significant expansion of the bus network.

More frequent intercity rail services will be introduced under Transport 21 providing services every hour on the Dublin-Cork route, every hour at peak on the Dublin-Galway and Dublin-Limerick routes and improved services on all other routes. The Western Rail Corridor will be re-opened from Ennis to Claremorris, enabling rail travel between the cities of Galway and Limerick. In parallel, the Rural Transport Initiative will be made permanent following the completion of the pilot period in 2006. Funding will be increased on a phased basis, with initially a doubling of the cash provision by 2007 compared with 2005.

3.3.2.2.3 Bus Services

Sustained investment has also taken place in the road transport network which has benefited and improved bus services. The total number of passengers (excluding school journeys) carried by Bus Éireann increased by approximately 20% between 2000 and 2005. Similarly, Dublin Bus increased the number of passengers (excluding school journeys) carried by almost 8% between 2000 and 2005.

Transport 21 will see a doubling of bus priority measures in the Greater Dublin Area (GDA) with a 60% increase in bus capacity. Significant capital funding for the purchase of a large number of new buses in the GDA will be provided. The cities of Cork, Galway, Limerick and Waterford will also benefit from funding for city bus services, a range of traffic management,

bus priority and car restraint measures, including Green Routes / Quality Bus Corridors (QBCs), Park and Ride facilities, cycle paths and improved pedestrian facilities.

3.3.2.2.4 Roads Investment

It is well recognised that vehicles forced to travel at reduced speeds will be less fuel efficient than may be optimally possible. A high quality road network reduces inefficiencies such as bottlenecks and congestion, thereby delivering positive benefits in terms of improved journey times, reduced environmental impacts and more efficient energy use. The quality of the roads infrastructure will therefore play an important role in moderating CO_2 emissions from road transport.

Exchequer investment in national roads was €7.8 billion over the period 1997-2005, with over €1.4 billion invested in 2005. By end-2005, a total of 84 projects have been completed. A further 22 projects are currently in construction with a significant number of other projects at various stages of planning

The national road network will be significantly upgraded over the next 10 years under Transport 21, removing bottlenecks, reducing congestion and improving journey times. The five major interurban motorways (linking Dublin with Belfast, Cork, Galway, Limerick and Waterford) will be completed by 2010. The Atlantic Road Corridor from Letterkenny through Sligo, Galway, Limerick, Cork and Waterford will be developed, connecting the Gateway cities identified in the National Spatial Strategy. The rest of the national primary network will also be upgraded. National secondary routes, which are particularly important for regional development, will also be improved. This upgrading of the national road network will substantially reduce journey times while at the same time increasing reliability. This will play an important role in improving the efficiency of the transport sector.

3.3.2.2.5 Cycling facilities

Almost €30m has been spent on provision of cycling facilities in the Greater Dublin Area over the period 1994 – 2005, which has delivered 220km of cycle lanes. Despite this, the number of people cycling to work and school has continued to fall - although less so where there has been most investment. Under Transport 21, support will continue for the cycling network and improved pedestrian facilities in cities such as Dublin, Cork, Galway, Limerick and Waterford, as mentioned above. However, a more integrated approach will be required changing the focus from investment in infrastructure alone to the development of more widely based strategies to encourage and facilitate increased walking and cycling as healthy and environmentally friendly options.

3.3.2.2.6 Freight

Road freight accounts for the bulk of Irish freight transport. Analysis of goods vehicles shows that 41% of vehicles are less than four years old. This is positive from an emissions viewpoint, as newer vehicles are more fuel-efficient and have reduced emission levels. The road haulage sector is pre-disposed to maintaining fuel-efficient operations, since fuel represents a significant cost for the sector. In addition, the new EU Driver Training Directive includes logistics and route planning modules for road hauliers, which will help to improve the efficiency of road freight operations and thereby reduce emissions.

Iarnród Éireann has held consultations with business interests in order to identify freight activities best suited to rail transport. The company has developed a business plan that includes the targeting of trainload traffic, increasing the existing profitable business but withdrawing from those businesses that are heavily loss-making. The company has made significant progress in growing the rail freight business in areas where it holds a competitive advantage over road haulage.

In relation to testing alternative fuels, Transport 21 provides funding for hauliers to pilot a range of biofuel blends and energy efficient driving styles as a means of addressing CO_2 emissions from road freight operations in Ireland.

3.3.2.2.7 Maritime Transport

Energy usage in maritime transport is predominately provided by fuel oils, much of which is low quality, end of refining process stock. Usage of such fuel has consequences that are currently being addressed both in EU and international legislation. This strengthening of legislation will result in usage of cleaner fractions of oil particularly in environmentally sensitive areas. While the IMO (International Maritime Organisation) is currently developing emissions trading legislation to apply to international shipping, such trading schemes are problematic in their implementation. Much of international shipping is outside EU ownership and consequently not subject to EU regulation or energy policies. With regard to future developments in alternative energy sources and energy efficiency, there are early developments in use of bio fuels for ships. The take up of such fuels will depend on the economics of production and the tax regime in the various jurisdictions.

3.3.2.2.8 Tax exemption for public transport commuting

The TaxSaver Commuter Ticket Scheme was initiated in 1999, and can be availed of by any employer or employee. Under the scheme, employers and employees may receive tax relief on the cost of annual bus, Luas or rail tickets. The incentive is a positive way to encourage more people to choose public transport for their journeys. In 2004 over 1300 companies (public and private sector) availed of the scheme offered by Dublin Bus, Iarnród Éireann and LUAS.

3.3.2.3 Demand Management

3.3.2.3.1 Relationship between transport and spatial policies

Demand-side measures, correctly targeted, seek to maximise the efficiency of the transport network by managing the demand for travel and influencing patterns of commuting behaviour. Demand management comprises a range of measures, including :

- land use policies that bring homes, workplaces and services closer together or facilitate better links with public transport, cycling or walking;
- soft measures to reduce car use including car sharing, flexible working and individual or workplace travel plans; and
- fiscal measures to encourage sustainable travel behaviours and discourage unsustainable travel once the relevant infrastructural investment has taken place.

The Dublin Transportation Office (DTO) has been engaged in formulating policy recommendations in relation to demand management for the Greater Dublin Area (GDA). The recommendations on demand management are being designed to focus on policies that will help the Government and the local authorities in the GDA to respond to growing travel demand, in general, and to specific problems such as long distance commuting. In this regard, road pricing and congestion charging are options to be considered as elements in the possible range of policies for managing traffic demand.

3.3.2.3.2 National Spatial Strategy

The Department of Transport developed a set of Guiding Principles to guide and inform new transport policies and strategies, which include facilitating a closer integration between land-use planning and transport investment. The daily peak demand for passenger transport is inextricably linked to the places where people live and work. The choice of these places is in turn influenced, in part, by spatial, land use and planning policies.

The Guiding Principles recognise that the National Spatial Strategy to 2020 is a key backdrop to all transport plans and policies. The integration of spatial development and transport investment should support more sustainable travel patterns for individuals and business, including facilitating a modal shift to more sustainable forms of transport (e.g. public transport, cycling and walking) and delivering net benefits in terms of reduced environmental and health costs. The National Spatial Strategy notes that transport's role in supporting balanced regional development is to:

- build on Ireland's radial transport system of main roads and rail lines connecting Dublin to other regions, by developing an improved mesh or network of roads and public transport services;
- ensure, through building up the capacity and effectiveness of Ireland's public transport networks, that increases in energy demand and emissions of CO_2 and other air pollutants arising from the demand for movement are minimised;
- allow internal transport networks to enhance international access to all parts of the country, by facilitating effective interchange possibilities between the national transport network and international airports and sea ports;
- address congestion in major urban areas by increasing the use of public transport;
- address decisions on land use and development which must take account of the existing public transport networks or support the emergence of new or augmented networks.

The National Spatial Strategy is given regional effect through the Regional Planning Guidelines and Local Authority City/County Development Plans, which reflect the RPG principles and priorities at local planning level. It is estimated that a 2.5% reduction in passenger kilometres travelled on implementation of the National Spatial Strategy could contribute to an annual saving of around 0.075 Mt of CO_2 emissions over the period 2008 – 2012. This reduction in emissions will arise because of shorter commuting distances and a shift to public transport, cycling and walking. Passenger journeys undertaken by public transport will also have associated CO_2 emissions. However, the distances travelled are anticipated to be shorter and emissions much less compared to private car travel.

3.3.2.3.3 Regional Planning Guidelines

The Regional Planning Guidelines, which were adopted by all Regional Authorities in May 2004 and are implemented by local authorities through City/County Development Plans, can help align land-use planning and transport investment. The transport planning perspectives will continue to provide an input to reviews of the Guidelines and local authority development plans.

3.3.2.3.4 Cork Area Strategic Plan

The Cork Area Strategic Plan 2001-2020 (CASP) provides an excellent example of successful land-use planning, with appropriate use of rail, bus and cycle solutions. The Department of Transport is committed in Transport 21 to the implementation of the CASP including investment in rail infrastructure and in bus priority Green Routes as envisaged in the CASP. The CASP areas to the east and north of Cork City provide good examples of successful land use and transport planning. New development adjoins to existing urban areas and is contiguous to existing transport infrastructure , such as rail lines where the particular strengths of rail can be exploited by operating from and to substantial catchment areas and on routes where rail has a competitive advantage over road transport.

The Cork Area Strategic Plan 2001 - 2020 states that "There will be a major growth corridor in the northern and eastern part of the Metropolitan area between Blarney and Midleton. This will help achieve greater social inclusion by improving access to public transport, jobs and services, amenities and a wider range of housing. The location for the development must be close to the existing rail system in order to avoid the traffic gridlock that would occur if a simple roll out of the City were to be adopted as a policy."

3.3.3 BUILT ENVIRONMENT & RESIDENTIAL SECTOR

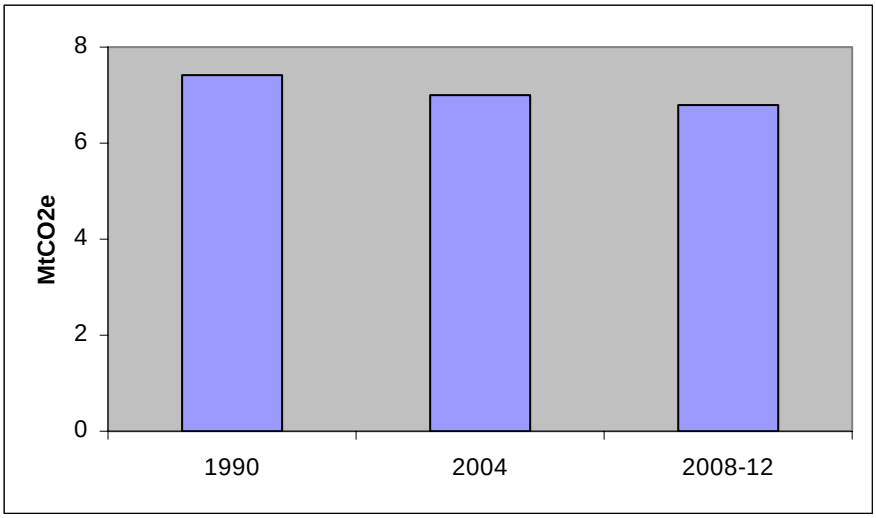
This sector comprises both residential housing stock and all non-residential buildings in the commercial and services sectors, including in the public sector. Recognising that a proportion of all energy consumed by the non-residential built environment relates to the provision of space and water heating and the use of appliances, policies and measures directed at the non-residential element of the built environment are considered in this section.

For the purposes of reporting greenhouse gas emissions, this sector only includes emissions arising from direct energy consumption in private dwellings for space and water heating. Greenhouse gas emissions arising from non-residential buildings, such as those in the commercial and public sector, are included in the Industry, Commercial and Services sector. Greenhouse gas emissions in the residential element of this sector comprised approximately 10% of total greenhouse gas emissions in 2004.

While energy consumption, excluding electricity use, rose by 23% between 1990 and 2004, mainly due to an increase of 44% in housing stock in the State from approximately 1.01 million units to approximately 1.44 million in 2004, direct emissions associated with non-electricity energy use fell by almost 4% from 7.355 Mt to 7.099 Mt during this period. Emissions from the average dwelling fell by 30% between 1990 and 2004. This fall is a result of a significant shift away from solid fuel use towards less carbon-intensive fuels such as

natural gas as well as the adoption of strengthened energy efficient standards for new buildings under the national building code.

Figure 3: Emissions from Residential Sector 1990-2012



This shift has been driven by a number of factors, including, inter alia, the availability of natural gas, the ban on the sale and marketing of bituminous coal in certain urban areas and higher income levels resulting in a higher emphasis on convenience over price.

Continued decreases in emissions are projected for the period 2008-2012, due to ongoing improvements in building efficiencies and continued fuel switching. Average annual emissions from the sector are projected to be 6.833 Mt CO_2e or 7% below the 1990 level, despite a forecasted increase in total household numbers to 1.74 million by 2012. By 2012 average emissions per household will have fallen to 55% of their 1990 level, or 3.86 tonnes per household.

3.3.3.1 Improved Spatial and Energy Use Planning

3.3.3.1.1 National Spatial Strategy

The National Spatial Strategy, published in 2002, aims to achieve a better balance of social, economic and physical development across Ireland. The Strategy provides a 20-year framework for planning at national, regional and local level. Balanced regional development requires that the full potential of each region be developed on a sustainable economic, social and environmental basis to contribute to the overall performance of the State. Good spatial planning has the potential to deliver beneficial environmental impacts in areas such as transport and a general holistic approach to continued spatial development. The National Spatial Strategy will therefore contribute to preparing Ireland for more stringent emission reduction requirements in the future, in particular through reducing the dependence on private car-based transport arising from more sustainable spatial planning.

At national level substantial progress is being made in implementing the NSS, which is having an increasing influence on policies and programmes across a range of Government Departments and agencies. At regional level, a key policy bridge between national

development priorities and local planning has been put in place with the adoption of Regional Planning Guidelines. These provide a strategic framework for local planning. At county and city level, strategic land use and planning frameworks for a number of Gateways are in place, with work well advanced on others.

The potential impact of the National Spatial Strategy in terms of achieving more balanced regional development has been underscored by the Government's decision in July 2005 that the regional dimension of the next National Development Plan, now in preparation, will be broadly based on the NSS. The priorities of the NSS and regional planning guidelines have also been recognised in the Government's 10-year investment plan for transport, Transport 21.

3.3.3.1.2 Development Plan Guidelines

Draft Guidelines for Planning Authorities on the preparation of County and City Development Plans were published for public consultation in 2006. The Draft Guidelines emphasise the importance within such plans of creating a clear strategic framework for the proper planning and sustainable development of the relevant area consistent with the longer-term aims set out in the NSS, national policies and regional planning guidelines.

In particular, the Planning and Development Act 2000 provides that a development plan may include objectives for promoting design in structures for the purposes of flexible and sustainable use, including conservation of energy and resources.

3.3.3.1.3 Residential Density Guidelines

Planning Guidelines on Residential Density, which were published in 1999, are intended to assist planning authorities, An Bord Pleanála, developers and the general public by providing guidance on the benefits of higher residential density in appropriate locations and on the safeguards required in promoting greater residential density generally.

The Guidelines on Residential Density give effect to Government policy of encouraging more sustainable urban development through the avoidance of excessive suburbanisation and the promotion of higher residential densities in appropriate locations, especially in conjunction with improved public transport systems. The Guidelines set out in a detailed manner the locations appropriate for higher residential densities, the range of densities appropriate to various locations and the need to achieve a high quality of residential environment.

The Guidelines stress that firm emphasis must be placed by planning authorities on the importance of qualitative standards in relation to design and layout in order to ensure that the highest quality of residential environment is achieved. Planning authorities have generally reviewed and varied their Development Plans as necessary to give full effect to the recommendations and policies contained in the Guidelines.

Taking account of experiences to date with the 1999 guidelines, the rapidly changing demographics and settlement patterns, the need for more compact urban development (particularly within the Greater Dublin Area) and the on-going policy of delivering sustainable communities towards enhancing quality of life, the Department is proposing to prepare a suite

of new planning guidelines on residential development during 2007. In essence, the new guidelines will:

- facilitate the development of sustainable communities through effective planning and the provision of necessary supporting services and amenities;
- help achieve the most efficient use of urban land through housing densities that are appropriate to the location involved and availability of supporting services and infrastructure, particularly transport; and,
- set high standards in terms of space and facilities to meet the needs of the Irish context into the future.

It is envisaged that this updated and expanded guidance will deliver a coherent and comprehensive policy response to the issues, addressing not only the question of individual housing and apartment standards, including space standards, but also issues relating to how high quality residential development can deliver more sustainable communities, with improved integration between residential development and supporting community and social infrastructure, including schools, child care amenities. It will also integrate planning design and policy with *Transport 21* to help deliver a comprehensive approach to high quality urban design.

3.3.3.1.4 More Energy Efficient New Buildings Regulations

Amending Part L (Conservation and Fuel Energy) Building Regulations were made in 2002, providing for higher thermal performance and insulation standards for dwellings. Higher standards for new dwellings, envisaged in the NCCS to be implemented in two phases (2001 and 2005), were implemented in a single step with effect from 1 January 2003. The amending Part L Regulations 2002 also set higher thermal performance for replacement doors, windows and roof-lights (roof windows) in existing houses with effect from 1 July 2003. These measures were estimated to reduce CO_2 emissions by 250,000 tonnes by the end of 2012.

Further amending Part L Regulations made at the end of 2005 to incorporate higher thermal performance/insulation standards for new non-domestic buildings (such as offices, shops, factories and leisure centres) will commence on or after mid-2006. This will lead to an additional 45,000 tonne reduction in CO_2 emissions per annum by the end of 2012.

It is estimated that both the 2002 and 2005 amendments to Part L of the Building Regulations will together give a total reduction of CO_2 emissions in excess of the projection in the original NCCS i.e. by more than 0.3Mt per annum by 2012. This is due to the increase in the annual volume of new house building from less than 50,000 house completions in 2000 to more than 80,000 house completions at present.

Higher thermal performance/insulation standards under Part L have significant economic and social benefits, in addition to the environmental benefits set out above. For example, the higher standards for new dwellings operative from 1 January 2003 are estimated to reduce the energy requirements for domestic space and water heating by 23%-33%, depending on the size and type of dwelling. Such energy saving would be particularly beneficial for low-income families affected by fuel poverty. In the case of commercial buildings, the lifetime cost of operating and maintaining a building is a multiple of the initial capital cost. Accordingly,

additional investment in energy saving technology at the construction stage could represent good value for money.

3.3.3.1.5 EU Energy Performance of Buildings Directive (EPBD)

Amendments to Part L Building Regulations were made in December 2005 to partly transpose Articles 3, 4, and 5 of the EU Energy Performance of Buildings Directive. The Regulations also provide the legal basis for the introduction of revised energy performance assessment methodology (Domestic Energy Assessment Procedure or DEAP) for new dwellings. This expresses the energy performance of the building as a single parameter- CO_2/m2 per annum and provides explicit recognition of the possible contribution of high-efficiency boilers, e.g. condensing boilers, and renewable energy technologies.

The NCCS proposed an energy efficiency rating for older, pre-Building Regulations, dwellings. This proposal has been superseded by the Energy Performance of Buildings Directive requirement for a Building Energy Rating (BER) for all categories of buildings. The Action Plan for the implementation of the EPBD in Ireland proposes to phase in BER as follows:

- BER of new Dwellings, with effect from 1 January 2007
- BER of new Non- Domestic Buildings, with effect from 1 July 2008,
- BER of existing buildings, when sold or let, with effect from 1 January 2009.

A BER certificate or “label” will allow prospective tenants or buyers to objectively compare the energy performance of a building. An Advisory Report attached to the BER certificate will set out cost effective ways of improving building energy performance for the information of building owners and landlords in planning future upgrade works

3.3.3.2 Sustainable and Energy Efficient Buildings and Low Energy Housing

3.3.3.2.1 House of Tomorrow

This SEI programme stimulates the uptake of energy-efficient practices in building design and construction. The programme funds designers and architects who work on “clusters” of buildings (normally 10–100 buildings) with considerably improved energy use parameters, typically 20–40% better than the requirements of the current Building Regulations.

3.3.3.2.2 Energy Efficiency Design and Technology

To promote sustainable energy efficiency in housing, the Department of the Environment, Heritage and Local Government is now funding the inclusion of a variety of energy efficiency technologies on a pilot basis, in a number of social and voluntary housing schemes. Policy is aimed at directly funding energy efficient practices in design and construction of social housing provided by local authorities or the voluntary and cooperative housing sector as part of the capital funding for such schemes while ensuring that the energy efficient proposals meet the approval of SEI.

3.3.3.2.3 Design of Large Buildings

The Energy Performance of Buildings Directive requires that the economic and technical feasibility of alternative/renewable energy systems be assessed during the design of large

buildings over 1,000 m^2. This will be operative from 2007. Sustainable Energy Ireland has published a national feasibility study covering a wide range of large buildings. SEI will also publish free software to enable designers undertake the relevant feasibility assessments.

3.3.3.2.4 Design Guidelines for Social Housing

Guidelines for Social Housing provide that all social housing incorporate whole house heating properly designed and using efficient systems while having due regard to the preferences of the likely occupants. The standards of insulation required have been progressively improved in line with improvements in the Building Regulations. The improved thermal performance and insulation standards will deliver reduced heating costs for the occupants of local authority dwellings and reduce greenhouse gas emissions due to lower energy requirements. A review of the design guidelines was underway and revised guidelines will be published in 2007.

3.3.3.2.5 Greener Homes Scheme

The Greener Homes Scheme, launched in 2006, provides assistance to homeowners who intend to purchase a new renewable energy heating system for either new or existing homes. The scheme is administered by Sustainable Energy Ireland and aims to increase the use of sustainable energy technologies within Irish homes over the next five years. It is estimated the full uptake of the funding available under the scheme will reduce CO_2 emissions by 20,500 tonnes annually. Householders can receive grant assistance to install renewable heating systems (solar, biomass or heat pump based) that meets their particular needs in terms of heat demand, budget and environmental considerations.

3.3.3.3 Improved Efficiency of Existing Buildings

It is generally argued in Europe that the housing stock consists primarily of older, less efficient dwellings and that, consequently, the relatively small annual addition to this stock, as represented by new house-building to higher energy performance standards, has a limited impact on overall energy efficiency of the housing stock. This is less true in Ireland because of the house construction boom since the mid 1990s. We are now building new dwellings at the rate of around 20 per 1000 population or about 5 times the EU average. About 38% of our housing stock has been built since modern building regulations were introduced in 1992 and this proportion will be significantly higher by 2012.

3.3.3.3.1 Building Regulations

The requirements of Part L of the Building Regulations apply both to “change of use” situations and to material alterations, i.e. major refurbishments that have implications for structure or fire safety. Part L also applies to window replacement in existing buildings.

3.3.3.3.2 Local Authority Housing Regeneration Programme

Upgrading and redevelopment of the existing local authority housing stock is carried out through a combination of new build, refurbishment and demolitions. In 2006 over €233 million is being made available across the various regeneration programmes administered by the Department of Environment, Heritage and Local Government. Regeneration programmes have involved the refurbishment or construction of over 1,000 units since 2000.

3.3.3.3.3 Area Regeneration Programme

Dublin City Council received a grant of €82.5 million (1997 prices) under the Area Regeneration Programme. This programme, which is now complete, consisted of once-off upgrading of high-density older housing complexes - mainly flats at various locations around the city and was linked to the development of a strong estate management programme to overcome chronic social problems associated with many flat complexes. Typical works included window replacement, installation of central heating, repairs to roofs and precinct improvement works. Over the lifetime of the programme, over €100 million was provided to local authorities to undertake work on over 9,500 units.

3.3.3.3.4 Central Heating Scheme

A special programme for the installation of central heating in local authority rented dwellings which lacked such facilities was introduced in July 2004. Some €42 million has been paid to date and a further €35 million has been allocated to the scheme in 2006. Under the Programme, the Department of the Environment, Heritage and Local Government pays to the housing authority a grant of €5,600 or up to 80% of the cost, whichever is the lesser, in respect of the provision of central heating facilities and related energy improvement and smoke detection measures in each eligible dwelling. The balance of the cost is met by local authorities.

3.3.3.3.5 Remedial Works Scheme

Under the Remedial works Scheme, which was introduced in the mid-1980s, capital assistance is made available to local authorities to fund major refurbishment works to groups of their rented dwellings. Since 2000, 2650 housing units have benefited under the remedial works scheme.

3.3.3.3.6 Low Income Housing Programme

This SEI programme aims to facilitate coordinated action to ensure that homes which are subject to fuel poverty have access to cost-effective heating, hot water and lighting through the installation of energy efficiency measures. Delivered primarily through the Warmer Homes Scheme, actions in low-income housing are designed actively to develop, promote and champion responses to fuel poverty issues within the context of national housing and sustainable energy policies. Budget 2006 provided an additional €2 million funding for the installation of insulation in households experiencing fuel poverty.

3.3.3.4 Improved Efficiency of Appliances

Energy labelling of appliances, to enable consumers to compare energy consumption of product alternatives, is designed to promote the uptake of more energy-efficient and therefore cheaper appliances. Requirements for energy labelling are laid down in a series of EU Directives and currently apply to washing machines, driers, combination washer driers, fridges, freezers fridge freezers, dishwashers, ovens and air conditioners. Under the Regulations, suppliers and distributors are required to produce the labelling material and to ensure accuracy. Retailers are required to ensure that all display models carry the correct energy labels.

3.3.3.5 Demand Side Management

Controlling the demand for energy consumption in the residential sector will benefit not only the consumers of energy in terms of reduced costs, but will also help to reduce Ireland's overall energy requirement and reduce the pressure on existing electricity generating capacity. As well as programmes directed towards the industrial and commercial sectors, Sustainable Energy Ireland provides advice to residential customers on reducing their energy consumption, including a home energy survey to identify areas in which the greatest energy savings can be made.

3.3.3.6 Changing Fuel Mix

Between 2000 and 2005, an additional 162,357 residential customers have been added to the Bord Gáis natural gas network, an increase of 46%. In addition, 5,204 new industrial and commercial customers have been added in the same period. The completion of the Dublin-Galway-Limerick ring main pipeline together with a second interconnector between Ireland and Scotland and the commencement of work on a North/South interconnector has driven the increased number of households connecting to the natural gas network.

3.3.3.7 Public Sector Buildings Investment Programme

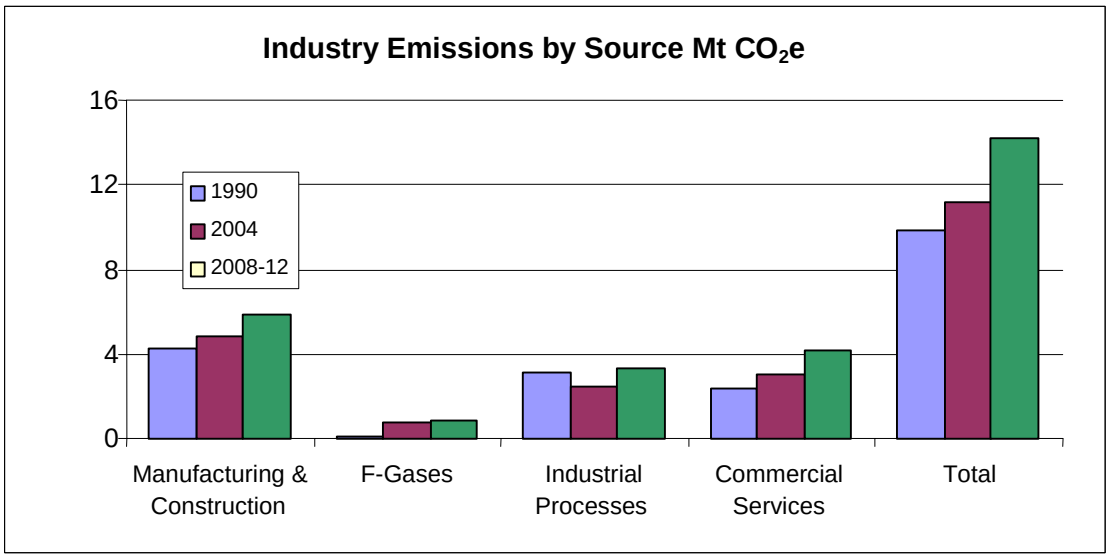
This programme aims to stimulate the application of improved energy efficiency design strategies, technologies and services in public sector building construction and retrofit projects. It facilitates the delivery of significant energy efficiency improvements in the design and specification of new-build and refurbishment construction. The programme is in the process of establishing energy management bureaux to encourage the provision of contracted energy control and management for public sector buildings which lack the scope to provide the service from internal resources, and help public sector organisations to manage their energy consumption and costs. Two bureaux are now fully operational: the first is located in the Office of Public Works, covering over 150 of the largest buildings in the central Government offices estate; the second covers the main third level colleges in Dublin: UCD, Trinity, Dublin Institute of Technology and Dublin City University. Work has commenced in establishing a Bureau that incorporates the five Dublin Academic Teaching Hospitals: St. James' Hospital, St. Vincent's Hospital, Beaumont Hospital, The Mater Hospital and the Adelaide and Meath Hospital. These hospitals are some of the largest users of energy within the health sector.

The Energy Performance of Buildings Directive requires that a BER certificate be displayed in all public service buildings, including existing older public buildings. This will become fully operative in 2009.

3.3.4 INDUSTRY, COMMERCIAL & SERVICES SECTORS

Emissions from this sector arise from a range of sources, but predominantly from the combustion of fossil fuels for either heating or as part of industrial processes. In addition there are substantial amounts of CO_2 released during the production of cement, lime and periclase. Other more potent greenhouse gases, collectively known as fluorinated or F-gases, are released from a wide variety of commercial and industrial activities such as refrigeration and the production of semiconductors. Emissions from the sector as a whole grew by 13%

between 1990 and 2004. Within the overall increase, however, emissions from the commercial / services sector grew by 29% and emissions from industry grew by 8%.



3.3.4.1 Emissions Trading

The EU Emissions Trading Scheme, introduced in 2005 for energy and large industrial emitters, covers 100% of industrial process emissions and approximately 80% of combustion-related emissions from manufacturing industry. The small number of commercial installations included in the Scheme account for less than 2.5% of emissions from the commercial/services sub-sector. The operation of the trading scheme is described in more detail earlier in this chapter.

3.3.4.2 Investment Analysis

The Department of Enterprise, Trade and Employment has established an Inter-Agency Group, comprising representatives of enterprise development agencies, to explore options for determining the impact of inward and indigenous investment proposals/decisions by the development agencies. The Group is considering mechanisms for assessing the greenhouse gas impacts of investment proposals. It is intended to establish a mechanism for factoring the carbon emissions impact of proposed projects into decisions on grant-aid provided by the development agencies under the Department of Enterprise, Trade and Employment for industrial projects.

3.3.4.3 Energy Efficiency Measures

Sustainable Energy Ireland provides a range of advice to promote energy awareness and efficiency for the industrial and commercial sectors, as well for other energy users. For example, the Building Energy Manager's Resource Guide, published by SEI, provides a range of advice for those responsible for energy management in organisations. Information on SEI programmes specifically geared to the industrial and commercial sectors is set out below.

3.3.4.3.1 Negotiated Agreements

In 2002 and 2003, Sustainable Energy Ireland engaged in a pilot Negotiated Agreements programme involving 26 companies. The pilot programme estimated efficiency gains over

business as usual of 5.4% (individual agreement), 16.4% (collective agreement) and 17.1% (technology agreement). A key incentive for the introduction of negotiated agreements was a proposed exemption from any carbon tax that might be introduced. Following the 2004 Government decision not to introduce a carbon tax, SEI has re-focused its work in this area on the development of Energy Management Action Plans and, with the National Standards Authority of Ireland, on a new Energy Management Standard.

3.3.4.3.2 Large Industry Energy Network (LIEN)

Now in its eleventh year, this programme is a voluntary networking initiative of eighty-five of the largest industrial energy users in the country, with an annual energy spend of approximately €300 million. The LIEN Programme focuses on improving competitiveness by reducing energy costs and assists companies in meeting environmental and regulatory requirements. A structured approach to energy auditing and management, and an annual statement of energy accounts, which is a condition of membership of the network, is a valuable tool for driving energy efficiency. The industry participants report energy performance, progress and target realisation. Information and experience, to achieve best practice, are shared through fora including workshops, members' internet sites, networking, courses, and case studies.

3.3.4.3.3 Energy Agreement Programme

The Energy Agreements Programme is based on the Irish Standard on Energy Management Systems (IS 393). By joining the Energy Agreement Programme, companies undertake to work towards achieving certification to IS 393, supported by tailored advice from SEI. IS 393 requires that energy is managed by companies through formalised structures to achieve significant savings in energy use and greenhouse gas emissions. The Standard covers all aspect of a company's approach to managing its energy costs and use. It is designed for large energy intensive enterprises, which may be more exposed than others to changes in energy costs. It is expected that 20 of Ireland's largest industrial energy users will have signed up to the Energy Agreements Programme by the end of 2006. It is expected that Sustainable Energy Ireland will eventually attract 60 to 100 of the largest industrial energy users in Ireland, with an annual energy bill of €2 million qualifying for participation. With full participation, annual savings in greenhouse gas emissions arising from the scheme are conservatively estimated to be 150,000 tonnes. A parallel Energy Management Action Programme (EMAP) is in place for those companies who may not have the resources to commit the audit requirements necessary to obtain IS 393.

3.3.4.4 Fuel Switching

Conversion of industrial and commercial fuel consumption to lower carbon intensive fuels is encouraged by a range of Government programmes. These support the deployment of renewable energy, which as well as promoting the increased contribution of renewable electricity to the share of national electricity generation, also promote the uptake of renewable energy for electricity and heat in the commercial and industrial sectors. The introduction of a renewable energy feed-in tariff (REFIT), for example, includes separate tariffs for biomass and landfill gas biomass.

The Government announced a new commercial bioheat grant aid scheme to provide up to €22 million for the installation of wood chip and wood pellet boilers in large buildings and commercial enterprises. The Commercial Bioheat Scheme recognises that high equipment and installation costs for renewable energy systems have prevented many businesses from switching to such systems. The scheme will support the conversion to renewable energy in up to 600 premises. When fully implemented, approximately 600,000 megawatt hours of wood fuel will be used annually to displace in the region of 60 million litres of heating oil per year. This will result in the reduction in CO_2e emissions of about 160,000 tonnes each year.

3.3.4.5 IPPC Licensing

The 2003 Protection of the Environment Act introduced provisions enabling the EPA to consider greenhouse gas emissions as part of the Integrated Pollution Prevention and Control (IPPC) licensing regime. In addition, the European Commission is preparing general BREF documents on energy efficiency in the context of the IPPC Directive to provide information on the development of best practice for energy systems that are used in a variety of industrial processes.

3.3.4.6 Fluorinated Greenhouse Gases

The most potent of all greenhouse gases comprise SF_6 and the families of gases known as HFCs and PFCs. Collectively known as F-Gases, their use has grown more then three-fold between 1995 (the base year for these gases) and 2004. Although less than 1% of total emissions in Ireland in 2004, there is an upward trend of emissions of F-gases, attributable to increased semiconductor production, refrigeration and air-conditioning. The phasing out of CFCs, for the purpose of complying with the Montreal Protocol on substances that deplete the ozone layer, has also been a factor in increased use of HFCs and PFCs as alternatives. In some cases, the use of F-Gases is unavoidable, given the lack of alternatives to replace ozone-depleting substances being phased out under the Montreal Protocol.

In April 2006, the EU Environment Council adopted a regulation on fluorinated greenhouse gases and a directive on emissions from air conditioning systems in motor vehicles following an agreement reached with the European Parliament earlier in the year.

These measures are aimed at introducing cost-effective mitigation measures for the use of fluorinated greenhouse gases. The measures are expected to reduce projected emissions of fluorinated gases across the EU by around 23Mt of CO_2e by 2010, and even greater reductions thereafter.

- F-Gases Regulation: The regulation provides for a number of measures to control emissions of F-gases. Operators will be required to prevent, detect and repair leakages from a list of specified stationary applications and to maintain adequate records on the quantity of F-gases installed in an application and records related to maintenance, servicing and final disposal. Appropriate arrangements, underpinned by training and certification for relevant personnel, must also be put in place for the recovery and recycling or destruction of gases. Appliances containing F-gases can only be placed on the market if they bear a label indicating the chemical names of these gases and the quantity contained, and stating that they are covered by the Kyoto Protocol. In addition,

the regulation introduces prohibitions and other restrictions for certain products containing F-gases. The regulation will apply with effect from 4 July 2007.

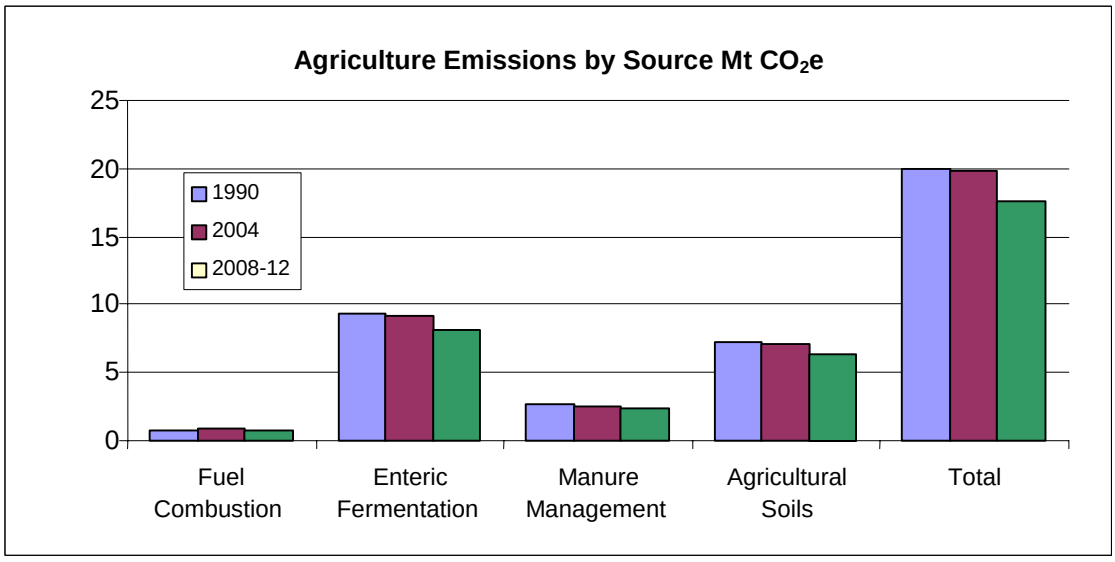
- Mobile Air-Conditioning Directive: Vehicles with air-conditioning units use a refrigerant known as HFC-134a, which has a global warming potential of 1300 times that of CO_2. Because air-conditioning units in cars have the potential to leak, this directive places restrictions on the types of units fitted to vehicles before they can be approved for sale. Gases with a global warming potential of greater than 150 will be prohibited from use in air-conditioning units from 2011 onwards. The directive also provides for harmonised leak detection tests and limits on the retrofitting and refilling of mobile air conditioning units. The directive amends the European Whole Vehicle Type Approval Directive, which sets out Member States' obligations to achieve compliance with technical requirements before vehicles are placed on the market.

3.3.5 AGRICULTURE SECTOR

Emissions from the sector consist mainly of non-CO_2 greenhouse gases, N_2O and CH_4, and arise from four distinct processes:

- Methane (CH_4) release during enteric fermentation - part of the digestion process in ruminant animals.
- Management and recycling of animal manures results in emissions of methane (CH_4) and Nitrous Oxide (N_2O).
- Nitrogen inputs to soils from the use of natural and synthetic fertilisers results in emissions of Nitrous Oxide (N_2O) from agricultural soils.
- Combustion of fossil fuels resulting in emissions of CO_2, CH_4 and N_2O.

Agricultural emissions of greenhouse gases are very significant in the Irish context. Greenhouse gas emissions in 1990 from the agricultural sector were 35% of total national emissions, the highest of all sectors. By the end of 2004, this had fallen to 27.7%.



Total emissions from the sector have fluctuated over the period 1990 (19.979 Mt CO_2e) to 2004 (19.881 Mt CO_2e). There was a sustained increase in emissions from 1990 to a peak of 22.014 Mt CO_2e in 1998, however, substantial reductions have taken place in the period from 1999 to 2004. Emissions are closely linked to livestock numbers and sales of nitrogenous fertilisers and have tended to track these over the period.

Research by the FAPRI-Ireland Partnership[5] in 2003, in light of the reform of the EU Common Agriculture Policy (CAP), concluded that given full decoupling of aid from production – the option chosen by Ireland – across the EU15, emissions from agriculture would decrease to a level 16% below that recorded in 1990. This research was based on full decoupling by all 15 EU Member States.

The positive contribution of farming and agricultural policy to reducing greenhouse gas emissions and increasing levels of carbon sequestration is an important element of Ireland's response to its greenhouse gas emissions reduction target for the purposes of the Kyoto Protocol.

The link between the production of agricultural output and public goods such as the rural landscape, cultural or heritage features, biodiversity and greenhouse gas absorption is reflected in what has been termed the European Model of Agriculture. This idea stresses the multifunctional character of European agriculture and provides a justification for Government's role in support of agriculture and its provision of public good outputs. The public good provided by agriculture also reinforces the role that agriculture will play in sustainable rural development. The development of tourism in Irish rural areas will be contingent on the continued environmental health of rural Ireland to which agriculture makes, and will continue to make, an important contribution.

A critical consideration in national climate change policy is to balance the environmental objective of greenhouse gas emissions reductions with the economic and social objective of promoting the development of a rural economy, which sustains the maximum number of farm families and rural households.

3.3.5.1 European Common Agricultural Policy

The National Climate Change Strategy proposed a reduction in methane to be achieved by reducing stock numbers below business as usual expectations for 2010, on the basis that the required CH_4 reduction is equivalent to a reduction of 10% in livestock numbers over the period.

The decision by Government to adopt full decoupling of direct payments from production corresponded with the expectation that significant reductions in emissions from the sector would be achieved. A new direct payment scheme, the Single Farm Payment Scheme, was introduced on 1 January 2005 to replace the Livestock Premia and Arable Aid Schemes. The introduction of this scheme provides greater freedom to farmers to make production decisions

[5] Food and Agricultural Policy Research Institute, 'The Luxembourg CAP Reform Agreement: Analysis of the Impact on EU and Irish Agriculture,'2003
http://www.tnet.teagasc.ie/fapri/downloads/pubs2003/luxsg/paper3141003a.pdf

that more closely correspond with market signals. This will incentivise farmers to improve efficiencies of inputs. Recipients of the single payment must be in compliance with five statutory environmental management requirements (SMRs) as well as other SMRs, and maintain land in 'Good Agricultural and Environment Condition' (GAEC).

3.3.5.2 Policies to Reduce Livestock Numbers

Prior to the introduction of the Single Farm Payment, a number of developments had an influence on livestock numbers and age profile, which had an impact on greenhouse gas emissions:

- Extensification premium: the qualifying criteria for payment under this scheme encouraged farmers to farm at a lower stocking rate in order to receive a higher rate of payment.
- Special Beef Premium: since 2000 stricter scheme eligibility criteria were applied to farmers applying under this scheme, in the form of lower stocking rate density limits.
- The payment basis for the Disadvantaged Areas Compensatory Allowances Scheme was changed from a headage basis to an area basis, thereby removing the inducement for farmers to maximise stocking levels.
- Interim Commonage Framework plans introduced in 1998 reduced stock numbers by 30% on commonages in six western counties. Permanent destocking arrangements were put in place for commonages in the final Commonage Framework Plans introduced in 2002.

3.3.5.3 Policies to Reduce Emissions per Animal

3.3.5.3.1 Suckler Cow Premium

Additional eligibility criteria facilitated a reduction in the average age of the suckler herd and the number of calves born by allowing an increasing number of heifers to be eligible for payment. Increasing the number of heifers (younger animals) eligible for payment had the effect of reducing methane emissions from the suckler herd as heifers have lower emissions than the cows they replaced.

3.3.5.3.2 Animal Husbandry

One of the factors that influences methane emissions from the dairy herd is longevity of the cows, which is influenced by the health and fertility of the cows. As yields per cow increase there is a tendency for fertility to reduce, thereby leading to an increase in the number of replacements kept on farms. Teagasc has an ongoing research programme aimed at improving fertility levels in the dairy herd. They are also focused on improving grazing techniques and pasture management in both dairying and beef systems with a view to identifying the best and most environmentally sustainable management systems that facilitate increased productivity, improving output per unit of input. In addition, an important part of the Teagasc research and advisory programme focuses on improving the uptake of various technologies that will have the effect of increasing outputs and reducing inputs. Improvements in efficiencies, which flow from this work, should lead to a reduction in the production of greenhouse gases per unit of output.

3.3.5.3.3 Animal Diet Research

Research is ongoing to evaluate a range of measures that could be used to reduce emissions per animal. Examples of such measures are increasing the level of oil or organic acids (e.g. fumaric or malic acids) in the diet. Field scale research with beef cattle has shown that reductions of circa 20% in daily enteric methane output are possible when coconut oil is added to the diet at a rate of 250 grams per day. However this practice is likely to be feasible only in part of an animal's life (i.e. the finishing winter when concentrates are being fed which allow delivery of the oil), and thus the reduction in lifetime emissions would be 5-6%. Coconut oil is expensive and the measure will likely have some cost of implementation at farm level, depending on the relative costs of oil, other feedstuffs and the value of beef output. The economics of providing incentives for the use of coconut oil in the diet of the beef herd to reduce methane emissions will be the subject of a cost-benefit analysis by the Department of Agriculture and Food. Automatic adoption by farmers cannot therefore be assumed. The feasibility of using other cheaper oils e.g. soya oil is being explored. A range of commonly used concentrates are being examined to determine of one is more suitable than another in terms of reducing methane emissions. Research is also being carried out to identify technologies to reduce the populations of methane producing micro-organisms in the rumen.

Organic acids have also been shown to reduce enteric methane emissions when added to the diet of beef cattle, but synthetic acids are expensive. Current research is looking for ways to increase natural levels of organic acids in the diet. Replacing roughage or forage feeds with concentrates may reduce enteric methane emissions, but in some circumstances, it could actually increase the emissions. Research has commenced to evaluate the use of alternative forages to grass silage in the diet of beef cattle. With regard to dairy cows, further work needs to be carried out to determine how milk quality and composition would be affected by these strategies

3.3.5.4. Manure Management and Agricultural Soils

3.3.5.4.1 Environmental Legislation

Agricultural activities in certain areas are already subject to local by-laws implemented by local authorities. In some instances, by-laws may include a requirement for nutrient management planning. Nutrient management planning is a compulsory feature of IPPC licensing. IPPC licensing is implemented by the EPA, and applies to intensive pig and poultry units.

3.3.5.4.2 Rural Environmental Protection Scheme (REPS)

REPS is a voluntary scheme designed to compensate and reward farmers for delivering environmental benefits. There were 46,500 farmers participating in REPS at the end of 2005 (34% of all farmers), each implementing a nutrient management plan. The number of REPS participants is projected to reach 55,000 by end-2006 (40% of all farmers). This is providing a more sustainable farming environment, improving the management of organic manures and chemical fertilisers and reducing nitrous oxide emissions. Nutrient Management Planning, a cornerstone of REPS, establishes farming practices that lead to greater efficiency in the use of nitrogenous fertiliser. This is achieved by minimising nutrient losses from agriculture and making better use of the nutrients in animal manures.

An analysis of the 2002 National Farm Survey (NFS) revealed that chemical nitrogen use on REPS farms was 65 kg/ha; the average for similar non-REPS farms being 95 kg/ha. Use of organic nitrogen on REPS farms was 91 kg/ha, slightly less than similar non-REPS farms, which had an average of 94 kg/ha. The analysis shows an average decrease of circa 45% in chemical nitrogen use on extensive REPS farms using nutrient management planning. This points to the efficacy of nutrient management planning as a means of reducing chemical nitrogen. The Department of Agriculture and Food will continue to encourage farmers to join REPS.

REPS Planners are now required to identify areas suitable for forestry during preparatory work for REPS plans, identifying farm areas appropriate for afforestation on environmental, agricultural, forestry and socio-economic grounds. The Department of Agriculture and Food is examining ways to utilise this new provision so that afforestation on REPS farms can be made more attractive

3.3.5.4.3 Good Farming Practice

All farmers participating in schemes such as Compensatory Allowances, On-Farm Investment, Installation Aid or Rural Environment Protection and transferees under the Early Retirement Scheme must practice farming in accordance with the environmental requirements set out in the Good Farming Practice booklet published by the Department of Agriculture and Food in August 2001. Key aspects of the Good Farming Practice include nutrient management and restrictions on applications of organic and chemical fertilisers.

3.3.5.4.4 EU Nitrates Directive

Regulations to implement the EU Nitrates Directive, which would place limits on the amount of livestock manure that may be applied to land, were developed. These regulations set down legal maximum limits for fertiliser applications (organic and chemical) based on stocking rate, crop requirements and soil type. This will lead to more efficient use of nitrogenous fertiliser and to a reduction in N_2O emissions.

3.3.6 FORESTRY SECTOR

The Irish afforestation programme will play an important role in carbon sequestration during the first and any subsequent Kyoto carbon reporting periods. While the NCCS envisaged that sequestration under Article 3.3 would account for a total of 1.0 Mt CO_2, per annum between 2008 and 2012, it is now forecast that, with the levels of afforestation that have occurred since 1990, the average rate of sequestration in qualifying forests over the Kyoto first commitment period will be 2.074 Mt CO_2 per annum. This revised forecast is based on approaches and methodologies for accounting of sequestration agreed to by Kyoto Protocol parties, particularly in the Marrakech Accords, the Good Practice Guidance of the Intergovernmental Panel on Climate Change, and on research and modelling of carbon sequestration in Irish forests undertaken by COFORD, the National Council for Forest Research and Development. Current afforestation will have little effect on levels of sequestration during the first commitment period, as forests grow relatively slowly as they establish themselves over the

first five years or so. However, in the period after 2012, they will make a substantial contribution to climate change mitigation.

3.3.6.1 Afforestation Programme

One of the aims of Ireland's forest policy is to encourage planting by providing an annual premium to farmers and land owners that compensates for income foregone from conventional farming, and the long pay back periods associated with forestry. Ireland has had, on a per capita basis, one of the most intensive afforestation programmes in the developed world since 1990, funded jointly by the Government and the EU, under successive accompanying measures to CAP reform. Since 1990, some 244,000 hectares have been afforested, with deforestation of approximately 1,500 hectares over the same period. Despite this rate of planting, however, Ireland remains one of the least forested countries in the EU. At the end of the year 2005, the national forest estate stood at over 709,000 ha. This represents about 10.29% of the area of the country, compared to the 35% average throughout the other EU Member States.

3.3.6.2 Integration of REPS and forestry

The administration of REPS requires planners to identify farm areas appropriate for afforestation. As an important contributor to carbon sequestration, ways of promoting greater synergy between REPS and forestry are being examined with a view to increasing the level of afforestation on REPS farms.

3.3.6.3 Development of domestic forest energy markets

Policies aimed at promoting renewable energy (in the form of heat and electricity) from biomass will create a market for thinnings and residues (both in-forest and from saw-milling). Research is required to develop effective production methods. Research is required to develop effective production methods. Recent developments on the policy front include a pilot grant scheme for commercial wood chip boilers for space heating, which was introduced and administered by Sustainable Energy Ireland.

3.3.7 WASTE SECTOR

Emissions from the waste sector consist mainly of methane (CH_4) from the anaerobic decomposition of solid waste that has been deposited in landfill sites. In addition small amounts of methane and nitrous oxide arise from wastewater treatment. With increased levels of waste generation, emissions rose steadily through the 1990s and this pattern would have continued if it were not for a step change reduction in the level of emissions arising from the introduction of landfill gas capture for power generation in 1997. Improved landfill gas management through flaring since 2001 is also contributing to a reduction in methane emissions. However, emissions have again begun to increase as the additional volumes of waste being sent to landfill over the period during which gas is produced through anaerobic decomposition have overtaken the incremental rate at which methane capture systems are being introduced. Consequently emissions in 2004 were 1.83 Mt CO_2e - 26% above their 1990 level.

National policy is to regard waste as a resource. This is reflected in our commitment to developing a recycling society. It is also reflected in the Government giving priority to incineration with energy recovery over landfill for dealing with residual waste. In examining the potential for waste management policies to contribute to emissions reductions, the Government is cognisant that climate change impacts are only one of a number of environmental impacts that derive from solid waste management options. Local factors, such as the availability of existing waste management facilities, markets for recyclables, as well as geographic, demographic and socio-economic factors, must also be considered. In overall terms, source segregation of municipal solid waste (MSW) followed by recycling (for paper, metals, textiles and plastics) and composting or anaerobic digestion of putrescible wastes, gives the lowest net generation of greenhouse gases, compared with other options for the treatment of bulk MSW.

3.3.7.1 Waste Licences

Waste Licences issued for landfill sites by the Environmental Protection Agency invariably require the preparation of evaluation reports by the licensee on the viability of landfill gas collection, flaring and / or energy production. Gas collection and energy generation is undertaken at high gas-yield sites and modern enclosed ground flares are installed at landfill facilities possessing sufficient gas potential to support combustion. In addition, the waste licensing system requires the modernisation of older facilities via the implementation of conditioning plans that are designed to increase the operational standards of landfill sites through a process of continuous improvement.

The generation of heat and electricity from waste in thermal treatment plants and landfill gas plants is targeted to displace CO_2 emissions from fossil fuel based plants. The contribution such an approach can make to energy and climate change policy is reflected in the projected outputs from the proposed Dublin waste to energy plant. This will have the capacity to produce 60Mw of electricity, which is enough to service the needs of 50,000 homes. In addition it will be capable of meeting the heating needs of a further 60,000 homes by means of district heating.

3.3.7.2 Diversion of Biodegradable Waste from Landfill

The deposition of biodegradable waste in landfill produces methane, with the potential for generation of gas being determined by the amount of degradable organic carbon in wastes, which in turn depends on the quantity and composition of the waste material present. Gas production in landfill occurs predominantly over a 21-year period and is greater in well-managed landfill sites where the potential for aerobic decomposition is more limited. Ireland is obliged under the EU Landfill Directive to ensure that no more than 35% of 1995 levels of biodegradable municipal waste is landfilled by 2016.

Ireland's approach to achieving the targets will be set out in 2006 in a National Strategy on Biodegradable Waste. It will set out the Government's approach to reducing the amount of biodegradable municipal waste going to landfill and encouraging measures aimed at the prevention, recycling and recovery of biodegradable municipal waste. The Strategy will require that projected arisings of biodegradable municipal waste be diverted from landfill by 2016 and is based on the integrated waste management approach established as

Government policy since publication of the national policy framework document Changing Our Ways in 1998. Under this approach, the preferred options for dealing with biodegradable municipal waste, based on the internationally recognised waste hierarchy, are:

- prevention and minimisation – avoiding generation of waste;
- recycling – mainly of paper and cardboard but also of textiles;
- biological treatment – mainly of kitchen and garden waste including composting; and
- residual treatment – thermal treatment with energy recovery or by way of mechanical-biological treatment.

3.3.7.3 Renewable Energy from Waste - Landfill Gas Capture

Waste biomass encompasses not only the biodegradable fraction of municipal and industrial waste, but also the biodegradable fraction of products and residues from agriculture, forestry and related industries. There is potential within biodegradable municipal waste management to make a contribution to renewable energy generation through the development of active supply chains and from synergies with other biomass materials and fuels e.g. to co-fire peat power plants or cement kilns.

In addition, landfill gas accounts for the majority of the currently installed 28 Mw of generation from biomass including 4Mw of capacity at the Ringsend waste water treatment plant, opened in 2004. The level of landfill gas capture is increased through the implementation of the technical requirements of the Landfill Directive, and utilisation for electricity generation is supported by Government policies and incentives aimed at increasing the penetration of renewable electricity in Ireland. However, the technical upper limit of 50% on the amount of landfill gas that can be recovered will ultimately limit the greenhouse gas mitigation potential of this measure.

4. PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

4.1 Introduction.

The projections in this chapter present a 'with measures' scenario based on currently implemented and adopted policies and measures. The main implemented and adopted policies are set out in Table 4.1 below. A 'with additional measures' scenario is not presented here as the National Climate Change Strategy (NCCS) is currently under review and is due in early 2007. The review when finalised will contain government agreed additional policies and measures to assist Ireland in complying with it Kyoto obligations. A counterfactual 'without measures' scenario has not been developed. The various models used to develop the projections are contained in Annex 3.

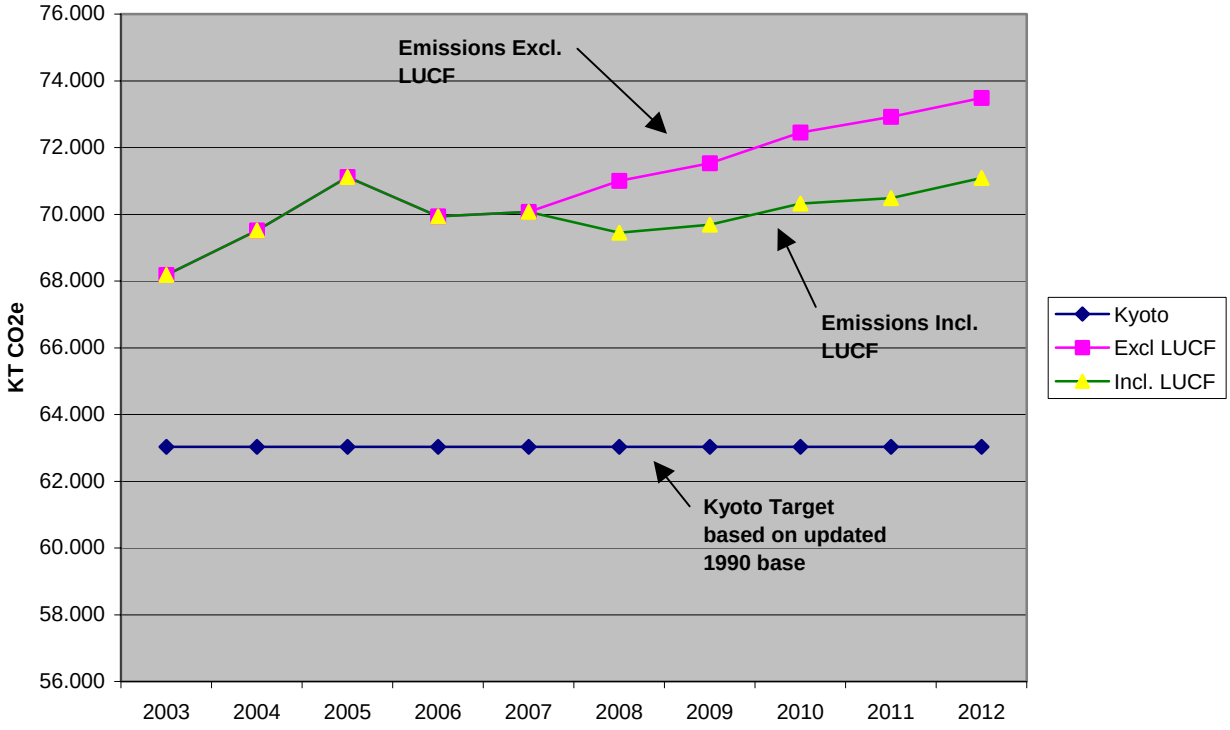
Table 4.1 Implemented and Adopted Policies & Measures for 'With Measures' Scenario.

Policies & Measures	Average Reduction 2008-2012 Mt CO_2e
Reform of the Common Agriculture Policy – decoupling of agriculture support from production commencing 1 January 2005	2.40
Continued planting of 14,000 ha per annum of forests as part of the National Development Plan	2.08
Compliance with EU RES-E Directive that requires 13.2% of electricity generation to be from renewable sources by 2010	1.30
Decomposition of methane emissions from landfill wastes disposal sites by flaring or capture for power generation	0.70
Voluntary agreement between the EU and automobile manufacturers to reduce average CO_2 emissions to 140g/km by 2008	0.48
In accordance with the EU Energy Performance of Buildings Directive higher thermal energy standards for new and existing residential and commercial buildings	0.30
Various projects to reduce road traffic congestion such as the Dublin Port Tunnel	0.27
Excise relief for biofuel as a replacement for fossil fuel in read transport commencing in 2008	0.25
Biodegradable Waste Strategy to ensure compliance with EU Landfill Directive	0.06
Replacement of cast iron pipes by plastic ones on natural gas distribution network	0.06
Rebalancing of motor tax and efficiency labelling to encourage the purchase of more efficient private passenger cars	0.05
Total	**7.95**

4.2 Overall Projected Trends.

Overall emissions are projected to rise up to 2005 before falling in 2006 and stabilising for 2007, resuming upward growth from 2008 onwards. The fall from 2005 is largely due to a fall in the energy sector resulting from the introduction of cleaner generating plant to meet electricity demand.

Fig. 4.1 'With Measures' Scenario - GHG Emissions Projections 2002-2012



4.3 Sectoral Share of Emission Projections.

The largest single source of emissions in 2003 was from agriculture. However, over the Kyoto commitment period, energy is projected to be the largest source with almost 27%; and this is projected to remain the case for 2015 and 2020.

Agriculture is the second largest source over the commitment period with 25% of emissions and its share is projected to fall slightly to around 24% for 2015 and 2020.

Industry is the third largest source with 19% of emissions over the commitment period, rising to 21% and 22% in 2015 and 2020 respectively.

The transport sector is responsible for over 18% of emissions in the commitment period rising to 20% and 21% of emissions respectively in 2015 and 2020 respectively.

The share of emissions from the residential sector is set to remain stable between the commitment period and 2020 at a little over 9%.

Finally the share of emissions from the waste sector is projected to fall from 2.6% in 2010 to 2.1% in 2015 and 1.2% in 2020.

The table below summarises the details. More detailed projections for 2004 – 2012, 2015 and 2020 as well as actual inventory data for the years 1990 to 2003 is presented in Table 4.2 at the end of this chapter.

	Mt CO_2e					Change on 1990 Base			
Sector	1990	2003	2008-12	2015	2020	2003	2008-12	2015	2020
Energy	11.805	16.847	18.748	19.664	20.515	43%	59%	67%	74%
Residential	7.355	6.614	6.833	6.591	6.820	-10%	-7%	-10%	-7%
Industry	10.023	11.225	14.194	15.553	16.697	12%	42%	55%	67%
Agriculture	19.979	20.075	17.644	17.065	17.047	0%	-12%	-15%	-15%
Transport	5.160	11.851	13.029	14.113	15.384	130%	152%	174%	198%
Waste	1.461	1.750	1.830	1.495	0.847	20%	25%	2%	-42%
LUCF	-	-	-2.074	-3.350	-4.650				
Total	**55.783**	**68.362**	**70.204**	**71.131**	**72.660**	**23%**	**26%**	**28%**	**30%**

4.4.1 Energy Industries.

Greenhouse gas emissions from the energy industries are predominantly derived from fossil fuel derived electricity generation. Since 1990, the share of high carbon content fuels such as coal and peat used for electricity generation has reduced and been replaced with relatively low carbon natural gas or zero carbon renewables, predominantly wind and hydro. This has resulted in a decoupling of CO_2 emissions from electricity generation and a drop of 33% in the carbon intensity of electricity generation between 1990 and 2004, from 925 g CO_2/kWh to 624 g CO_2/kWh. The trend is projected to continue to the Kyoto period

Greenhouse gas emissions are projected for five separate source categories in the energy sector, namely,

- fuel combustion for electricity generation;
- emissions from oil refining;
- emissions from peat briquetting;
- emissions from natural gas production
- and methane leakage from natural gas distribution.

Electricity production accounted for 93% of emissions from this sector in 2003 and is projected to account for 96% over the Kyoto commitment period. Between 2003 and the commitment period, CO_2 emissions from power generation are projected to rise by 14.6% from 15.1 Mt to 17.3 Mt, whereas non-CO_2 emissions are projected to rise over the same period by 19.8% from 0.5 Mt to 0.7 Mt. CO_2 emissions from oil refining and peat briquetting are projected to increase by 16.3% from 0.5 Mt to 0.6 Mt. Together power generation, oil refining and natural gas production account for 99% of all greenhouse gas emissions from the sector. Overall emissions from the energy sector are projected to grow by 4.9% to 2015 and 9.4% to 2020 from the Kyoto period. The table below provides summary details for the overall greenhouse gas emissions from the sector.

	Mt CO2e					Change on 1990 Base			
Energy Sector	1990	2003	2008-12	2015	2020	2003	2008-12	2015	2020
Power Generation	11.288	15.650	17.320	18.692	19.469	39%	53%	66%	72%
Oil Refining	0.186	0.379	0.465	0.682	0.751	104%	150%	267%	304%
Solid Fuel Manufacture	0.042	0.121	0.124	0.110	0.100	188%	195%	162%	138%
Natural Gas Production	0.163	0.627	0.114	0.124	0.124	285%	-30%	-24%	-24%
Fugitive	0.127	0.070	0.067	0.071	0.071	-45%	-47%	-44%	-44%
Total	**11.806**	**16.847**	**18.090**	**19.679**	**20.515**	**43%**	**53%**	**67%**	**74%**

4.4.2 Industry, Commercial and Services Sector.

Greenhouse gas emissions from this sector result predominantly from the combustion of fossil fuel for heating requirements. In addition the production of cement, lime and periclase result in significant process emissions of CO_2. The production of fertiliser ceased in Ireland in 2003 and has resulted in a sharp fall in process emissions from the sector.

Emissions from industry, commercial and services sector are projected for four separate categories, namely,

- fossil fuel combustions;
- process emissions;
- solvent use in industry;
- F-gas use in industry.

Fossil fuel combustion in manufacturing and construction accounted for 42.5% of CO_2 emissions from the sector in 2003 and is projected to account for 40.2% in the Kyoto commitment period. Fossil fuel combustion in Commercial and Services accounted for 27% in 2003 and 28.2% in the Kyoto commitment period. Taken together fossil fuel combustions accounts for 70.8% of emissions in the sector with industrial process emissions from cement, lime and periclase manufacture accounting for 23.5% of emissions. The remaining 5% is made up of emissions from solvent and F-gas use. The use of F-gases rose dramatically between the baseyear (1995) and 2003, up 233.3% from 0.21 Mt CO_2e to 0.7 Mt CO_2e mainly due to increases in semiconductor production and the use of refrigeration and air conditioning, however, it still only accounted for less than 1% of the national total. Overall, emissions from the sector are projected to grow by 9.6% to 2015 and 17.6% to 2020 from the Kyoto period. The table below provides summary details for overall greenhouse gas emissions from the sector.

	Mt CO_2e					Change on 1990 Base			
Industry	1990	2003	2008-12	2015	2020	2003	2008-12	2015	2020
Manufacturing	4.250	4.942	5.895	6.602	7.235	16%	39%	55%	70%
Industrial & F Gases	0.117	0.781	0.811	0.811	0.811	568%	593%	593%	593%
Industrial Processes	3.130	2.346	3.340	3.716	4.012	-25%	7%	19%	28%
Commercial & Services	2.356	3.155	4.148	4.424	4.639	34%	76%	88%	97%
Total	**9.853**	**11.224**	**14.194**	**15.553**	**16.697**	**14%**	**44%**	**58%**	**69%**

4.4.3 Agriculture.

Agriculture is the largest single source of emissions in Ireland, accounting for 27.8% of greenhouse gas emissions in 2003. However, projections for the Kyoto commitment period indicate that agriculture will become the second largest source, after energy industries, with

24.4% of emissions. Emissions for agriculture are projected for four separate sources, namely,

- fossil fuel combustion
- enteric fermentation form ruminants;
- manure management;
- agriculture soil management.

Enteric fermentation accounted for 45.8% of agriculture emissions in 2003 and is projected to account for 46.3% in the Kyoto commitment period. The share of emissions from agriculture soils and manure management also remain essentially stable at around 38% and 11% respectively. The remaining 4.6% results from fossil fuel derived energy in the sector.

Overall emissions for the sector are projected to fall by 12.1% between 2003 and the Kyoto period, down from 20.1 Mt CO_2e to 17.7 Mt CO_2e. Over the same period, emissions from enteric fermentation and agriculture soils show a projected fall of 11% and 8% respectively. Emissions from manure management and energy consumption in the sector are projected to show larger falls of 25% and 17% respectively. Overall emissions from agriculture are projected to stabilise between 2015 and 2020 at 3.3% below emissions in the Kyoto period. The table below provides summary details of overall greenhouse gas emissions from the sector.

	Mt CO_2e					Change on 1990 Base			
Agriculture	1990	2003	2008-12	2015	2020	2003	2008-12	2015	2020
Fuel Combustion	0.739	0.937	0.778	0.729	0.711	27%	5%	-1%	-4%
Enteric Fermentation	9.338	9.204	8.161	7.798	7.798	-1%	-13%	-16%	-16%
Manure Management	2.632	2.586	1.951	2.209	2.209	-2%	-26%	-16%	-16%
Agricultural Soils	7.271	7.348	6.754	6.329	6.329	1%	-7%	-13%	-13%
Total	**19.980**	**20.075**	**17.644**	**17.065**	**17.047**	**0%**	**-12%**	**-15%**	**-15%**

4.4.4. Residential.

Greenhouse gas emissions arise primarily from the combustion of fossil fuel for space and water heating. Only direct emissions from residential units are included in the sector, emissions from residential electricity consumption are included in the energy industries sector. Emissions fell by 10% between 1990 and 2003 from 7.4 Mt CO_2e to 6.6 Mt CO_2e as a result of a significant switch from carbon intensive solid fuels (coal, peat) to natural gas, and improved building standards. Solid fuel use fell from 72% of the market in 1990 to 28% in 2001, driven in part by the ban on the sale and marketing of bituminous coal in certain urban areas and increased availability of natural gas as the grid was extended in the 1990s. The fall in emissions happened despite a significant growth in the number of households, up from 1.03 million in 1991 to 1.33 million in 2003. Emissions per household have fallen by 30% over the period 1990 to 2004 from 7.4 to 5.1 tonnes CO_2e.

The projections for the sector are based on the 'high economic growth scenario' of the ESRI's medium term review. The downward trend in emissions per household is projected to continue over the Kyoto period, driven primarily by the shift to cleaner natural gas and improved energy efficiency and thermal insulation prescribed in building regulations. However rapid growth in population and the number of households will act as a countervailing force

with emissions averaging 6.8 Mt CO_2 per year during the Kyoto period, 7% below 1990 levels. Projections for emissions from the sector are to remain below 7 Mt CO_2e per year out to 2020.

4.4.5 Waste.

Emissions from this sector derive predominantly from anaerobic decomposition of organic waste in landfills which produces methane. The process occurs over a twenty-one year period and is greater in newer, well-managed landfills with more anaerobic conditions. Emissions of N_2O also result from waste water treatment.

Methane derived from landfilled waste accounted for 94% of methane emissions in 2003 and is projected to account for 92% of emissions over the Kyoto period, and N_2O emissions from wastewater treatment account for the remainder. Emissions from waste are projected to increase slightly between 2003 and the Kyoto period from 1.75 Mt to 1.83 Mt CO_2e per annum but with significant falls thereafter to 0.85 Mt by 2020. The table below provides summary details of overall greenhouse gas emissions from the sector.

	Mt CO_2e					Change on 1990 Base			
Waste	1990	2003	2008-12	2015	2020	2003	2008-12	2015	2020
Landfill	1.332	1.597	1.687	1.341	0.684	20%	27%	1%	-49%
Wastewater	0.129	0.153	0.144	0.154	0.163	19%	12%	19%	26%
Total	**1.461**	**1.750**	**1.831**	**1.495**	**0.847**	**20%**	**25%**	**2%**	**-42%**

4.4.6 Transport.

The transport sector has been the fastest growing sector in Ireland with overall reportable emissions up 130% over the period from 1990 to 2003. Emissions from the sector are dominated by road transport, and though the significant growth does reflect both increased mobility and vehicle stock, the figure is also inflated by the phenomenon of so called ‘tank tourism’ or ‘fuel tourism’ which results in a net outflow of fuel from the state in recent years. In 1990, the phenomenon was reversed with significant net inflow of fuel into the state, thus further inflating growth estimates between 1990 and 2003. Had emissions been calculated on the basis of domestic consumption rather than sales then estimates indicate that total transport emissions would have increased by 77% between 1990 and 2003 from 5.55 Mt to 9.81 Mt CO_2e. The trend is projected to continue albeit on a more moderate pathway, with projected increases of just under 10% between 2003 and the Kyoto period. Overall emissions from the sector are projected to grow by 8% to 2015 and 18% to 2020 from the Kyoto period. The table below provides summary details of overall greenhouse gas emissions from the sector.

	Mt CO_2e					Change on 1990 Base			
Transport	1990	2003	2008-12	2015	2020	2003	2008-12	2015	2020
Road Transport	4.789	11.425	12.472	13.495	14.702	139%	160%	182%	207%
Railways	0.166	0.140	0.166	0.186	0.205	-16%	0%	12%	23%
Domestic Civil Aviation	0.060	0.104	0.134	0.166	0.211	73%	123%	177%	252%
Domestic Navigation	0.096	0.068	0.066	0.066	0.066	-29%	-31%	-31%	-31%
Gas Transmission	0.049	0.114	0.191	0.200	0.200	133%	290%	308%	308%
Total	**5.160**	**11.851**	**13.029**	**14.113**	**15.384**	**130%**	**153%**	**174%**	**198%**

4.4.7 Forestry.

Projections of sequestration from sinks relation only to sequestration activities under Article 3.3 of the Kyoto Protocol. In relation to the 'additional activities' under Article 3.4, it is not anticipated that net emissions and removal from these activities will be included. Based on the national plantation rate to date and a projected afforestation rate of 14,000 ha. per annum and a deforestation rate of 500 ha. per annum, the projected net estimate for carbon sequestration over the Kyoto commitment period is 10.37 Mt CO_2 (2.074 Mt CO_2 per year or 1.56, 1084, 2.13, 2.44, 2.40 Mt CO_2 respectively from 2008 to 2012). The estimates have been made using the CARBIWARE model to predict carbon sequestration based on forest area and a number of factors such as growth increment, bulk density, carbon content and biomass expansion factor.

4.5 Meeting Kyoto Targets

As mentioned above, a 'with additional measures' scenario is not presented as the full suite of additional policies and measures are due to be agreed by government in early 2007.

Table 4.2 Summary of Greenhouse Gas Emissions Inventories and Projections 2000-2020

		National Inventory Report 2006				Projections ICF BOC										
		2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2015**	**2020**
Carbon Dioxide (Gg)	Energy	16,058	17,274	16,333	15,658	16,196	16,688	16,100	16,671	17,345	17,708	18,116	18,310	18,635	18,961	19,797
	Residential	6,346	6,479	6,461	6,382	6,925	7,060	7,191	7,016	6,794	6,646	6,558	6,517	6,491	6,381	6,604
	Industry	10,683	10,900	10,762	10,174	10,907	11,405	11,412	11,656	12,378	12,613	13,139	13,418	13,704	14,376	15,490
	Agriculture	862	853	836	837	804	805	806	787	768	754	743	734	728	698	681
	Transport	10,211	11,063	11,231	11,393	11,607	11,820	11,899	12,007	12,092	12,326	12,558	12,747	12,902	13,568	14,789
	Waste	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	**44,160**	**46,569**	**45,623**	**44,444**	**46,439**	**47,778**	**47,408**	**48,137**	**49,377**	**50,047**	**51,114**	**51,726**	**52,460**	**53,984**	**57,361**
Methane (Gg)	Energy	4.898	4.975	3.977	30.431	3.81	4.143	4.143	4.143	4.143	4.143	4.143	4.19	4.19	4.095	4.095
	Residential	2.235	2.138	2.113	1.725	1.952	1.952	1.952	1.905	1.81	1.762	1.714	1.667	1.667	1.571	1.619
	Industry	0.465	0.474	0.48	0.638	0.619	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.714	0.714
	Agriculture	554.173	552.735	546.568	541.772	542.762	539.143	516.429	500.762	491.857	486.667	481.238	476.286	471.476	464.619	464.619
	Transport	2.603	2.589	2.484	2.337	2.381	2.429	2.429	2.476	2.476	2.524	2.571	2.619	2.667	2.762	3.048
	Waste	72.582	64.367	70.422	77.191	85.857	87.667	85.143	81.667	81.143	81.095	80.762	80.381	78.19	63.857	32.571
	Total	**636.956**	**627.278**	**626.044**	**654.094**	**637.381**	**636.001**	**610.763**	**591.62**	**582.096**	**576.858**	**571.095**	**565.81**	**558.857**	**537.618**	**506.666**
Nitrous Oxide (Gg)	Energy	1.957	2.191	1.979	1.775	1.894	2.039	2.048	2.061	2.039	2.055	2.058	2.068	2.071	2.039	2.039
	Residential	0.631	0.645	0.645	0.63	0.71	0.719	0.726	0.694	0.671	0.642	0.626	0.616	0.603	0.571	0.587
	Industry	3.476	2.723	1.768	0.824	3.465	3.542	3.535	3.552	3.59	3.613	3.648	3.671	3.69	3.748	3.845
	Agriculture	26.262	25.133	24.779	25.356	24.577	24.087	23.181	22.552	22.19	22.023	21.874	21.745	21.635	21.323	21.319
	Transport	1.206	1.335	1.276	1.32	1.345	1.368	1.377	1.39	1.4	1.429	1.455	1.474	1.494	1.571	1.713
	Waste	0.409	0.405	0.411	0.417	0.423	0.429	0.435	0.442	0.448	0.458	0.465	0.471	0.477	0.497	0.526
	Total	**33.941**	**32.432**	**30.858**	**30.322**	**32.414**	**32.184**	**31.302**	**30.691**	**30.338**	**30.22**	**30.126**	**30.045**	**29.97**	**29.749**	**30.029**
Total Emissions GWP-CO2e (Kilo-Tonnes)	Energy	16,767	18,058	17,030	16,847	16,863	17,407	16,822	17,397	18,064	18,432	18,841	19,039	19,365	19,664	20,515
	Residential	6,589	6,724	6,705	6,614	7,186	7,324	7,457	7,271	7,040	6,882	6,788	6,743	6,713	6,591	6,820
	Industry	11,769	11,754	11,319	10,444	11,183	11,706	11,711	11,960	12,694	12,936	13,473	13,759	14,051	14,742	15,886
	Agriculture	20,641	20,252	19,995	20,075	19,821	19,595	18,837	18,294	17,976	17,801	17,630	17,477	17,336	17,065	17,047
	Transport	10,638	11,531	11,678	11,851	12,074	12,295	12,377	12,490	12,578	12,822	13,063	13,259	13,421	14,113	15,384
	Waste	1,651	1,477	1,606	1,750	1,934	1,974	1,923	1,852	1,843	1,845	1,840	1,834	1,790	1,495	847
	F-Gases	671	698	649	781	811	811	811	811	811	811	811	811	811	811	811
	LUCF	-	-	-	-	-	-	-	-	-2,074	-2,074	-2,074	-2,074	-2,074	-3,350	-4,650
	Total	**68,726**	**70,494**	**68,982**	**68,362**	**69,872**	**71,112**	**69,938**	**70,075**	**68,932**	**69,455**	**70,372**	**70,848**	**71,413**	**71,131**	**72,660**

5. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

5.1 Impacts of Climate Change

The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC, 2001) represents the most authoritative scientific assessment of climate change by several hundred scientists. Ireland, as an Island mid-latitude country, can be expected to be faced with the effects of global trends, identified in the TAR, which have implications for the future course of Irish climate, and with it for a range of impacts that it is prudent to anticipate.

The Environmental Protection Agency, through the Environmental Research, Technological Development and Innovation (ERTDI) research programme, has provided some €6.4m towards climate change research in Ireland in the areas of mitigation, adaptation, basic science and observations. Specific objectives for the investment in climate change adaptation research include the provision of analyses of projected climate change and its impacts for Ireland and development of analytical capacity in this area. Reports published to date include *Climate Change: Scenarios and impacts for Ireland*[6], *Climate Change Indicators for Ireland*[7] and *Climate Change: Regional climate model predictions for Ireland*[8].

5.1.1 Climate Change Indicators for Ireland

The *Climate Change Indicators for Ireland* report shows climate change-associated trends are evident in the meteorological and ecological records. These include increasing average temperature, changes in rainfall patterns and a lengthening of the growing season.

5.1.2 Climate Change: Scenarios and Impacts for Ireland

Climate Change: Scenarios and Impacts for Ireland is a major assessment of the possible impacts of climate change on Ireland. The study employs downscaling of sophisticated global climate prediction models. While global models provide information on future climate conditions, outputs from such models are coarse – Ireland, for example, is represented by a small number of grid squares. More detailed outputs and analyses are required to inform planning requirements at smaller regional and local scales. Regional Climate Models offer a solution to this requirement by taking spatially coarse climate predictions from global models and producing detailed analyses for targeted areas. This will increase national capacity to dynamically analyse future climate conditions in Ireland and their impacts at local level.

The study identifies areas of vulnerability to climate change and addresses likely adjustments in the operation of environmental systems in response to such change. It concludes that, in sectors such as agriculture, some new opportunities may arise through increases in certain crop yields. In other areas such as water resource management, long term planning

[6] 'Climate Change: Scenarios and Impacts for Ireland.' Report for the Environmental Protection Agency by the Department of Geography, NUI Maynooth and the Department of Botany, TCD, under the Environmental RTDI Programme 2000 – 2006.
[7] 'Climate Change Indicators for Ireland.' Report for the Environmental Protection Agency by the Department of Geography, NUI Maynooth and the Department of Botany, TCD, under the Environmental RTDI Programme 2000 – 2006.
[8] 'Climate Change: Regional climate model predictions for Ireland.' Report for the Environmental Protection Agency by Community Climate Change Consortium for Ireland, under the Environmental RTDI Programme, 2000-2006.

strategies will be necessary to adapt to adverse impacts. Long lead-in times for adjustment characterise many sectors, for example in forestry, and the study highlights the importance of advance warning arrangements to trigger appropriate responses. By anticipating change, the study concludes that it may be possible to adopt adaptation strategies that minimise the adverse impacts and maximise the positive aspects of global climate change.

The study poses specific scenarios that suggest significant climate change can be anticipated in Ireland over the next half century. These scenarios anticipate that by 2050:

- there will an increase in January temperatures of 1.5ºC;
- winter conditions on the north coast and the north midlands will be similar to those currently experienced along the south coast;
- July temperatures will increase by approx 2.5ºC; and,
- there will be marked reductions in summer rainfall by 25 – 40%.

Furthermore, the study highlights possible impacts of these scenarios in key areas such as agriculture, water supply, marine coastline and the natural environment including the following:

- **Agriculture**: Droughts may result in the need for increased irrigation. The viability of certain crops, such as potatoes, may be threatened.
- **Water**: Impacts include pressures on the water supply infrastructure in the Greater Dublin Area, and the likelihood of increased frequency of flooding in the West.
- **Marine Environment**: General impacts as a result of higher water temperatures; threats to the coastline due to higher sea levels; and general threats to ecosystems and biodiversity.

5.1.3 Climate Change: Regional Climate Model Predictions for Ireland

A study published in 2005 *Climate Change: Regional Climate Model Predictions for Ireland* prepared by the Community Climate Change Consortium for Ireland (c4i), provides an analysis of future Irish climate conditions for the period 2012-2060 using a regional climate model. The study applies data from this model to assess the impact of climate change on river discharge and local flooding in the River Suir catchment area. Conclusions from the study include the following general scenarios:

- **Precipitation**: Most significant changes will occur in June and December. Rainfall in June will decrease by about 10% compared to the present while December values show increases ranging between 10% in the south-east and 25% in the north-west.
- **Flooding**: The predicted increase in winter rainfall was found to increase the risk of future flooding in the area.
- **Temperature**: General warming with mean monthly temperature increasing by between 1.25º and 1.5º. The largest increase will occur in the South East and East, with the greatest warming occurring in July.
- **Storms**: Increased frequency of storms over the North Atlantic in the vicinity of Ireland by about 15% compared to current conditions.

The first report from the c4i project confirms and expands on the findings in the *Climate Change Scenarios and Impacts for Ireland* study. Established in 2003, c4i has enabled the development of a regional climate modelling facility in Met Éireann. The new capacity will

contribute to national efforts in climate change research, will support the community of environmental scientists and will assist policymakers in planning to adapt to climate change.

Further analyses of climate scenarios are being conducted under the auspices of C4i, which will examine the impacts for agriculture and water management, focusing on river basin districts. This analysis is being carried out by Met Éireann and the National University of Ireland Maynooth and will become available in 2006. This will be further developed in subsequent years. Ongoing work includes analysis of river and coastal flooding (storm surges) as well as analysis of change in surface wind for the wind energy community. Increasing attention is also being given to the occurrence of extreme events. The impacts of extreme floods, storms and heat waves have been observed globally in recent years. They can be more damaging than gradual or average changes, which are more easily predicted by climate models. New approaches to statistical and probabilistic analysis of extreme events are being developed to better inform decision making on associated risks and likely impacts.

5.2 Adaptation Measures

5.2.1 Flood Policy

The potential for climate change impacts are already being addressed in a number of policy-making areas. The 2004 report of the Flood Policy Review Group, established following serious flooding in parts of the country in the latter part of 2002, recognised the need to devise a clearly defined and comprehensive policy approach to flooding nationally and a precise definition of the roles and responsibilities of the various stakeholders involved. Climate change is identified as one of the key elements that need to be addressed when assessing future flood relief measures in Ireland.

Following the report, the Government appointed the Office of Public Works (OPW) as the lead agency to implement flooding policy in Ireland and the OPW is currently developing a strategy to manage flood risk in conjunction with other relevant State agencies. The strategy is likely to involve non-structural measures such as storage and better flood forecasting and warning, but will also include structural works particularly where flooding is already a problem. OPW has a programme of flood defence schemes at different stages of development. One aspect of this strategy is the need to raise awareness about how to prepare for potential flooding. A website due to be launched in 2006, will soon be augmented with details of available flood records since the early 1900s which will provide a public record of flood risk areas.

Local Authorities now have the power to consider adaptation initiatives in relation to their development plans. The Planning and Development Act, 2000, empowers planning authorities to provide, in their development plans, that development in areas at risk of flooding may be regulated, restricted or controlled. If development is proposed in a flood-risk area, the risk of flooding can be carefully evaluated and planning permission refused, if necessary.

5.2.2 Integrated Costal Zone Management

Integrated costal zone management is supported by the planning system. Since its inception, the planning system has had a broad remit, not only in the proper planning of our land resources but also in environmental protection. While specialised environmental legislation

has been introduced over the years, the planning system still complements environmental legislation and will continue to play a major part in relation to coastal zone management. The Planning and Development Act, 2000 was introduced to ensure that the Irish planning system can face the challenges meeting the country as it continues to grow and prosper. New requirements for forward and strategic planning have been introduced. A sustainable development ethos has been explicitly incorporated into the planning system. Under the provisions of the Act, each local planning authority must prepare a development plan setting out an overall strategy for the proper planning and sustainable development of the area. The Act provides that a planning authority's development plan may include objectives for, inter alia:

- regulating, restricting or controlling development in areas at risk of flooding (whether inland or coastal), erosion and other natural hazards;
- regulating, restricting and controlling the development of coastal areas and development in the vicinity of inland waterways;
- regulating, restricting and controlling development on the foreshore, or any part of the foreshore.

6. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

6.1 Overseas Development Assistance Programme

Ireland's Official Development Assistance (ODA) has continued to increase since the publication of Ireland's Third National Communication in 2003. In 2003, total ODA stood at €446 million; in 2004, it had increased to €489 million; and by 2005, it had reached €578 million. This represents 0.43% of GNP. At the Millennium Review Summit in 2005, Ireland committed to reaching the UN target of 0.7% ODA by 2012.

Table 1: ODA Volumes 2003-2005

ODA Volumes 2003-2005 €million		
Year	TOTAL ODA	ODA as % GNP
2003	€445.705	0.40%
2004	€488.923	0.40%
2005	€578.460	0.43%

Ireland's development assistance is focused on the Least Developed Countries, particularly those in sub-Saharan Africa. Ireland has bilateral development programmes with Lesotho, Ethiopia, Mozambique, Tanzania, Uganda and Zambia. Irish Aid also has a programme in South Africa and in Timor Leste and Vietnam.

The bulk of Ireland's assistance to developing countries is administered by Irish Aid, located in the Department of Foreign Affairs. The Departments of Agriculture and Food, Environment, Heritage and Local Government, and Enterprise Trade and Employment also contribute to Ireland's ODA. In the last number of years since the publication of Ireland's Third National Communication, Ireland, like a number of other donors, has been working towards a more programmatic and harmonised approach to development cooperation. Ireland is committed to honouring the Paris Declaration on Aid Effectiveness agreed in March 2005. In order to make aid more effective the Declaration states that developing countries will exercise effective leadership over their development policies and strategies and coordinate all development activities. Donor countries should then base their support on these country-owned and led strategies and policies, and work with other donors to ensure harmonised, transparent and cost effective responses to priority needs.

In practical terms, commitment to aid effectiveness involves aligning bilateral assistance with the national poverty reduction strategies of partner governments. This often results in providing financial support to sectors such as health, education and agriculture, or directly to the government's central budget through Direct Budget Support. The essence of the approach is that developing countries should prioritise their development needs and that donors should respond to these rather than their own priority issues. This new approach has obvious implications for reporting on bilateral climate related funding in two key ways:

(i) climate change must be stated as a national priority in order to receive bilateral funds; and

(ii) it is often difficult to segregate spending on climate change as it may be disbursed through support to the central budget or to a key sector such as agriculture or water.

Given the shortage of references to climate change in the development policies and poverty reduction strategies of Ireland's partner countries, there are a limited number of bilateral climate change programmes to report. However, Ireland does support a wide range of activities, programmes and sectors which have benefits for countries addressing climate change. Many activities related to agriculture, health, infrastructure, water resource management and disaster prevention have positive impacts in terms of adaptation to climate change. For example, Ireland spent over US$21 million on agriculture in its programme countries in 2004. Many of the activities supported such as crop diversification, irrigation and the introduction of new crop varieties can make a positive contribution to adaptation to climate change. As it is not possible to put an accurate figure on Ireland's total bilateral contribution to climate change in developing countries, this report focuses on presenting illustrative examples of the types of initiatives supported.

Irish Aid has started to raise awareness of climate change and the risks to development posed by the impacts of climate change in its programme countries. It also supports programmes that build the capacity of policy makers to integrate mitigation and adaptation to climate change into national development plans. Through these efforts Irish Aid hopes to raise awareness of the need to raise the policy profile of climate change in developing countries.

Within its bilateral programme, Ireland supports a range of activities which promote sustainable management of natural resources. Many of these contribute directly to adaptation to climate change, for example agriculture diversification, water resource management, vulnerability assessment and risk reduction. Irish Aid is committed to the EU Action Plan on Climate Change in the Context of Development Cooperation and has recently developed an Environment Policy for Sustainable Development which enhances efforts to mainstream environmental issues into all aspects of the programme.

Ireland also supports climate change activities through multilateral programmes and through support to international agencies. Funding administered through these channels has continued to rise on an annual basis since the Third National Communication. Ireland continues to provide funds to the GEF and in 2005 it also contributed to the Least Developed Countries Fund and the Special Climate Change Fund. Ireland is committed to the Bonn Declaration and has committed funds towards the US$410 million from 2005 to 2008. As a result new and additional funds amounting to US$2,900,000 were made available in 2005.

As part of Ireland's ODA, the following contributions were made in the years 2003-2005.

Table 2: Financial Contributions to the Global Environment Facility

Contribution US$ million			
	2003	**2004**	**2005**
Global Environment Facility	1.3	1.3	1.3
SCCF			0.55
LDCF			2.0
Trust Fund for Participation	0.25		0.1

An overview of funds made available to multilateral institutions and programmes is presented in Table 3.

Table 3: Financial Contributions to Multilateral Institutions and Programmes

Institution or Programme	*Contributions (US$ million)*		
	2003	**2004**	**2005**
1. World Bank	6.4	6.3	9.0
2. IFC			
3. ADB			
4. Asian Development Bank			
5. EBRD			
6. I-A DB			
7. UNDP	15.3	15.5	
8. UNEP	1.6	1.6	1.6
9. UNFCCC Funds: LDCF SCCF			 2.0 0.55
10. Others: LEG LDCF Workshop		 0.02	 0.04 0.05
Multilateral - Scientific, Technological, Training Programmes			
UNITAR		0.15	0.18
REEEP			0.25
CGIAR	7.5	8.4	4.2

6.1.1 Bilateral Cooperation

Over the reporting period interventions designed to improve environmental sustainability were implemented in a number of Irish Aid programme countries. Many of these contribute directly to preparing for and adapting to climate change.

In Tanzania, Irish Aid has supported the Tanga Coastal Zone and Conservation Development Programme over a number of years. This programme, implemented by the IUCN, promotes sustainable fishing practices and has contributed to a significant improvement in coral reef health and fish stocks. In addition, seaweed production has been introduced as a new source of income for women. Mangroves have been replanted and are managed to protect the coast from erosion and storms. Tanga is the only region in Tanzania where the area under mangrove has increased in the past decade. These measures will help local people to adapt to climate change through income diversification, improved management of their resources and protection of the coastline.

Irish Aid supports the national Productive Safety Nets programme in Ethiopia - US$6.9 million was contributed in 2005. The programme targets the most vulnerable members of society who suffer from chronic food insecurity due to drought, soil erosion and degradation and unviable land holdings. The programme addresses hunger, malnutrition and destitution through the provision of cash and food for work. A central focus of the programme is on improving the natural environment, primarily through soil and water conservation activities. Ultimately, the programme hopes to assist chronically poor households to climb out of poverty and to have access to the natural resources they need to survive. Finding ways to cope with

vulnerability under current conditions will help communities to adapt to the increasingly harsh conditions expected due to climate change.

Starting in 2005, Ireland is funding the Ethiopian Bale Eco-region Sustainable Management Programme in collaboration with the Norwegian and Dutch Governments. The programme supports improved planning and management of the largest area of Afroalpine habitat on the African Continent. This area forms the watershed of the Bale Massif, which is critical for the livelihoods and well-being of hundreds of thousands of people in the lowlands of southeast Ethiopia and Somalia. The Herenna Forest, covering the southern part of the mountains, is the second largest stand of moist tropical forest in Ethiopia. The forests together with the Afroalpine plateaux are host to a globally unique and diverse fauna and flora, including several rare and endemic species. By putting in place measures to sustainably manage the Eco-region, the programme will reduce the vulnerability of the ecosystem and its plant, animal and human inhabitants to the impacts of climate change. Irish Aid is supporting this programme over a period of 6 years, starting with US$404,000 in 2005.

6.1.2 Support to Environmental Organisations

6.1.2.1 UNEP

In 2002 Irish Aid entered into a three year Trust Fund arrangement with UNEP focusing on Sub-Saharan Africa. US$1.6 million was provided to UNEP each year for activities related to:

- the protection of freshwater resources;
- access to environmental information for decision-making;
- protection of coastal and marine environment (with an emphasis on coastal and marine fisheries management); and,
- conservation of biological diversity (with an emphasis on monitoring of land cover, protected areas and indigenous vegetation change)

All of these activities helped to increase our knowledge of natural systems and to develop systems to manage resources sustainably and reduce vulnerability to environmental stresses such as climate change.

6.1.2.2 International Institute for Environment and Development (IIED)

In 2005, Irish Aid entered into a funding arrangement with the International Institute for Environment and Development (IIED). Irish Aid supports activities related to biodiversity, climate change and capacity building. For example the Poverty and Conservation Learning Group focuses on bringing the conservation and development communities together to better face the challenges posed to biodiversity conservation, including climate change. Support for climate change activities in the Least Developed Countries builds capacity among decision makers and civil society to address climate change.

Ireland's contribution to the IIED will also support action-oriented research on how to mainstream environmental sustainability into Budget Support and Sector–wide Approaches. This is particularly important, as donors will continue to find it difficult to provide funds for climate change on a bilateral basis until it is a priority in partner countries.

6.1.2.3 World Conservation Union (IUCN)

In 2005, Irish Aid provided support to the IUCN to support local level environmental management activities in Tanzania. Through the development of Village Environmental Management Plans local communities prepare for and adapt to observed and expected climate change. Irish Aid is increasing its support to the IUCN in the period 2006-2008.

6.1.2.4 Consultative Group on International Agricultural Research (CGIAR)

Irish Aid Provides funds to CGIAR for agricultural research which addresses many aspects of adaptation to climate change including crop development, livelihood diversification and water resource management. Irish Aid supports the International Water Management Institute (IWMI), the International Livestock Research Institute (ILRI), The International Food Policy Research Institute (IFPRI) and the International Centre for Research in Agro Forestry (ICRAF). Ireland provided US$7.5 million to CGIAR in 2003 and US$8.5million in 2004.

6.2 Multilateral and International Initiatives

6.2.1 Adaptation

6.2.1.1 Least Developed Countries

In 2005, Irish Aid provided funds to assist the UNFCCC secretariat to hold a workshop on the Least Developed Countries Fund in Bonn. The workshop successfully brought Parties together to discuss the purpose and modalities of the fund. Ireland welcomed the operationalisation of the fund at COP11 and contributed US$ 2 million to the fund in 2005. In addition, Irish Aid provided funds to the UNFCCC's Least Developed Countries Expert Group (LEG) in 2004 and 2005 to facilitate the provision of technical guidance and advice to LDCs on adaptation strategies and plans to address Climate Change. The LEG plays in an important role in supporting LDCs to address climate change in their own countries.

6.2.1.2 Non-Governmental action on Climate Change

Irish Aid supported a Climate Action Network (CAN)/ IIED initiative on adaptation to climate change in developing countries in 2005. Irish Aid provided financial support amounting to US$18,000. The consortium held several events at COP11 focusing on adaptation to climate change, the challenges facing developing countries and ways to strengthen planning for climate change. Irish Aid also supported the Miombo Network to hold an Africa Day event at COP 11.

6.2.2 Adaptation and Mitigation

6.2.2.1 UNITAR –Climate Change Capacity Development Programme

Over the period 2003 to 2005 Ireland granted US$ 333,684 (€276,000) to the United Nations Institute for Training and Research (UNITAR) for its Climate Change Capacity Development Programme. This programme aims to improve the participation of Developing Countries in the UNFCCC process and more specifically:

- to support the timely implementation of the UNFCCC and the Kyoto Protocol by Developing Countries;

- to enable better coordination and integration of national climate policies with sustainable development policies; and,
- to contribute to the sound implementation of donor-funded climate initiatives in Developing Countries.

The programme has met with considerable success in developing methodologies and training programmes to build capacity to climate-proof development, thus safeguarding donor investments. It has focussed on south-south collaboration and on training for trainers to ensure lasting capacity development in the field of Climate Change. Decision makers, high-level government officials and technical staff have been targeted to increase their capacity to integrate Climate Change policies into the overall dimensions of sustainable development.

6.2.2.2 Renewable Energy and Energy Efficiency Programme (REEEP)

Ireland announced funding of €0.21m to REEEP (Renewable Energy and Energy Efficiency Partnership) in 2005. REEEP is a Public-Private partnership and was launched at the Johannesburg World Summit on Sustainable Development in August 2002. It has been developed via an intensive consultation process in 2003 covering a wide range of stakeholders at the national and regional levels.

By providing opportunities for concerted collaboration among its partners, REEEP aims to accelerate the marketplace for renewable energy and energy efficiency. Its goals are to:

1. reduce greenhouse gas emissions;
2. deliver social improvements to developing countries and countries in transition, by improving the access to reliable clean energy services, and by making REES more affordable; and
3. bring economic benefits to nations that use energy in a more efficient way and increase the share of indigenous renewable resources within their energy mix.

Funding from Ireland has been prioritised for projects in least developed countries, and in particular its programme countries of Ethiopia, Lesotho, Mozambique, Tanzania, Uganda and Zambia.

6.2.2.3 Civil Society Partnerships

Irish Aid provides a substantial amount of ODA through partnership with Civil Society Organisations. In 2004 expenditure through civil society partnerships exceeded US$80 million. In recent years more strategic, programmatic cooperation with civil society organisations has increased the effectiveness of spending. The Multi-Annual Programme Scheme is an arrangement begun in 2003, which provides longer term programmatic funding to five NGOs. Two of these, in particular, focus on sustainable natural resource management and disaster risk reduction. Through their programmes these NGOs and the local civil society organisations that they work with in developing countries carry out a wide range of activities, which address livelihood vulnerability and disaster preparedness. It is not possible to put concrete figure on the amount spent on climate change-related activities through these partnerships but it is substantial.

Some examples include a drought management programme in Kenya, an agricultural recovery and diversification programme in Angola, emergency preparedness in Ethiopia and capacity building to address natural disasters in West Africa.

6.2.2.4 Emergency and Recovery

Irish Aid's Emergency and Recovery Programme addresses disaster risk reduction and disaster preparedness. Funds are provided to multilateral institutions and civil society organisations to build community and government capacity to respond to and plan for disasters. It is not possible to give an accurate value for funding to climate change related activities but a growing awareness of climate change is reflected in the projects and programmes supported.

6.3 Technology Transfer

Ireland provides development assistance in line with the priorities expressed by partner countries. To date requests for assistance in the area of technology development and transfer are primarily in connection with water supply, transport infrastructure and agriculture.

An innovative programme in Ethiopia carries out operational participatory research with farmers, extension workers and government officials to identify, develop and disseminate new agricultural technologies. Some of the successful technologies such as soil conservation techniques are based on traditional practices. Other new technologies are related to new crop varieties and irrigation.

6.4 Private Sector

In addition to ODA, private companies also provide technology and advice to developing countries, particularly in the energy sector. Due to the range of funding sources no precise figure is available for funding attributed to technology development and transfer. Ireland's support to REEEP is worth mentioning again here as an example of Ireland's support for technology transfer. REEEP brings the private and public sectors together to facilitate the financing, development and transfer of renewable energy technologies. Ireland believes that this type of public-private collaboration is essential for the development of appropriate and environmentally sound technologies and to facilitate their application and use in developing countries.

Table 4:Overview of Bilateral and Regional Financial Contributions related to the Implementation of the Convention (US$) 2003-2005

2003

	Mitigation	Adaptation		
Recipient Country/Region	**Energy**	**Capacity Building**	**Coastal Zone Management**	**Vulnerability / Risk Reduction**
Tanzania			600,000	
Africa + Asia		111,228		

2004

	Mitigation	Adaptation		
Recipient Country/Region	**Energy**	**Capacity Building**	**Coastal Zone Management**	**Vulnerability / Risk Reduction**
Tanzania			660,000	
Ethiopia				4,200,00
Africa + Asia		111,228		

2005

	Mitigation	Adaptation		
Recipient Country/Region	**Energy**	**Capacity Building**	**Coastal Zone Management**	**Vulnerability / Risk Reduction**
East & South Africa	250,000			
Tanzania			700,000	
Ethiopia				7,300,000
Africa + Asia		111,228		

7. RESEARCH AND SYSTEMATIC OBSERVATION

7.1 General Policy on Funding of Research & Systematic Observations

Funding for climate change research, systematic observations and related activities is provided on a national level though a number of thematic agencies and organisations. The budgetary allocations are provided via relevant Government Departments. Since 2000 research funding has been provided through the National Development Plan (NDP) 2000-2006.

Under the NDP direct funding for environmental research is the responsibility of the Department of Environment, Heritage and Local Government who have requested that the Environmental Protection Agency (EPA) undertake the task of management of this research allocation. The EPA (www.epa.ie) has given a high priority to climate change research and is funding several large-scale projects in this area.

Other Government Departments have similarly devolved direct responsibility for research funding. Climate change related studies have thereby received funding from a number of such bodies. These include the Higher Education Authority (HEA) (www.hea.ie) which provides funding for university and other educational institutions. The HEA have provided funding for the establishment of Environmental Change Institute, which includes a Climate Change Cluster as one of 7 clusters (www.nuigalway.ie/eci). The National Council for Forest Research and Development (COFORD, www.coford.ie) have developed research programs on carbon sequestration in Irish forest ecosystems.

The national meteorological service, Met Éireann, operates a climate analysis section from within its own budget and has primary responsibility for systematic observations of meteorological parameters. Sustainable Energy Ireland (SEI) has responsibility for the development of research in relation to energy, energy management and education on energy usage. Individual research projects and NGO funded work has also been carried out.

In addition other National organisations have supported a number of projects with climate change themes or components, these include Enterprise Ireland (www.enterprise-ireland.com), Teagasc, the Irish agricultural research organisation (www.teagasc.ie) and the Marine Institute (www.marine.ie).

7.2 Exchange of Data and Information

The absence of a climate change data and analysis co-ordination centre, for archiving and decimation of climate change related data and analyses of these, has been identified as a barrier to progress in the development and integration of national climate change work. This is also recognised as a barrier to international access to these data.

The EPA has taken an initiative to overcome these barriers by identifying co-ordination and archival of non-meteorological climate change related data as a function of the National Environmental Research Centre of Excellence (http://coe.epa.ie/). Relevant national emissions data and data collected under EPA funded research programmes will be made available through this centre. Data will be open access via a web interface subject to standard

access and publication protocols. Data from other projects will also be either directly included in this database or linked to it.

Meteorological data for climate change related research are provided on request by Met Éireann. In general, all such data are provided free, or at cost, for research purposes.

7.3 Climate Change Research

Climate change research has developed significantly under the National Development Plan 2000-2006. The EPA investment in climate research is of the order of €7m over the NDP period. Linked infrastructure development, investments for other state agencies, as well as input from European and bilateral projects, are estimated to be of a similar order.

Projects are largely carried out in the university sector but these are also carried out by specialise state agencies and by consultants. This investment has enabled development of national capacity and provided information on a range climate issues.

7.3.1 Climate Process and Climate Systems Studies including Paleoclimate

Climate process studies have been significantly progressed since 2000. These include analysis of signals of climate change, studies of GHG emissions and sinks, analysis of peatlands, studies of aerosol radiative impacts and paleoclimate analysis.

7.3.2 Indicators of Climate Change

A report on climate change indicators was produced in 2002[9]. This report provided a detailed analysis of signals of climate change from meteorological and ecological data, e.g. phenological observations. This shows significant changes to climate of Ireland and ecosystem responses to these changes. This study also contributed to Europe wide indicators analysis published by the EEA. This work is currently being updated.

7.3.3 Greenhouse gases (GHG) Emissions and Sinks

In the European context, Ireland has a relatively unique GHG emissions profile because of its large agricultural sector, a low level of forest coverage. Ireland also has high percentage of peatland, which are of special interest due to their high carbon levels. Research investments have aimed to improve understanding of theses systems and process, their mitigation potentials and also assist reporting to the UNFCCC.

A major study agricultural methane (CH_4) and nitrous oxide (N_2O) emissions has been completed by University College Dublin (UCD) and Teagasc. This has improved national GHG emissions inventories and provided analyses of potential mitigation options, e.g., through the use of feed additives that reduce methane production. This work provided a basis for systems models, which can be used to support decision-making on mitigation options.

A high level analysis of land use and land use change in relation to carbon stocks has been completed by Queens University Belfast. This will assist in future reporting in relation to this

[9] Climate Change, Indicators for Ireland Sweeney et al 2002 ERTDI Report series no. 2

area. A system model and remote sensing study of peatland carbon fluxes has also been competed.

Teagasc is working on analysis of available national soil databases to estimate the quantity of carbon in Irish mineral soils and to examine spatial and temporal variation in soil carbon. A complementary study by University of Limerick examines carbon build up in, and removal from, soils.

COFORD has significantly advanced Forest studies. These have examined carbon sequestration by Irish forest ecosystems. This focuses on Sika Spruce and development of high resolution measurements and systems models. This work informs national inventory analysis for UNFCCC reporting purposes as well as providing decision support tools.

The EPA has funded flux studies by University College Cork and Trinity College Dublin of carbon dioxide (CO_2) and N_2O in grassland, intact peatland and arable land. These studies will be linked to EC funded projects CarboEurope, NitroEurope. An important development has been the application of process models such as the DNDC model to analyse N_20 emissions. This is seen as vital to emissions analysis and determination of mitigation options for this complex area.

At a macro-scale, work on the application of inverse modelling techniques has been applied to ambient measurements of greenhouse gases at the Mace Head atmospheric research station. These methods have been applied to estimate Irish emissions and sinks for certain greenhouse gases including industrial gases. The general approach is to develop complementary bottom-up, top-down and intermediate scale analyses in order to provide cross-validation of research outputs. The EPA in-house environmental research centre (ERC) also facilitates this strategy and ensures that research outcomes support national and international policy aims under the UNFCCC

7.3.4 Peatlands

Peatlands make up approximately 17% of national land cover and a major carbon reservoir. The need to insure its sustainability has been recognised through the establishment of a large scale integrated sustainable development project in 2005. This flagship project will build on and enhance completed and ongoing studies e.g. on carbon fluxes, systems and process models, though integration of these with areas such as sociology, economics, archaeology etc, in-order to develop a strategy for sustainable management of Irish peatlands.

7.3.5 Aerosol Radiative Impacts

Irish scientists have made important contributions to the development of atmospheric sciences. In recent years national research has focused on aerosol science and aerosol cloud inter-actions. Aerosol radiative forcing provides most of the uncertainly in relation to anthropogenic forcing of climate. An extensive range of aerosol measurements and other atmospheric composition studies are carried out at the Mace Head Atmospheric Research Station operated by the National University of Ireland, Galway. These are funded through national and international sources.

7.3.6 Paleoclimateology

Irish peatland and lake systems provide a rich source of information on long-term climate change. The NUIG based Palaeoenvironmental Research Unit (www.nuigalway.ie/pru/) has a very active research programme on the late-glacial period c. 15,000 to 11,500 years Before Present and Holocene environments in Ireland. Studies in TCD have advanced the application of statistical methods to reconstruction of past climate based on pollen analysis (www.tcd.ie/Statistics/).

The recently completed national sea-bed survey by the Geological Survey Ireland (www.gsi.ie) and the Marine Institute has provided a detailed morphology of seabed features and information on composition creating a framework for future paleoclimate studies (www.gsiseabed.ie).

7.3.7 Modelling and Prediction, Impacts and Adaptation

A major achievement of the research programme has been the development of regional modelling and forecasting capacity within Met Eireann[10], which is linked to statistical downscaling work and impacts analysis in the university sector. This enables the ongoing provision of high-resolution information needed to inform sectoral planning. This provides a basis for adaptation planning at national and local levels. This work has been linked to similar activities at European levels e.g. the EC funded Ensembles project and similar UK activities through the British Irish Council.

Work to improve probabilistic analysis of impacts and risks for key sectors, e.g. agriculture, ecosystems and to inform adaptation decision making is being carried out at NUI Maynooth (NUIM). Ongoing development is required to take account of evolving international understanding of global climate change. Impacts of climate change for Ireland have been outlined in a number of research reports[11]

7.3.8 Socio-Economic Analysis

The EPA and SEI have funded a series of economic studies to determine economic and social impacts of climate change. These have principally been focused on impacts of energy/carbon taxes and changes to agricultural practices. The publication of studies on the impacts of climate change and development of regional climate model will facilitate future studies on adaptation and mitigation. Sustainable development studies also include economic analysis as a key component of this work. Further integration of socio-economic analyses into climate change research project is anticipated in future research programmes

7.3.9 Mitigation Technologies and Energy

There is ongoing research in relation to energy efficient and sustainability mainly funded by SEI. This included work on research on the efficient use of energy, CHP and renewable energy sources including biofuels. The EPA has engaged in the promoting the EC Environmental Technologies Action Plan (ETAP) within Ireland. Clean combustion was the

[10]The regional climate model operated by Met Eireann is based on the HIRLAM forecast model.
[11] Climate Change, Scenarios and Impacts for Ireland, Sweeney et al. ERTDI, Report no 15, 2003, Climate Change, Regional Climate Model Predictions for Ireland, McGrath et al ETRDI Report no. 36 2005

theme in a recent call under this thematic plan. Further development of this work to assess issues such as carbon capture and storage is being planned.

7.4 International Participation

Ireland recognises the international nature of climate change and the need to participate in global efforts. The Irish Committee on Climate Change (ICCC) coordinates activities in relation international bodies such as the International Geosphere -Biosphere Programme (IGBP). A Surface Ocean-Lower Atmosphere Study (SOLAS) group has recently been established in NUIG. The development of national climate research capacity has enabled greater national participation in IPCC activities. A number of Irish scientists are lead or review authors in the forthcoming fourth assessment report (AR4). Ireland also hosted an IPCC workshop on uncertainly and risk in 2004 as part of the AR4 development process.

Ireland supports the European Union/European Space Agency (ESA) Global Monitoring for the Environment and Security (GMES) activities and influences its development through the GMES Advisory Council (GAC). Ireland is a member of the Intergovernmental Group on Earth Observations (GEO) and supports its development. Both GMES and GEO contribute to the development of sustained observations systems as required and in support of Global Atmospheric Observing Systems (GCOS). Ireland has also indicated that it will shortly fully join the ESA Earth Observations Programs.

7.5 Systematic Observation

A number of national bodies/organisations are engaged in systematic observations including Global Atmospheric Observing Systems (GCOS). Met Éireann has primary responsibility for meteorological/climatological observations listed below. Responsibility for terrestrial and oceanographic observations is divided among a number of State agencies including the EPA, Marine Institute, universities and other academic institutions. The EPA, Met Éireann and the Marine Institute have established a process to develop a national GCOS plan in response to the GCOS 10 year implementation plan. As part of this process, an international review of national Global Atmospheric Watch was undertaken in 2005. This report is available from http:\\erc.epa.ie\.

7.5.1 Meteorological Observations

Ireland has three main groupings of meteorological observing stations:

- 16 Synoptic stations
- 83 Climate stations
- 491 Rainfall stations

The synoptic stations operated by Met Éireann provide hourly observations of the standard meteorological parameters. This network consists of one Observatory (Valentia) manned 24 hours, five airport stations manned 24 hours, three Coastal (Type 1) stations manned 24 hours Four inland (Type II) stations manned part time but with Automatic Weather Stations (AWS), two unmanned Automatic Weather Stations

All climate stations return daily values of Dry, Wet, Max and Min temperatures and rainfall. 18 of these also report daily sunshine. 15 report on soil and earth temperatures at three depths

each. Roughly 50% of the total would report on some soil and earth temperatures. The daily readings are taken at 0900 GMT. Readings are taken by private individuals, Government bodies, local authorities, schools and colleges etc.

452 of the rainfall stations report daily rainfall at 0900 GMT and 39 stations report monthly falls. Readings are provided by a variety of bodies and private individuals in the same way as for climate stations.

In addition, there are 44 daily and 6 weekly Dines Tilting Syphon Rain Recorders in operation at various locations. There are also 20 evaporation stations using Class A pan evaporimeters.

Data from all the above networks are archived by Met Éireann. These data are quality controlled and kept under continuous scrutiny by the Climatology and Observations Division. The stations are visited regularly by inspectors to ensure, as much as possible, that the siting of instruments and the accuracy of records conform to WMO standards. Records from some stations span more than 100 years. Much of the data since 1941 from the above stations is held in electronic form

7.5.2 Participation in the Global Atmospheric Observing System (GCOS)

Table 1: Atmospheric Observations

	GSN[1]	GUAN[2]	GAW[3]
Number of Stations	2	1	2
Operating Now	2	1	2
Operating to GCOS Standards	Yes	Yes	Yes[4]
Expected to be operating in 2007	2	1	2
Providing Data to International Centres	2	1	2

Notes
[1] Met Éireann stations WMO numbers 03953 and 03980
[2] WMO station number 03953
[3] Mace Head (53° 20'N 9° 54'W) is a Global GAW site operated by the National University of Ireland. Galway and WMO station number 03953 is operated by Met Éireann
[4] Steps are being taken to address a small number of issues identified in the international review of these sites.

Table 2: Participation in the Global Oceanographic Observing Systems

	VOS	SOOP	TIDE GUAGES	SFC DRIFTERS	SUB-SFC FLOATS	MOORED BUOYS	ASAP
For how many platforms is the Party responsible?	15	0	5	0	0	5	0***
How many are providing data to international datacentres?	15	0	0	0	0	5	0
How many are expected to be operating in 2007?	15	0	8 to 11	0	0	6	0

* Reports to GTS only.
** Part of EUCOS SURFMAR.

Table 3: Participation in the Global Terrestrial Observing Systems

	GTN-P	GTN-G	FLUXNET	Other
How many sites are the responsibility of the Party?	-	-	-	-
How many of those are operating now?	-	-	-	-
How many are providing data to international data centres?	-	-	-	-
How many are expected to be operating in 2007?	-	-	-	-

8. EDUCATION, TRAINING AND PUBLIC AWARENESS

The principal vehicles for promoting public awareness of climate change issues are the Environment Information Service (ENFO) of the Department of the Environment, Heritage and Local Government, the National Sustainable Development Partnership (COMHAR), the Environmental Protection Agency (EPA), Sustainable Energy Ireland (SEI) and through the environmental non-governmental organisation (NGO) sector.

8.1 Environment Information Service (ENFO)

ENFO was established in by the Government in 1990 with the mission to promote environmental awareness and sustainable living. It has its own premises which are open to the public and includes a reference library. It has a comprehensive web-site (www.enfo.ie), publishes information leaflets involves itself in various outreach activities such as school visits, thematic exhibitions, lectures and seminars and participates in public events and occasionally radio and television programmes. Most of its services are provided free of charge.

ENFO currently addresses over 100 environmental topics. Climate change receives prominent attention. For example, ENFO prepared and distributes a number of leaflets on climate change, “Climate Change: Science”, “Climate Change: Impact”, “Climate Change: Policy” and the “Greenhouse Effect”. Every year, ENFO hosts exhibitions relating to climate change with accompanying workshops attracting approx. 2,000 school children.

8.2 COMHAR

COMHAR was established by the Government in 1999 in order to promote sustainable development across economy and society. COMHAR’s 25 members are appointed by the Minister for the Environment, Heritage and Local Government from the state/public sector, economic sectors, environmental NGOs, social/community NGOs and the professional/academic sector. COMHAR organizes its work around seven themes: satisfaction of human needs by the efficient use of resources, equity among generations, respect for ecological integrity and biodiversity, equity among countries and regions, social equity, respect for cultural heritage/ diversity, and good decision-making.

COMHAR actively cooperates with other councils for sustainable development in Europe. Since 2002, COMHAR has had a working group on climate change, which prepared publications on climate change such as “Subsidies and emissions of greenhouse gases from fossil fuels” and “Options for carbon taxation expenditure in favour of renewable energy and against fuel poverty in Ireland”, developed recommendations to the Government on the NCCS and on the introduction of carbon/energy taxation, and acted as a forum for dialogue on climate-related issues among various stakeholders.

8.3 Sustainable Energy Ireland (SEI)

SEI promotes sustainable supply and use of energy. Within the “Built Environment”. programme, SEI provides training on efficient use of energy in buildings, administers grants for businesses and homeowners to install renewable energy technologies, prepares and distributes information leaflets and organizes public consultations. The “Industry” programme

targets specific needs of the industry sector through demonstration and dissemination of best practices in energy saving; preparation of training guides and case studies; and organization of topical exhibitions, seminars and conferences. Other relevant activities include a curriculum-based schools programme; preparation and distribution of various printed materials on efficient use of energy; support of an energy hotline; support of the SEI web site (www.sei.ie); and organization of national campaigns such as the annual Energy Awareness Week (since 1998) and the annual Car Free Day (since 2000).

8.4 Environmental Protection Agency

The Environmental Protection Agency has generated considerable public discussion through its research programmes and publications, including “Climate Change – Scenarios and Impacts for Ireland” and “Climate Change – indicators for Ireland”.

8.5 Department of the Environment, Heritage and Local Government

The Department of the Environment, Heritage and Local Government has also raised public awareness of climate change in the context of the national Environmental Awareness Campaign, focusing mainly on the domestic sector to show people where they contribute to increasing greenhouse gas emissions. The climate change element of the campaign included a communication on straightforward steps the individual can take to decrease emissions through the climate change part of the broader “10 Steps” campaign; a burst of television advertising backed up by a series of radio advertisements; development of both general and technical web-site material on climate change to allow easy access to the information required; a leaflet raising awareness of climate change, particularly in relation to driving habits, for mail-out with motor taxation renewal forms; and a poster campaign. In addition, a climate change logo was developed to be used across the full spectrum of media and communication tools. The logo will have longevity for use in future campaigns.

8.6 Environmental Non-Governmental Organisations

Environmental NGOs play an important role in raising public awareness of climate change and are active during the preparation of national policy on Climate Change. The Environmental NGO sector is less developed than those in some other member states of the EU. The Department of the Environment, Heritage and Local Government has been engaged in helping such NGOs to build capacity through the provision of funding and the establishment of a limited company to provide shared resources and to coordinate efforts of the sector.

The Department also provides financial support for specific programmes and initiatives undertaken by NGOs to raise awareness of environmental issues, including climate change. The Green Schools Programme is one such initiative, which is administered by An Taisce and has engaged over 60% of schools in the State. Its focus has been on sustainable waste management but is also covers sustainable energy use, water management and transport.

Annex 1: Greenhouse Gas Emissions 1990-2004

I. CO_2 Emissions Trends 1990-2004

II. CH_4 Emissions Trends 1990-2004

III. N_2O Emissions Trends 1990-2004

IV. HFCs, PFCs, SF_6 Emissions Trends 1990-2004

V. All GHG Summary Emissions Trends 1990-2004

I. Carbon Dioxide (CO_2) 1990-2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**30,383.71**	**30,461.61**	**31,079.37**	**30,731.50**	**31,903.86**	**32,648.99**	**33,883.11**	**35,966.57**	**37,879.80**	**39,762.91**	**41,376.65**	**43,533.24**	**42,752.56**	**42,098.05**	**42,687.92**
A. Fuel Combustion (Sectoral Approach)	30,244.81	30,319.31	30,938.62	30,571.59	31,741.21	32,482.19	33,722.39	35,825.55	37,771.95	39,645.86	41,305.84	43,399.24	42,687.16	42,039.16	42,616.62
1. Energy Industries	11,099.29	11,572.35	12,248.31	12,256.14	12,601.19	13,268.56	13,991.19	14,664.34	15,032.71	15,686.74	15,987.06	17,196.14	16,267.87	15,598.85	15,218.91
2. Manufacturing Industries and Construction	4,112.24	3,842.26	3,619.81	3,598.98	3,708.70	3,527.72	3,511.76	3,987.60	3,917.48	4,237.75	4,743.34	4,726.29	4,892.17	4,784.71	4,710.24
3. Transport	5,035.61	5,265.07	5,682.19	5,667.32	5,882.58	6,368.98	7,127.86	7,752.89	8,847.78	9,818.64	10,210.97	11,062.84	11,230.63	11,392.65	12,092.64
4. Other Sectors	9,997.67	9,639.63	9,388.32	9,049.14	9,548.75	9,316.93	9,091.58	9,420.72	9,973.98	9,902.73	10,364.47	10,413.97	10,296.49	10,262.95	10,594.83
5. Other															
B. Fugitive Emissions from Fuels	138.90	142.30	140.75	159.91	162.65	166.80	160.73	141.02	107.85	117.06	70.82	134.00	65.40	58.88	71.30
1. Solid Fuels															
2. Oil and Natural Gas	138.90	142.30	140.75	159.91	162.65	166.80	160.73	141.02	107.85	117.06	70.82	134.00	65.40	58.88	71.30
2. Industrial Processes	**2,094.84**	**2,012.20**	**1,925.66**	**1,886.35**	**2,127.53**	**2,047.50**	**2,111.49**	**2,449.89**	**2,337.40**	**2,288.11**	**2,783.96**	**3,091.47**	**2,870.75**	**2,345.62**	**2,504.09**
A. Mineral Products	1,105.67	981.62	922.69	940.89	1,071.72	1,074.50	1,189.03	1,375.68	1,279.30	1,345.02	1,900.68	2,054.06	2,061.07	2,345.62	2,504.09
B. Chemical Industry	989.17	1,030.58	1,002.97	945.46	1,055.81	973.00	922.46	1,074.21	1,058.10	943.09	883.29	1,037.40	809.68		
C. Metal Production															
D. Other Production															
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other															
3. Solvent and Other Product Use	**80.94**	**82.82**	**83.04**	**83.50**	**84.40**	**86.19**	**86.87**	**87.28**	**88.33**	**85.01**	**80.32**	**79.55**	**77.20**	**75.71**	**74.47**
4. Agriculture															
A. Enteric Fermentation															
B. Manure Management															
C. Rice Cultivation															
D. Agricultural Soils															
E. Prescribed Burning of Savannas															
F. Field Burning of Agricultural Residues															
G. Other															
5. Land Use, Land-Use Change and Forestry[2]	**106.75**	**350.38**	**449.39**	**182.48**	**152.41**	**188.53**	**178.72**	**393.21**	**166.07**	**11.76**	**111.96**	**-51.88**	**-22.00**	**-298.02**	**6.82**
A. Forest Land	-522.31	-446.07	-225.49	-281.62	-225.18	-264.06	-231.63	-319.14	-470.41	-533.30	-446.06	-643.18	-744.28	-1,043.95	-638.82
B. Cropland	10.52	16.28	12.44	-57.72	-14.62	-51.24	-13.00	39.16	51.58	-7.20	36.25	29.36	120.74	103.42	171.93
C. Grassland	562.67	725.23	619.02	476.95	348.79	464.03	401.41	621.90	535.75	497.71	473.19	514.97	577.61	607.63	476.45
D. Wetlands	44.68	44.56	44.43	44.31	42.37	31.87	31.43	31.00	30.56	30.13	23.36	22.92	22.49	22.05	21.62
E. Settlements	11.20	10.39	10.92	12.48	14.36	14.35	17.85	20.29	23.69	24.42	25.22	37.61	31.73	40.37	38.97
F. Other Land	NA,NE,NO	NA,NE,NO	-11.92	-11.92	-13.31	-6.42	-27.34		-5.10			-13.57	-30.30	-27.54	-63.32
G. Other															
6. Waste															
A. Solid Waste Disposal on Land															
B. Waste-water Handling															
C. Waste Incineration															
D. Other															
7. Other *(as specified in Summary 1.A)*															
Total CO2 emissions including net CO2 from LULUCF[3]	**32,666.23**	**32,907.01**	**33,537.46**	**32,883.83**	**34,268.20**	**34,971.21**	**36,260.20**	**38,896.96**	**40,471.60**	**42,147.79**	**44,352.89**	**46,652.37**	**45,678.51**	**44,221.37**	**45,273.31**
Total CO2 emissions excluding net CO2 from LULUCF[3]	**32,559.48**	**32,556.64**	**33,088.07**	**32,701.35**	**34,115.79**	**34,782.67**	**36,081.48**	**38,503.75**	**40,305.53**	**42,136.03**	**44,240.93**	**46,704.25**	**45,700.51**	**44,519.38**	**45,266.48**

II. Methane (CH_4) 1990-2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Total N_2O emissions	**31.62**	**31.07**	**31.14**	**31.55**	**32.54**	**33.16**	**33.42**	**33.29**	**35.18**	**35.59**	**33.94**	**32.43**	**30.86**	**30.32**	**29.82**
1. Energy	**3.15**	**3.23**	**3.34**	**3.28**	**3.65**	**3.63**	**3.81**	**4.18**	**4.55**	**4.92**	**4.86**	**5.34**	**5.05**	**4.87**	**4.93**
A. Fuel Combustion (Sectoral Approach)	3.15	3.23	3.34	3.28	3.65	3.63	3.81	4.18	4.55	4.92	4.86	5.34	5.05	4.87	4.93
1. Energy Industries	1.34	1.51	1.62	1.59	1.68	1.68	1.73	1.85	2.00	2.06	1.96	2.19	1.98	1.77	1.72
2. Manufacturing Industries and Construction	0.37	0.34	0.35	0.26	0.39	0.38	0.37	0.43	0.42	0.45	0.50	0.50	0.50	0.49	0.49
3. Transport	0.28	0.31	0.34	0.45	0.54	0.56	0.71	0.86	1.03	1.26	1.21	1.33	1.28	1.32	1.42
4. Other Sectors	1.16	1.07	1.03	0.98	1.03	1.01	1.00	1.04	1.10	1.14	1.19	1.31	1.29	1.29	1.30
5. Other															
B. Fugitive Emissions from Fuels															
1. Solid Fuels															
2. Oil and Natural Gas															
2. Industrial Processes	**3.34**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**1.89**	**0.94**	-	-
A. Mineral Products															
B. Chemical Industry	3.34	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	1.89	0.94	-	-
C. Metal Production															
D. Other Production															
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other															
3. Solvent and Other Product Use															
4. Agriculture	**24.76**	**24.85**	**24.80**	**25.27**	**25.90**	**26.55**	**26.63**	**26.12**	**27.63**	**27.66**	**26.05**	**24.81**	**24.46**	**25.04**	**24.46**
A. Enteric Fermentation															
B. Manure Management	1.31	1.36	1.37	1.40	1.39	1.41	1.43	1.46	1.49	1.51	1.44	1.38	1.35	1.34	1.33
C. Rice Cultivation															
D. Agricultural Soils	23.45	23.49	23.43	23.87	24.51	25.14	25.20	24.66	26.14	26.15	24.62	23.42	23.11	23.70	23.13
E. Prescribed Burning of Savannas															
F. Field Burning of Agricultural Residues															
G. Other															
5. Land Use, Land-Use Change and Forestry															
A. Forest Land															
B. Cropland															
C. Grassland															
D. Wetlands															
E. Settlements															
F. Other Land															
G. Other															
6. Waste	**0.37**	**0.37**	**0.39**	**0.38**	**0.37**	**0.36**	**0.36**	**0.37**	**0.38**	**0.39**	**0.41**	**0.41**	**0.41**	**0.42**	**0.42**
A. Solid Waste Disposal on Land															
B. Waste-water Handling	0.37	0.37	0.39	0.38	0.37	0.36	0.36	0.37	0.38	0.39	0.41	0.41	0.41	0.42	0.42
C. Waste Incineration															
D. Other															
7. Other *(as specified in Summary 1.A)*															

III. Nitrous Oxide (N_20) 1990-2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Total N_2O emissions	**31.62**	**31.07**	**31.14**	**31.55**	**32.54**	**33.16**	**33.42**	**33.29**	**35.18**	**35.59**	**33.94**	**32.43**	**30.86**	**30.32**	**29.82**
1. Energy	**3.15**	**3.23**	**3.34**	**3.28**	**3.65**	**3.63**	**3.81**	**4.18**	**4.55**	**4.92**	**4.86**	**5.34**	**5.05**	**4.87**	**4.93**
A. Fuel Combustion (Sectoral Approach)	3.15	3.23	3.34	3.28	3.65	3.63	3.81	4.18	4.55	4.92	4.86	5.34	5.05	4.87	4.93
1. Energy Industries	1.34	1.51	1.62	1.59	1.68	1.68	1.73	1.85	2.00	2.06	1.96	2.19	1.98	1.77	1.72
2. Manufacturing Industries and Construction	0.37	0.34	0.35	0.26	0.39	0.38	0.37	0.43	0.42	0.45	0.50	0.50	0.50	0.49	0.49
3. Transport	0.28	0.31	0.34	0.45	0.54	0.56	0.71	0.86	1.03	1.26	1.21	1.33	1.28	1.32	1.42
4. Other Sectors	1.16	1.07	1.03	0.98	1.03	1.01	1.00	1.04	1.10	1.14	1.19	1.31	1.29	1.29	1.30
5. Other															
B. Fugitive Emissions from Fuels															
1. Solid Fuels															
2. Oil and Natural Gas															
2. Industrial Processes															
A. Mineral Products															
B. Chemical Industry															
C. Metal Production															
D. Other Production															
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other															
3. Solvent and Other Product Use															
4. Agriculture	**24.76**	**24.85**	**24.80**	**25.27**	**25.90**	**26.55**	**26.63**	**26.12**	**27.63**	**27.66**	**26.05**	**24.81**	**24.46**	**25.04**	**24.46**
A. Enteric Fermentation															
B. Manure Management	1.31	1.36	1.37	1.40	1.39	1.41	1.43	1.46	1.49	1.51	1.44	1.38	1.35	1.34	1.33
C. Rice Cultivation															
D. Agricultural Soils	23.45	23.49	23.43	23.87	24.51	25.14	25.20	24.66	26.14	26.15	24.62	23.42	23.11	23.70	23.13
E. Prescribed Burning of Savannas															
F. Field Burning of Agricultural Residues															
G. Other															
5. Land Use, Land-Use Change and Forestry															
A. Forest Land															
B. Cropland															
C. Grassland															
D. Wetlands															
E. Settlements															
F. Other Land															
G. Other															
6. Waste	**0.37**	**0.37**	**0.39**	**0.38**	**0.37**	**0.36**	**0.36**	**0.37**	**0.38**	**0.39**	**0.41**	**0.41**	**0.41**	**0.42**	**0.42**
A. Solid Waste Disposal on Land															
B. Waste-water Handling	0.37	0.37	0.39	0.38	0.37	0.36	0.36	0.37	0.38	0.39	0.41	0.41	0.41	0.42	0.42
C. Waste Incineration															
D. Other															
7. Other *(as specified in Summary 1.A)*															

IV. HFCs, PFCs, SF_6 1990-2004

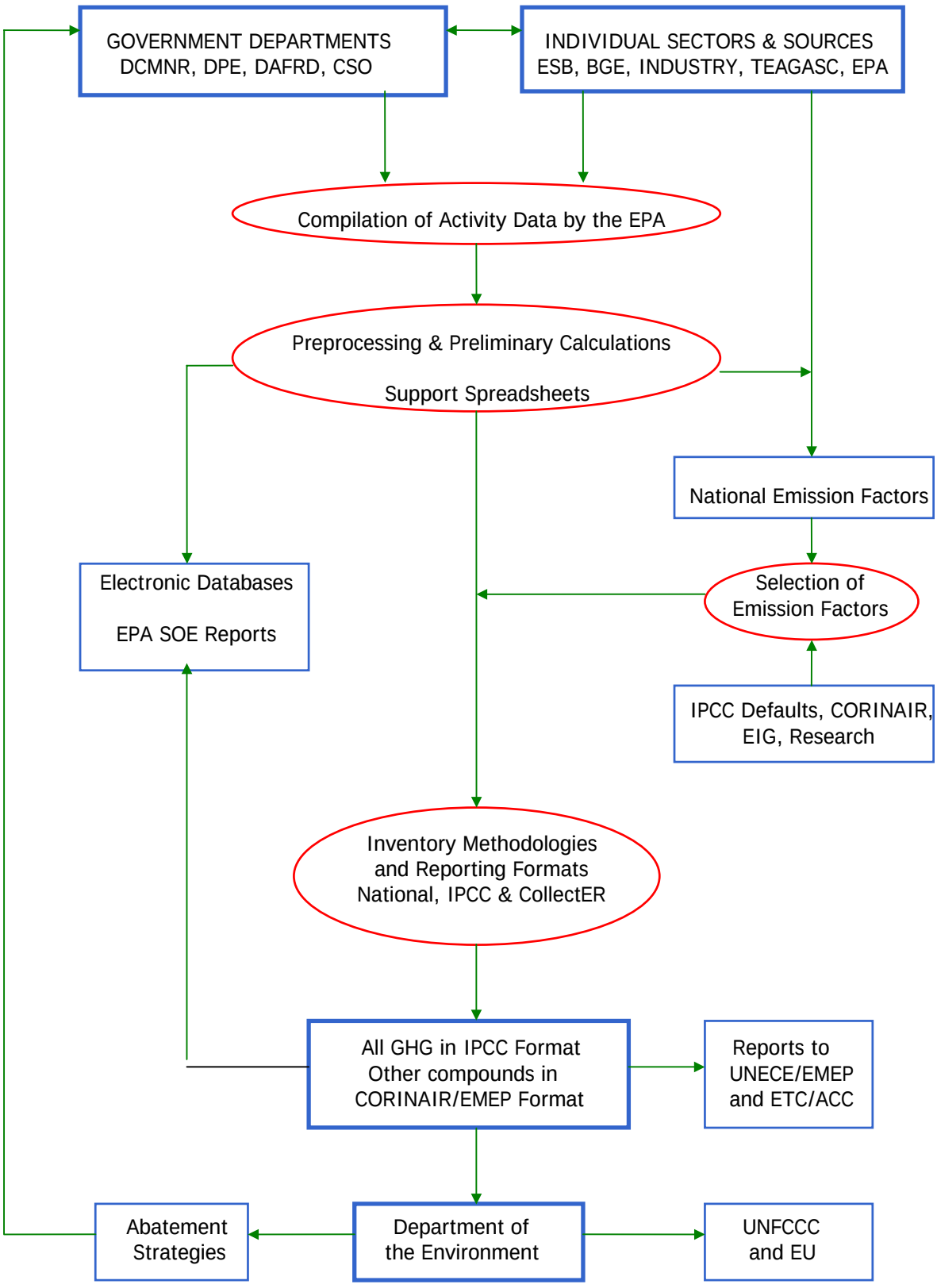
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990 (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)
Emissions of HFCs - ($Gg CO_2$ eq.)	**0.69**	**5.13**	**5.89**	**8.89**	**20.45**	**44.60**	**75.64**	**130.99**	**189.02**	**194.83**	**228.93**	**253.07**	**288.84**	**357.91**	**399.25**
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-41															
HFC-43-10mee															
HFC-125		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
HFC-134															
HFC-134a	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.08	0.12	0.11	0.13	0.15	0.17	0.20	0.21
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-143															
HFC-143a		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236fa															
HFC-245ca															
Unspecified mix of listed HFCs - ($Gg CO_2$ eq.)															
Emissions of PFCs - ($Gg CO_2$ eq.)	**0.09**	**0.09**	**0.09**	**0.09**	**75.38**	**75.38**	**103.09**	**130.82**	**61.87**	**195.93**	**305.41**	**295.98**	**212.40**	**228.79**	**196.37**
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
C_2F_6	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.02	0.02	0.02
C_3F_8															
C_4F_{10}															
$c\text{-}C_4F_8$													0.00	0.00	0.00
C_5F_{12}															
C_6F_{14}															
Unspecified mix of listed PFCs - ($Gg CO_2$ eq)															
Emissions of SF6 - ($Gg CO_2$ eq.)	**35.40**	**36.38**	**37.36**	**38.33**	**81.85**	**82.83**	**102.06**	**132.10**	**94.24**	**68.96**	**55.91**	**69.43**	**70.22**	**118.59**	**70.01**
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

V. Greenhouse Gases 1990-2004

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
CO2 emissions including net CO_2 from LULUCF	32,666.23	32,907.01	33,537.46	32,883.83	34,268.20	34,971.21	36,260.20	38,896.96	40,471.60	42,147.79	44,352.89	46,652.37	45,678.51	44,221.37	45,273.31
CO2 emissions excluding net CO_2 from LULUCF	32,559.48	32,556.64	33,088.07	32,701.35	34,115.79	34,782.67	36,081.48	38,503.75	40,305.53	42,136.03	44,240.93	46,704.25	45,700.51	44,519.38	45,266.48
CH_4	13,215.96	13,396.72	13,468.58	13,584.48	13,584.24	13,658.67	14,061.52	14,319.02	14,259.35	13,732.07	13,376.07	13,172.85	13,146.94	13,735.97	13,285.28
N_2O	9,801.99	9,632.70	9,654.21	9,779.97	10,086.57	10,279.24	10,361.68	10,320.58	10,905.14	11,034.23	10,521.43	10,054.19	9,565.64	9,399.85	9,243.07
HFCs	0.69	5.13	5.89	8.89	20.45	44.60	75.64	130.99	189.02	194.83	228.93	253.07	288.84	357.91	399.25
PFCs	0.09	0.09	0.09	0.09	75.38	75.38	103.09	130.82	61.87	195.93	305.41	295.98	212.40	228.79	196.37
SF_6	35.40	36.38	37.36	38.33	81.85	82.83	102.06	132.10	94.24	68.96	55.91	69.43	70.22	118.59	70.01
Total (including net CO_2 from LULUCF)	55,720.37	55,978.04	56,703.59	56,295.59	58,116.69	59,111.92	60,964.19	63,930.48	65,981.22	67,373.81	68,840.63	70,497.90	68,962.55	68,062.49	68,467.28
Total (excluding net CO_2 from LULUCF)	55,613.62	55,627.66	56,254.20	56,113.11	57,964.28	58,923.38	60,785.47	63,537.27	65,815.15	67,362.05	68,728.67	70,549.78	68,984.55	68,360.50	68,460.46

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.	CO_2-eq.
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
1. Energy	31,665.36	31,757.08	32,387.91	32,008.14	33,269.36	34,002.81	35,287.99	37,493.27	39,512.58	41,500.00	43,097.80	45,402.54	44,507.99	44,346.10	44,400.91
2. Industrial Processes	3,166.43	2,866.26	2,781.45	2,746.11	3,117.66	3,062.75	3,204.72	3,656.26	3,494.73	3,560.03	4,186.65	4,294.30	3,734.39	3,050.92	3,169.72
3. Solvent and Other Product Use	80.94	82.82	83.04	83.50	84.40	86.19	86.87	87.28	88.33	85.01	80.32	79.55	77.20	75.71	74.47
4. Agriculture	19,240.15	19,425.74	19,460.76	19,688.71	19,856.60	20,083.07	20,455.48	20,582.13	21,207.28	20,787.46	19,712.98	19,296.04	19,058.84	19,137.49	18,981.72
5. Land Use, Land-Use Change and Forestry	106.75	350.38	449.39	182.48	152.41	188.53	178.72	393.21	166.07	11.76	111.96	-51.88	-22.00	-298.02	6.82
6. Waste	1,460.75	1,495.77	1,541.04	1,586.65	1,636.26	1,688.55	1,750.39	1,718.33	1,512.23	1,429.55	1,650.92	1,477.36	1,606.13	1,750.28	1,833.63
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)	55,720.37	55,978.04	56,703.59	56,295.59	58,116.69	59,111.92	60,964.19	63,930.48	65,981.22	67,373.81	68,840.63	70,497.90	68,962.55	68,062.49	68,467.28

Annex 2: Institutional Arrangements for Compilation of Inventories



DMNR : Department of the Marine & Natural Resources
DPE : Department of Public Enterprise
DAFRD : Department of Agriculture, Food & Rural Development
CSO : Central Statistics Office
ETC/ACC : European Topic Centre Air & Climate Change

ESB : Electricity Supply Board
EPA : Environmental Protection Agency
BGE : Bord Gais Eireann
EIG : Emissions Inventory Guidebook
SOE : State of the Environment

Annex 3: Information on Models Used for Projections

Integrated Power Model – ICF Consulting	
Gas / Sector	Energy - Power Generation sub-sector - CO_2 CH_4 N_2O
Model Type	Optimisation model utilising a dynamic linear programming formulation to deliver a given level of electricity output at least cost given a set of capacity and dispatch constraints including among other things, national energy policy, reserve margins, connection with external electricity networks and the cost of carbon allowances within the EU ETS.
Purpose	Consulting tool developed by ICF Consulting
Strengths	Ability to accurately replicate the operation of complex electricity generation and transmission systems within a given market structure
Weakness	
Synergies	Takes account of national energy policy such as the EU RES-E Directive that requires Ireland to produce 13.2% of electricity output from renewable sources by 2010. The level of electricity demand is an exogenous variable that takes account of policies aimed at demand side management. The operation of the EU Emissions Trading Scheme is reflected by carbon allowances being valued as part of the dispatch decision making process
References	Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012 www.icfconsulting.com

Energy Model Linked to HERMES Macroeconomic Model – Economic & Social Research Institute	
Gas / Sector	Energy – Fugitive sub-sector - CH_4 Residential sector - CO_2 CH_4 N_2O Agriculture – Fuel Combustion sub-sector - CO_2 CH_4 N_2O Industry – Commercial, Institutional & Services sub-sector - CO_2 CH_4 N_2O Transport – Gas Transmission sub-sector - CO_2 CH_4 N_2O
Model Type	Iterative model with feedback mechanisms linked to HERMES econometric model of the Irish economy
Purpose	Economic forecasting and policy analysis
Strengths	Forecasts linked to future economic growth and energy prices
Weakness	Excludes impact of improved technology or energy efficiency
Synergies	
References	www.esri.ie

Waste Emissions Model – Department of Heritage, Heritage & Local Government	
Gas / Sector	Waste sector - CH_4 N_2O
Model Type	Excel based forecasting model
Purpose	Waste and waste emission projections
Strengths	Can be used for scenario analysis
Weakness	
Synergies	Incorporates effects of Biowaste Strategy April 2006
References	Graham_craig@environ.ie

CARBWARE – National Council of Forestry Research & Development (COFORD)	
Gas / Sector	Land Use Change & Forestry - CO_2
Model Type	Biological system model
Purpose	Calculate carbon sequestration from forestry in accordance with IPCC guidelines
Strengths	Sequestration calculated using Ireland specific research data and in accordance with IPCC best practice guidelines
Weakness	
Synergies	
References	www.coford.ie

FAPRI – Ireland Partnership	
Gas / Sector	Agriculture – Enteric Fermentation, Manure Management & Agricultural Soils sub-sectors - CH_4 N_2O
Model Type	Econometric model of agricultural outputs and inputs
Purpose	Economic forecasting and policy analysis
Strengths	Can model the effect of changes to the Common Agricultural Policy on the level of agricultural outputs and inputs at both the macro and farm level
Weakness	The calculation of agricultural emissions is complex and outputs from the model in some cases need to be manipulated before input into the Environmental Protection Agency models for calculating agricultural emissions
Synergies	Takes account of the agricultural policy framework under the Common Agricultural Policy as well as, the effect of wider environmental policies such as the EU Nitrates Directive, and macroeconomic projections from the Economic & Social Research Institute
References	www.tnet.teagasc.ie

Road Transport Emissions Model – Byrne O'Cleirigh Consultants	
Gas / Sector	Transport sector – Road Transport sub-sector - CO_2 CH_4 N_2O
Model Type	Excel based forecasting model
Purpose	Road transport emission projections
Strengths	Emissions from various categories of road transport are projected independently before the effect of various policies and measures are estimated
Weakness	Subjective estimation of estimating the effect of various emission reduction measures.
Synergies	Includes an estimation of the effect of various national and EU wide policies and measures to reduce emissions
References	Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012

Industry Emissions Model – Byrne O'Cleirigh Consultants	
Gas / Sector	Energy sector – Oil Refining & Solid Fuel Manufacture sub-sectors - CO_2 CH_4 N_2O Industry sector – Fuel Combustion & Process sub-sectors - CO_2 CH_4 N_2O Industry sector – Industrial Gases sub-sector – Solvents & 'F' Gases
Model Type	Bottom up model incorporating expert opinion from major emitters
Purpose	Preparation of National Allocation Plan for phase 11 of the EU-ETS
Strengths	A bottom up approach is required given the skewed pattern of emissions where a few large emitters account for c 85% of emissions
Weakness	Bias in expert opinion
Synergies	Takes account of major one off developments in industrial sector such as new cement production capacity
References	Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012