IRELAND

THIRD NATIONAL COMMUNICATION

under the

UNITED NATIONS FRAMEWORK CONVENTION

ON CLIMATE CHANGE

Contents

EXECUTIVE SUMMARY

This is Ireland's Third National Communication under the 1992 UN Framework Convention on Climate Change. It charts developments and identifies action in the context of Irish climate change policy since the Second National Communication (July 1997), the most significant being the publication of the National Climate Change Strategy (November 2000) and its ongoing implementation.

Within the EU, Ireland has one of the higher per capita emissions of greenhouse gases. This is in part due to the limited capacity for hydropower development and a policy not to avail of nuclear power. Energy generation accounts for nearly 30 % of national emissions of greenhouse gases and is almost totally dependent on fossil fuels. In addition, agricultural activity accounts for one-third of the total greenhouse gas emissions and, together with energy generation and transport, accounts for over 70% of emissions of greenhouse gases.

In 2001, net emissions of greenhouse gases were 31% above 1990 levels, therefore, rather than restricting increases, Ireland must reduce emissions in order to meet its 13% limitation target above 1990 levels by the commitment period 2008-2012. The National Climate Change Strategy (2000) recognises that significant action is required to meet Ireland's target and to prepare for more ambitious targets post-2012.

Ireland is committed to early and real action to tackle the world's most threatening environmental problem. Ireland continues to play its part in the EU's continuing leadership in international climate policy towards meeting commitments under the United Nations Framework Convention on Climate Change and Kyoto Protocol.

National Circumstances

Since the publication of the Second National Communication, Ireland has achieved sustained economic growth. The outlook for future growth depends to a significant extent upon the speed of recovery in the international economy, about which considerable uncertainties remain. However, economic growth is set to continue, albeit at a lower rate. This growth has a direct bearing on the increase in greenhouse gas emissions, namely through:

- increased energy consumption by industries, businesses and households;
- increased use of private transport;
- increased population and household formation;
- increased waste production with the bulk being consigned to landfill.

Current greenhouse gas emissions projections and Government policy to encourage continued economic growth and development underlie the need for effective sustained action across all sectors to achieve real emissions reductions. The Government is committed to achieving the required reductions while sustaining more favourable economic and social circumstances.

Greenhouse Gas Inventories

For some time Ireland has been working on the compilation of a consistent CRF time series for the years 1990 through 2001, as required by the UNFCCC Reporting Guidelines. Inventory data in the Third National Communication is consistent with the 1990-2001 CRF time-series and the second National Inventory Report compiled in accordance with the proposals for revision of the UNFCCC Reporting Guidelines on Annual Inventories (FCCC/SBSTA/2002/2/Add.2). Among the tasks and

improvements to achieve this consistent time series was substantially improved and refined estimates for carbon sequestration in forests recently calculated by COFORD (National Council for Forest Research and Development) together with the inclusion, of emissions estimates for HFCs, PFCs and SF_6. In this context, Ireland has intends to use 1995 as the base year for fluorinated gases.

Policies and Measures

The Government-agreed National Climate Change Strategy sets out a range of cross-sectoral and sector-specific measures for implementation over a ten-year period to ensure that Ireland meets its Kyoto target. Full implementation of the Strategy will reduce emissions by over 15 Mt CO_2 equivalent per annum during 2008-2012.

Key issues in the climate change strategy include the use of market mechanisms such as Taxation and Emissions Trading and sector-specific policies and measures to address greenhouse emissions. Targeted sectors include Energy, Transport, the Built Environment and Residential Sectors, Industry, Commercial and Services Sectors, Agriculture and Forestry

Projections and Total Effects of Policies and Measures

The national greenhouse gas projections presented here have been developed as part of the biennial review of the National Climate Change Strategy and to meet the needs of this communication. They incorporate several policy changes and developments since the previous projections (2000), notably, the reforms to the EU Common Agricultural Policy and the closure of several large industrial installations not yet fully reflected in the inventories. Total greenhouse gas emission projections for 2010 show an overall increase of 27.6 % on 1990, driven primarily by increases in CO_2 derived energy consumption but offset to some degree by a significant drop in projected emissions of CH_4 and N_2O as a result of agricultural policy reforms. The measures outlined in the NCCS which sets out domestic measures designed to deliver approx. 15 Mt CO_2 is sufficient for Ireland to comply with its Kyoto target.

Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

Climatic scenarios for Ireland for 2041 – 2070 and 2061 – 2090 suggest a general increase in January temperatures of approximately 1.5°C by mid century, increasing to 2.5°C by 2075. By mid century, winters in the northern part of Ireland and in the north midlands will be similar to those of Cork & Kerry during the 1961 – 1990 period. Summer temperatures will also rise, which, when combined with likely changes in precipitation patterns, may lead to increased occurrence of soil moisture deficits and drought stress. Precipitation scenarios suggest an average winter increase of 11% and an average decrease of 25% during the summer months. The magnitude and frequency of flood events will probably increase.

Agriculture and forestry practices will be significantly impacted through changes in temperature, precipitation and CO_2 concentrations in the atmosphere. Biological diversity and natural land and marine ecosystems are also likely to be impacted. Sea level change is likely to increase levels of coastal erosion

Financial Assistance and Transfer of Technology

The Irish Government's national programme of

assistance to developing countries, Development Cooperation Ireland, was established in 1974. While the programme has grown steadily over the past three decades, the rate of growth increased dramatically in recent years. Total spending on official development assistance is expected to reach €450 million in 2003 compared to €158 million in 1997, an increase of €292 million or 186% over the period. In 2003, Ireland devoted 0.41% of its GNP to ODA.

While much of Ireland's climate related assistance has been channelled through multi-lateral organisations, specific bilateral projects have been undertaken in the fields of Hydrology, Coastal Zone Management and Watershed Management. Ireland's bilateral support for the transfer of climate change related technologies has been limited to such adaptation related activities.

Research and Systematic Observation

Climate change research, systematic observations and related activities are undertaken on a national level through a number of thematic agencies and organisations. Since 2000, funding has been provided under the National Development Plan 2000 – 2006 and is directed through the most appropriate Government Department. While the environmental research allocation is managed by the Environmental Protection Agency (EPA), other funding bodies such as the Higher Education Authority, National Council for Forest Research and Development (COFORD), Enteprise Ireland, Teagasc and the Marine Institute have also provided resources for climate-change related research. Met Éireann, the national meteorological service, operates a climate analysis section from within its own budget and has primary responsibility for systematic observations of metereological parameters. Sustainable Energy Ireland (SEI) has responsibility for research in relation to energy, energy management and education on energy usage. Individual research projects and NGO funded work has also been carried out.

Research projects are currently underway in the areas of regional climate model development, indicators of climate change, impacts of climate change, paleoclimate studies, greenhouse gas emission inventories and the carbon cycle, the radiation balance, and economic and social impacts.

Met Éireann has primary responsibility for meteorological and climatological observations. However, a number of other bodies such as the EPA, Marine Institute, universities and other academic institutions are involved in terrestrial and oceanographic observations.

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, Comhar, the National Sustainable Development Partnership prepared proposals in 2001 on how best to communicate the National Climate Change Strategy. The National Environmental Awareness Campaign now includes a significant climate change element and over €1.2m was provided for the campaign in 2002.

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 House of Representatives), and the Seanad (the Senate). The current President is Mary McAleese. 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 the 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 Europe between longitude 6° and 9° west and at latitudes 52° and 56°. 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 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°C and 7°C while the warmest are July and August, with mean temperatures of between 14°C and 16°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

In 2002, the State's population was just over 3.9 million, a growth of over 10% on 1991 levels. On the basis of the 2002 census, a high proportion of the population continues to be concentrated in the younger age-groups, with approximately 37% aged under 25. Population density of

under 56 persons per square kilometre remains relatively low compared to other countries in Europe. 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. *Guidelines for Planning Authorities on Residential Density* were issued in 1999. The Guidelines recommend that, in general, increased densities should be encouraged on serviced land or land proposed to be serviced. The Guidelines state that planning authorities should review and vary, if necessary, their Development Plans to promote higher residential densities, particularly in re-developing brownfield sites and in proximity to town centres and public transport corridors. 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.

1.4 Economic Profile

The Irish economy is an open, mostly export-based economy that experienced an unprecedented level of growth during the latter half of the 1990s. The Irish economy is heavily dependant on trade, with export of goods and services amounting to over 96.8% of GDP (1999 figure). GDP grew by an average of 8.8% per annum over the period 1997-2002. The current outlook for the Irish economy depends upon the speed of recovery in the international economies about which considerable uncertainties remain. Membership of the European Union and access to the Single Market has allowed Ireland to diversify its trade patterns. Sustained growth has moved Ireland to a more favourable position among its EU partners, with income currently approximating the EU average. The tangible arrival of the Euro at the start of 2002 has helped cement the link between Ireland and the European Union and enlargement of the EU will provide an opportunity for Ireland to expand into new markets.

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 42%. 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 2001, 63% of Irish exports were to the EU. This is down from 70% in 1995, indicating increased diversification. The EU also accounted for 63% of imports. The UK remains our largest trading partner and is the destination for 22% of our exports.

The ICT, chemical/pharmaceuticals and food/agricultural products sectors continue to be the most important in terms of exports and contribution to GDP. The ICT sector alone employs over 80,000 people and accounts for 10% of Irish GDP. A further 35,000 are employed in pharmaceutical/chemical and medical companies, with exports valued at US$21 billion in 2000 (30% of total exports). The industrial sector as a whole accounts for 40% of GDP. 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 52% of GDP and for 64% of employment. In 2000, Ireland was the third-largest exporter per capita of internationally traded services, accounting for 18.7% of total exports. The most important service industries are computer services, tourism and financial services.

In 2001, the total labour force was reported to be 1,825,500, representing 59.7% 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 4.5% (Nov. 2002), representing almost full employment

1.6 Energy Profile

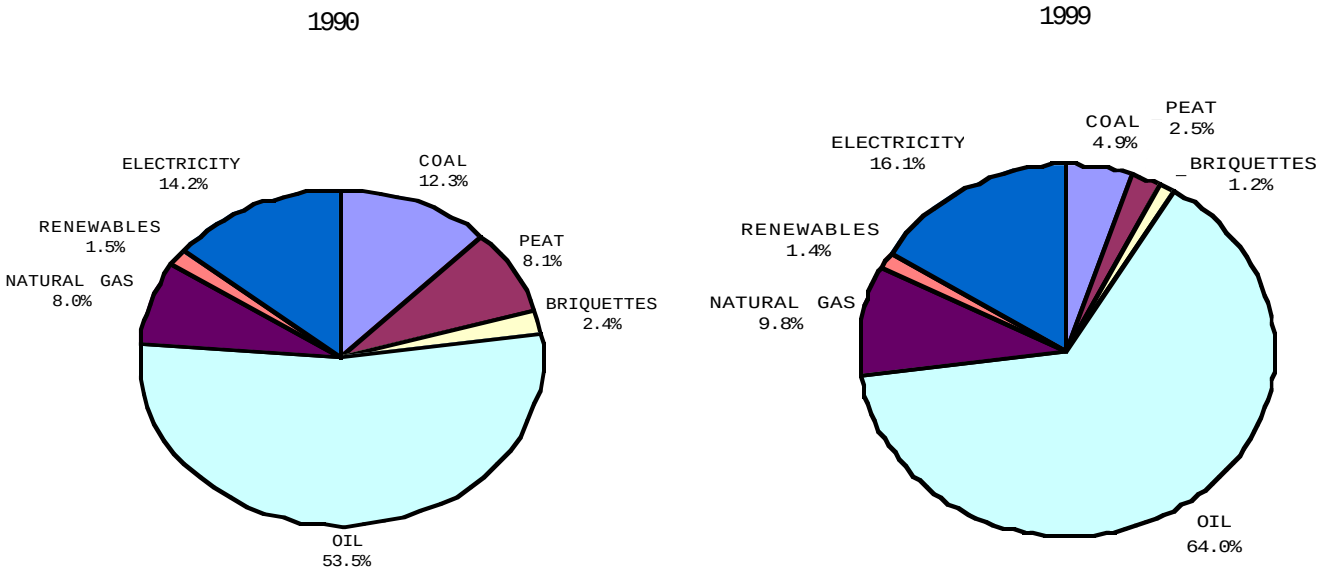
The use of energy in Ireland continues to grow; between 1990 and 2000, the total primary energy requirement grew by 49%. The amount of energy consumed per capita is also increasing, and this trend is projected to continue. There has been significant growth in the transport sector, which has seen energy consumption increase by 65% since 1990.

A report prepared by Sustainable Energy Ireland entitled *"Energy Efficiency in Ireland-2000"* highlighted the following indicators in relation to Irish energy consumption in the 1990's:

- In 1999 there was an increase in final energy consumption of 7.1%. This was slightly down on the 7.4% increase in 1998 but still reflects the rapid growth being experienced in Ireland's economy;
- Electricity showed strong growth with an increase of 7.1% in 1999, compared to 5.4% in 1998 and its overall share of final consumption went from 14% in 1990 to 16.1% in 1999;
- Growth in oil usage was 10.8% in 1999, compared to 9.9% in 1998 and the overall share of final consumption in the period 1990-'99 went from 54% to 64%;
- The natural gas share of final consumption rose from 8% to 9.8% between 1990 and 1999 and reflects its growing penetration in the residential sector. Natural gas growth in 1999 was somewhat slower at 3.5%, compared to 11.1% in 1998.
- The share of coal, peat and briquettes have all shown a fall in the share of final consumption (12%-4.9%, 8%-2.5% and 2%-1.2% respectively).

These increases in overall energy consumption reflect the strong economic growth in the mid 1990's, which peaked at 10.7% growth in 1997. An analysis of the figures of final energy consumption in 1990 and 1999 is outlined below.

Final Energy Consumption by Energy in Ireland



1.7 Transportation

In Ireland, roads are the dominant mode of internal transport, accounting for 90% of freight traffic and 96% of passenger traffic, and are therefore vital for future economic and social development at both national and local level. At the end of 2000, there were 1.3 million private cars on Irish roads, accounting for approximately 79% of all vehicles on the road. Some 205,000 freight vehicles are also registered, representing 12% 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 norm, up from 230 per 1,000 head of population in 1990 to 317 in 1997 and a projected 430 by 2010. Substantial traffic growth increases of up to 6% per annum have 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.

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 6.9 million hectares, of which 4.4 million hectares is used for agriculture (about 64% of total land area), and 650,000 hectares for forestry (about 9.4% of total land area). Some 80% of the agricultural land is devoted to grass (silage, hay and pasture), 11% to rough grazing and 9% to crop production. Beef and milk production currently account for 58% of output. The average farm size is now around 29 hectares. Primary agriculture accounts for some 3.4% of GDP, 6.6% of employment and 4.8% of exports[1] . Ireland's livestock numbers in June 2002 included 7 million cattle, 7.2 million sheep, 1.8 million pigs and 12.7 million poultry units.

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. Over the period 1990 to 2000, 273,000 hectares were afforested and 84,000 hectares reforested (after harvest). The total forest area in Ireland at the end of 2000 was 665,000 hectares which represents 9% of the total land area of the country.

1.9.1 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%.

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. Currently broadleaves comprise close to 20% of current planting, rising to 30% by the end of 2006.

The Irish wood harvest in 2001 was 2.5 million cubic metres, comprised in the main of conifers (97%) and predominantly Sitka spruce. The wood is used in a wide range of products, from structural sawnwood to fencing products, pallet products and panel products including 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.

Following the agreement at the Ministerial Conference on the Protection of Forests in Lisbon in 1998 on criteria and indicators for sustainable forest management, a National Forest Standard, supported by a Code of Best Forest Practice and a suite of environmental guidelines was launched by the Forest Service in 2000. The standard contains a range of indicators and measures that address Lisbon Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles. The standard is subject to continuous updating and monitoring by the Forest Service.

There is also close liaison between the Forest Service and environmental and planning agencies on forest development, especially in the area of forest establishment.

1.9.2 Carbon Sequestration

In the Irish Government's National Climate Change Strategy, forestry has been allocated a significant role in mitigating emissions. Forest sinks, resulting mainly from afforestation since

[1] 9.9% of GDP, 9.7% of employment and 8.4% of exports if agri-food sector is included – this covers agriculture, food, drinks and tobacco.

1990 (Article 3.3 of the Kyoto Protocol), are to remove 1.01 million tonnes of carbon dioxide annually. This represents 7% of the target annual reduction of 15.4 million tonnes over the first commitment period.

Initial estimates of carbon sequestration in Irish forests, based on the increment of conifer and broadleaved forests, have been significantly revised to make allowance for age distributions, harvest levels and afforestation achieved. It is now estimated that afforestation since 1990 will sequester 1.76 mega tonnes of carbon over the first commitment period, 2008-2012. It must be emphasised that these are preliminary data and more accurate estimates will emerge following the completion of the national forest inventory sampling phase and the Research and Development programme by COFORD, which is funding research on carbon stacks and dynamics in forest ecosystems in Ireland. This research is focused on four separate work areas - carbon fluxes using eddy covariance technology; soil carbon fluxes; soil carbon stores; and carbon stores and biomass expansion factors.

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

1.10 Waste 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 indicate that in 2001, more than 87% of municipal waste was sent to landfill (source: National Waste Database Report for 2001 – EPA).

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 Inventories

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 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 2002 and 2003.

The complete inventory currently comprises a time series from 1990 to 2001 for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and a time series from 1995 to 2001 for the fluorinated or F-gases (HFCs, PFCs, and SF6). It is intended that 1995 will be 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 2.

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

2.2 General Summary

Total reported emissions (excluding net CO_2 from Land use Change and Forestry) increased from 53.4 million tonnes CO_2 equivalent in the base year to 70 million tonnes CO_2 equivalent in 2001, an increase of 31%. The overall increase was driven by the growth in CO_2 emissions from energy use, which is well shown by the similarities between energy growth in figure 2.1 and the CO_2 trend in figure 2.2. The increase in CO_2 amounted to 46% over the 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. This reported increase is somewhat exaggerated by the effect of fuel 'tourism' in the in the transport sector (see below under 2.3 Carbon Dioxide CO_2). The increase in reported emissions from 2000 to 2001 was 2.6% for all greenhouse gases and 5.2 percent for CO_2.

Figure 2.1 Total Emissions by Source Category (Gg CO2)

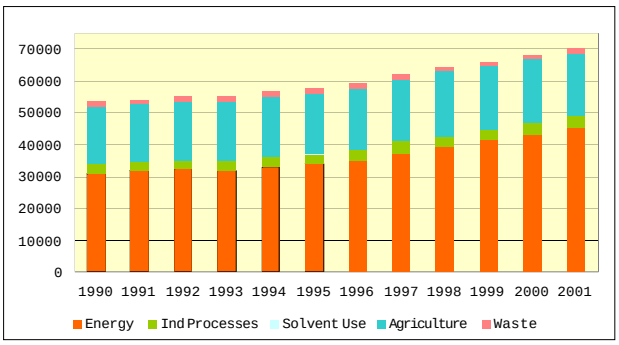
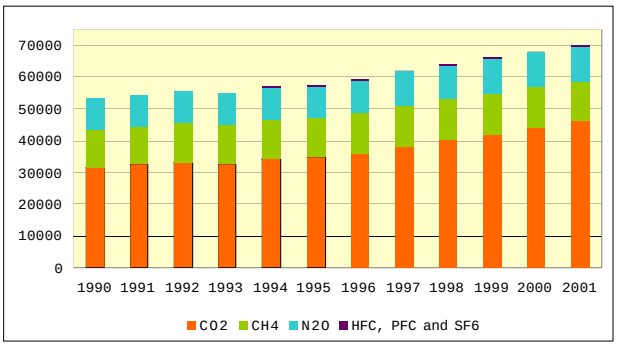
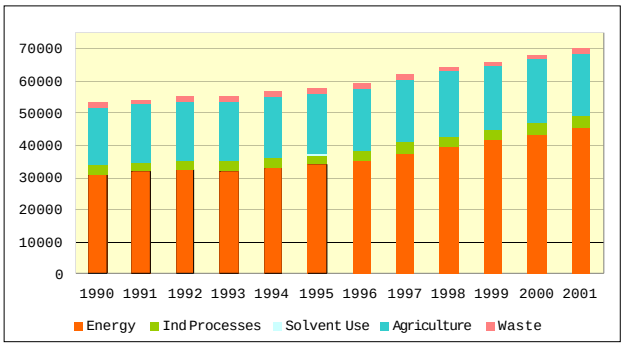


Figure 2.2 Total Emissions by Gas (Gg CO2)



In 2001, the *Energy* sector accounted for 65 % of total emissions, lower than most other Annex I parties, whereas *Agriculture* accounted for a comparatively larger share of total national emissions at 27 percent. A further 6 % emanated from *Industrial Processes* and 2% was due to *Waste*. Emissions of CO_2 accounted for 66% of the total 70 million tonnes CO_2 equivalent in 2001, with CH_4 and N_2O contributing 18% and 15% respectively, with the remainder from the F-gases. The CO_2 share in the total continues to increase as the emissions of the other main gases remain relatively constant. The trends in the principal components of agricultural emissions are shown in figure 2.3 in terms of CO_2 equivalent. These emissions from agriculture equal approximately 19m tonnes CO_2 equivalent annually. However, this share has decreased from 33% in 1990 to approximately 27 percent in 2001 due to the rapid CO_2 increase and a slight downturn in CH_4 and N_2O emission from agriculture after 1998, and this trend is likely to continue with the recently adopted EU CAP reforms and the decision by Ireland to opt for the full 'decoupling' option under these reforms. Although the emissions of F-gases show an increase of 331% from 1995 to 2001, their combined total accounted for less than 1 % of the total emissions in 2001.

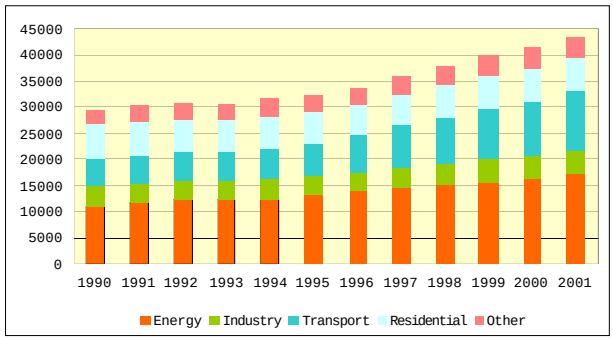
Figure 2.3 Emissions from Agriculture (Gg CO2)



2.3 Carbon Dioxide CO_2

Emissions of CO_2 accounted for 66 % of the total 70 million tonnes CO_2 equivalent in 2001, 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 (figure 2.4). 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 63% up to 2001. The increase in CO_2 from transport sources, largely accounted for by road traffic due to sustained growth in vehicle and road travel, is exaggerated by the phenomenon of fuel 'tourism', whereby a significant proportion of automotive fuel purchased in Republic of Ireland is consumed by vehicles in Northern Ireland and Britain because of favourable retail prices differential. The apparent increase in national transport emissions between 1990 and 2001 is 120%. The proportion of apparent national consumption which results from fuel 'tourism' was estimated to be approximately 6% for petrol in 2000 but it may have been as high as 20% in the case of diesel. The apparent increase in transport emissions between the 1990 base year and 2001 is exaggerated further by the fact that fuel 'tourism' was reversed in 1990 and there was significant cross-border movement of automotive fuels into the State, as fuel prices here were higher then than in the North.

Figure 2.4 CO_2 Emissions from Fuel Combustion (Gg CO2)



Ireland has only a small number of energy-intensive industries. Nevertheless, CO_2 emissions in the industrial sector grew by approximately 23% between 1990 and 2001. Residential fuel combustion accounts for the bulk of emissions from other energy-use sectors and this source category is a larger contributor to CO_2 emissions in Ireland than combustion in industry (figure 2.4). Although residential energy consumption increased by 15% from 1990 to 2001, the emissions in this sector have shown a modest decrease of 4% because of the decline in the use of carbon-intensive fuels such as peat and coal and an increase in the use of natural gas with the extension of the national gas pipeline system.

2.4 Methane (CH_4)

Emissions of CH_4 accounted for 18 % of the total 70 million tonnes CO2 equivalent in 2001, with 88% of this from the agriculture sector, a further 10% from waste disposal and the remainder from the energy sector. There has been little change in agricultural policy or practice in Ireland over the past 35 years. Large livestock populations produce about 0.55m tonnes of CH_4 annually through enteric fermentation. Methane emissions from agriculture have shown a small increase of 6% between 1990 and 2001. However, it is likely there will be reduction from this source category as herd numbers fall as a result of the reforms to the Common Agricultural Policy. Total emissions from agriculture show a slight downturn after 1999, reflecting a decrease in cattle populations and some reduction in fertiliser use.

2.5 Nitrous Oxide N_2O

Emissions of N_2O accounted for 15 % of the total 70 million tonnes CO_2 equivalent in 2001, with 78 % of this from the agriculture sector (of which 91% from agricultural soils), a further 16% 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_2O per year. N_2O emissions from agriculture have shown a small increase of 8 % between 1990 and 2001. There has been a decrease of 43 % of 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. Since 2001 nitric acid production has ceased entirely in Ireland. Emissions from transport, though a relatively small component of overall N_2O emissions, have increased by almost 500%, reflecting the increased penetration of vehicles fitted with catalytic converters between 1990 and 2001.

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

Emissions of the F-gases accounted for 1% of the total 70 million tonnes CO_2 equivalent in 2001, with 39% of these emissions from HFCs, 50 % from PFCs and 11% from SF_6 There has been just over an eleven-fold increase in emissions of HFCs between 1995 and 2001, 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 four, driven by the growth in semi-conductor manufacture, though emissions of SF_6 have fallen by 20%. Despite the large increases in the F-gases overall between 1995 and 2001, they still only account for 1% of overall emissions.

3. Policies and Measures

3.1 Climate Change Strategy

The Government-agreed National Climate Change Strategy (published November 2000) sets out a range of cross-sectoral and sector-specific measures for implementation over a ten-year period to ensure that Ireland meets its Kyoto target, within the EU burden-sharing agreement to limit the increase in greenhouse gas emissions to 13% above 1990 levels by 2008 to 2012. Full implementation of the Strategy will reduce emissions by over 15 $MtCO_2$ equivalent per annum during 2008-2012, which will ensure that Ireland meets its Kyoto target (see table).

Table 3.1 Proposed Reductions through the NCCS

Quantified Indicative Reductions Proposed in the National Climate Change Strategy*

SECTOR	Mt CO_2 Equivalent
Energy	5.65
Transport	2.67
Built Environment & Residential	0.9
Industry, Commercial Sector	2.175
Agriculture	2.41
Sinks (Additional Sequestration)	0.76
Waste	0.85
Overall Total	**15.415 $MtCO_2$ Equivalent**

* See Annex 3 for a more detailed breakdown table

Emission of greenhouse gases in 2001 were 31 % above 1990 levels and without the measures set out in the NCCS, the then projections indicated that, on a 'business as usual' basis, this figure could rise to 37% by 2010. The *ESRI Medium Term Review 2001-2007* (September 2001) suggests that the growth in emissions will now be 27% – 29%, resulting in an annual reduction target of 12 Mt CO_2 equivalent. However, this scenario assumes achievement of reductions in emissions from some measures already envisaged in the NCCS, and as such, does not mean that the ambition of the Strategy can be relaxed.

A cross-Departmental Climate Change Team, chaired by the Department of the Environment, Heritage and Local Government, oversees the implementation of the NCCS. The team has undertaken widespread consultation on implementation arrangements. It is developing indicators to measure implementation at sectoral and national level. The team will also look at the costs and benefits of implementing specific measures and is currently undertaking the first review of the Strategy, in consultation with Comhar, the National Sustainable Development Partnership.

3.2 CROSS-SECTORAL MEASURES

Cross-sectoral market-based instruments 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; equity requires that equivalent action be taken across all sectors. Economic instruments comprise a variety of measures that 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.

The two main market-based cross-sectoral instruments are ***taxation*** and the ***trading*** of greenhouse gas emissions.

Taxation

A paper on the key elements for a framework for greenhouse gas taxation was prepared by the Department of the Environment, Heritage and Local Government, in discussion with the Economic Analysis sub-group of the Climate Change Team. This was presented to the Tax Strategy Group under the aegis of the Department of Finance and, in his speech presenting the 2003 Budget, the Minister for Finance asked all relevant Government Departments to advance plans for a general carbon energy tax, with a view to introducing this from the end of 2004. The Department of Finance issued a comprehensive consultation document on the introduction of such a tax in August 2003.

Emissions Trading

Direct access for companies to emissions trading will be provided for through the European Union Emissions Trading Directive, which is currently being transposed into Irish law. This directive will apply to one third of Irish Greenhouse Gas Emissions[2]. Approximately 100 sites will be engaged directly in the Pan-EU emissions trading market. Their initial allocation will be reflective of their contribution to Ireland's obligations under the Kyoto Protocol. The total quantity of emissions allowances allocated to those engaged in trading will be decided by the Government, in accordance with the provisions of the Climate Change Strategy. The Environmental Protection Agency (EPA) will be responsible for operational aspects of the Trading Scheme and initial allocations to sites.

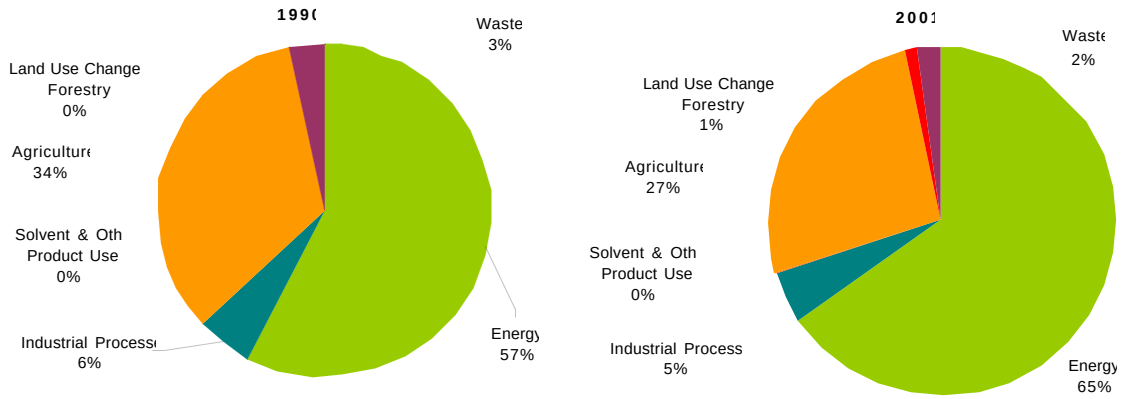
3.3 Sector Specific Measures

Examples of specific policies in the NCCS in the course of implementation and policies which have a beneficial benefit on overall greenhouse gas emissions follow below.

3.3.1 Energy Sector

Figure 3.1 shows that the share of Greenhouse Gas Emissions (GHG) arising from energy-related activities in Ireland has increased from 57% to 66% between 1990-2001. This differs from the EU as a whole, where energy production and use represented 80% of GHG emissions in 1990[3]. This divergence is due to the significant role of agriculture in the Irish economy.

Figure 3.1: Greenhouse Gas Emissions by Source



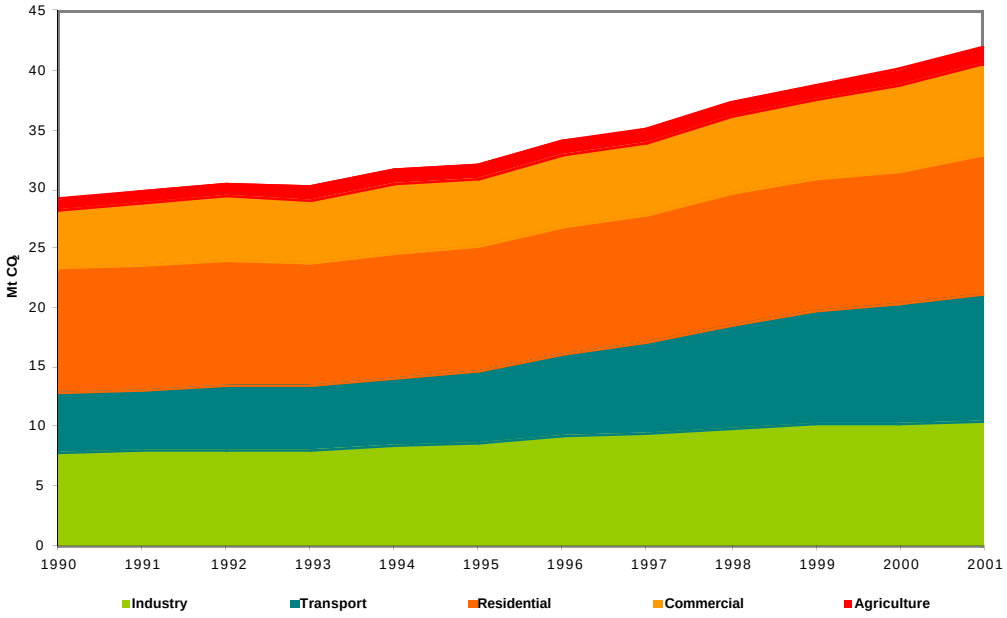
2 2001 inventory

3 Commission of the European Communities (1998) *COM(98)353 Climate Change – Towards an EU Post-Kyoto Strategy*.

Figure 3.2 provides a sectoral breakdown of energy related CO_2 emissions (which represent 96% of energy related GHG emissions) for 1990 to 2001. Energy-related CO_2 emissions in 2001 were 44% higher than 1990 levels.

The most significant area of growth has been in the transport sector, where CO_2 emissions in 2001 were 120% higher than in 1990(see chapter 2 for explanation). High growth levels were also evident in the commercial-public/ tertiary/services sector.

Figure 3.2: Transport Emissions and Energy Consumption Scenarios

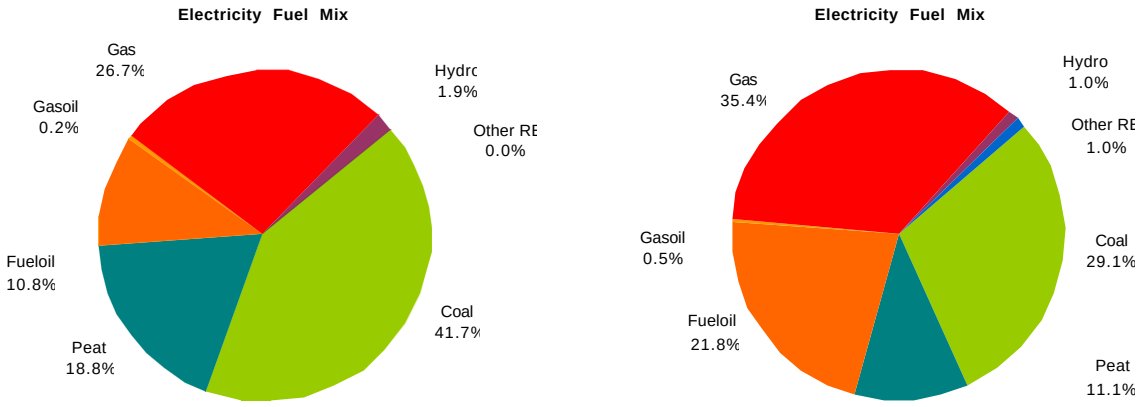


3.3.1.1 Electricity Production

The energy supply sector contributed 32.0% of Ireland's CO_2 emissions in 1990. Since 1990, changes in generating technology and the fuel mix have resulted in changes in the CO_2 emissions per kWh of electricity generated. The share of high carbon content fuels such as coal has been reducing, with a corresponding rise in the contributions from the low carbon fuel natural gas and from oil, a relatively low carbon fuel. This resulted in the carbon intensity of electricity dropping from 0.89 kg CO_2/kWh in 1990 to a low of 0.76 kg CO_2/kWh in 2000.

As Figure 3.3 demonstrates, gas has now become the dominant fuel source in electricity generation in Ireland, accounting for over 35% of total production. Although this increase in gas for electricity generation has positive environmental impacts due to its lower carbon content and increased efficiency, it also raises security of supply concerns. The depletion of the major domestic supply source, the Kinsale Fields, coupled with the availability of gas from the UK, has led to a consistent replacement of domestic gas with imports over the last five years. In 2001, gas imported from the UK supplied 82% of the Irish demand. However, the UK itself is expected to become a net gas importer by around 2006.

Figure 3.3: Electricity Generation Fuel Mix in 1990 and 2001



3.3.1.2 Renewable Sources

The national target, as set out in the *Green Paper on Sustainable Energy (September 1999)*, was to add 500 MW of new renewable energy-based electricity generating plant by 2005. This target has been increased, subject to EU State Aid approval, by an additional 140 MW onshore and specific categories of biomass-fed CHP (28 MW) and two 25 MW projects in offshore wind category. The latter two category projects are to be built by 2006.

Two competitions in the Alternative Energy Requirement (AER) Series, AER V and AER VI, were launched in 2001 and 2003 respectively to deliver these targets. The ESB is obliged to purchase the successful AER-sourced electricity at prices bid by the selected applicants for fifteen years. The ESB's net additional cost arising from this obligation, above what a best new entrant using conventional technologies would receive, is recoverable. The additional cost is passed on to all electricity account holders as a Public Service Obligation (PSO) levy and is clearly identified as a separate item on every individual's electricity bill.

When fully operational, the projects supported in both competitions will achieve a reduction of 977,000[4] tonnes of CO_2 emissions per annum for the purposes of the National Climate Change Strategy.

At the end of October 2003, five AER V projects (23MW) had been completed and a further 20 projects (150MW) were either under construction or are due to commence works before the end of the year. In addition, a further 40MW of wind capacity has been added to the grid since the beginning of January 2002 under the liberalised green electricity market mechanism.

Besides the contracts offered for two offshore wind demonstration projects in AER VI, construction of Phase 1 (25.2 MW) of an offshore project at the Arklow Banks is currently underway under the liberalised green electricity mechanism. Seven 3.6 Megawatt turbines have been installed approximately 10km from the Wicklow coastline. Commissioning of the units is currently in progress and the project is expected to begin producing electricity before the end of the 2003.

4 Source: Sustainable Energy Ireland

The Minister will launch a fundamental review of the renewable energy sector before the end of 2003. This will involve the publication of a consultation document with an invitation to all interested parties to contribute towards the process of determining future targets, support mechanisms and identification of impediments to the increased deployment of renewable energy technologies. The review will take into account the target and obligations addressed to Ireland in the *EU Directive on the promotion of electricity produced from renewable energy sources in the internal electricity market* to increase electricity consumption from renewables to 13.2% by 2010.

3.3.1.3 Planning Guidelines for Wind Energy

The *Strategy for Intensifying Wind Energy Deployment* (2000) published by the Renewable Energy Strategy Group included recommendations aimed at reducing obstacles to the increased deployment of renewable energy technologies in electricity production, including bottlenecks in relation to planning.

One solution recommended in the report was the development of a customised digital terrain map showing the wind resource, electricity network and areas suitable or likely sites for wind farm development from a planning perspective. The digitised wind resource map has now been procured (November 2003) and copies will shortly be publicly accessible.

The Strategy also recommended that the *Guidelines for Planning Authorities on Wind Farm Development*, published in 1996, by the then Department of the Environment should also be updated. A Committee established by the Department of the Environment, Heritage and Local Government is currently reviewing the Guidelines. The revised guidelines are expected to be published in early 2004.

3.3.1.4 Energy Efficiency

Energy efficiency has a significant role to play in reducing energy demand and is often described as the cheapest and cleanest method of meeting the objective of reducing energy demand in the economy. A general indicator used to measure overall energy efficiency trends is primary energy intensity (the ratio of primary energy consumption over GDP). Primary energy intensity in Ireland has been decreasing since 1990, with the average decrease being 3.0% per annum[5]. The factors that contribute to energy intensity include technological efficiency, choice of fuel and structure of the economy. The recent SEI publication *"Energy Trends in Ireland"* attributes 32% of the energy intensity gains to the change in the structure of the economy, which suggests that other effects such as changes in fuel mix and real energy efficiency gains have played a role. Ireland also scores well in comparison to our European counterparts, where we are second only to Luxembourg in final energy intensity gains in the period 1990 - 1999[6].

In pursuance of the policies in the Green Paper and in order to accelerate energy efficiency gains, a new state body - Sustainable Energy Ireland (SEI) – has been established with a mandate to promote and assist environmentally and economically sustainable production, supply and use of energy across all sectors of the economy. SEI provides the institutional capacity to design and implement energy efficiency and renewable energy policies in pursuit of that objective. SEI and its programmes are funded under the current National Development Plan and the Economic and Social Infrastructure Operational Programme to the end of 2006. A range of policies

5 Energy in Ireland 2002. Sustainable Energy Ireland (Energy Policy Statistical Support Unit (EPSSU))
6 Energy and the Environment in the European Union, 2002

and measures have been designed and are being implemented in the industrial, residential, public and services sectors, in energy research and development and renewable energy support. Sustainable Energy Ireland has published a Five Year Strategy[7] which sets out the range of programmes being undertaken and recently published its annual report for 2002 setting out the progress made thus far.

3.3.1.5 Sustainable Energy Ireland Programmes

Residential

Home Energy Rating: This programme addresses the need for a comprehensive, nationally recognised Home Energy Rating system, with the aim of making energy efficiency in homes an explicit and important factor in house purchase and renovation decisions. A draft strategy was developed and submitted for public consultation in 2002. The strategy was also the subject of government consultation. The public consultation was completed in November 2002 and the programme design will be finalised in 2003.

Low Income Households: This programme contributes to the establishment and implementation of a national plan of action to address fuel poverty in low-income households. A Low Income Housing programme strategy was developed and published following an extensive consultation process. A Fund Disbursement Programme was developed and a managing agent was appointed to develop and maintain the systems and processes required. This programme is scheduled to become fully operational in 2003 and a number of community-based organisations will be funded to install energy efficiency measures in low-income households.

Industry and Public Sector

Public Sector: This programme enables significant energy efficiency improvements to be made in the design and specification of new-build and refurbishment construction for which, under other NDP programmes, approximately 1.9 billion has been allocated.The programme has made substantial progress in achieving its 2006 NDP target, with 62 design studies approved, 33 model solutions approved and seven model solutions completed.

The final programme element, the Energy Management Bureaux, has also been launched. This will encourage the development of energy management service companies to provide off-site energy control and management for public sector buildings which lack critical mass to provide the service from internal resources, and to help public sector organisations to manage their energy consumption and costs.

Industry Agreements

The Large Industry Energy Network (LIEN), formerly the Annual Self Audit Scheme, supports 78 of the largest industrial sites in Ireland dedicated to reducing their energy intensity. It now represents approximately 40% of industrial energy consumption, with an annual energy spend of approximately €350 million. Meanwhile, SEI continues to provide a full-time secretariat to service the Network. In 2002, four quarterly newsletters were published and the 2002 Annual report was finalised (and published in 2003). The report concluded that if LIEN members had not implemented energy saving projects, their energy consumption would have been 285 GWh higher in a "business as usual" scenario which, in environmental terms, equates to a saving of 120,000 tonnes of CO_2.

7 http://www.sei.ie/uploads/documents/upload/publications/launch_doc.pdf

Research and Development

House of Tommorrow R&D: This programme stimulates widespread uptake of superior sustainable energy planning, design, specification and construction practices in both the new home building and home improvement markets. That includes improved technologies, products, processes, practices and policies aimed at impacting on these markets. Following the House of Tomorrow's launch in 2001, a series of six road shows were held around the country. This has resulted in eight supported applications up to December 2002, with over €950,000 approved.

Industry and Commercial R&D: Due to the historical underprovision of R&D in the Irish energy economy, there has been a failure to effectively exploit possible energy savings from the full range of opportunities within these sectors. This programme aims to address that failure by supporting the research, development, adaptation and demonstration of new energy efficient technologies, management systems and policy instruments, focused on creating a least-cost path to achieving reduced CO_2 emissions from these competitive market sectors.

The focus of progress to date has been on informing the implementation of the National Climate Change Strategy in respect of industry actions, principally Negotiated Agreements. This is to enable the development of policy options most favourable to national competitiveness. The programme provided support to a pilot project based on three types of Negotiated Agreements - a vertical, individual company agreement; a vertical collective agreement; and a horizontal technology agreement.

Contracts were signed with 26 companies (1 for the individual company agreement, 10 for the collective agreement and 15 for the horizontal technology agreement). The final report was published in September 2003 and showed that opportunities existed for energy efficiency gains in Irish industry and subsequent CO_2 reductions.

Combined Heat and Power (CHP)

Government policy to promote the deployment of CHP in Ireland resulted in the doubling of installed capacity during the 1990s. This was stimulated mainly by the incentives under the Alternative Energy Requirement (AER) scheme and the Irish Energy Centre's (now SEI) Energy Efficiency Investment Support Scheme. The expansion of CHP took place against a background of significant business growth for certain sectors, in particular the hotel and some manufacturing sectors. The generally high level of investment in these sectors for new or upgraded buildings and manufacturing facilities allowed for greater investment opportunity in CHP. Also, the increasing availability of natural gas, particularly in the south and east of the country, further assisted CHP growth, with virtually all the capacity installed during this period being based on natural gas. At the end of 2000, installed CHP capacity was 122 MW, contributing 2% of Ireland's electricity requirements.

However, this CHP growth during the nineties has come to a virtual halt with little recent additional capacity. This is due in part to changing market conditions and increased risks to investment. Specifically, the large increase in the price of gas available to fuel CHP plants at a time when the prices of electricity from competing conventional electricity generating plants have been effectively capped has made

the economics of gas fired-CHP less attractive. Recent increases in the ESB Public Electricity Supplier tariffs should improve the economics of CHP in the short term.

Related challenges to be addressed include:

- The absence of any heat distribution infrastructure (and the absence of a discrete commercial market for heat);
- The limitations of the existing gas grid;
- Difficulties in financing CHP/DH developments;
- Low population density;

- The limited number of continuously operated heavy industries with power and heat loads suited to CHP.

In the Green Paper on Sustainable Energy, Sustainable Energy Ireland (SEI) was given the task of producing a report for both the Minister and the Commission for Energy Regulation on the future potential of CHP in Ireland in the light of market liberalisation, technology advances, fuel sources, extension of gas grid and financial incentives. Produced following consultation with the main market actors, the Authority's Report – *"CHP in Ireland – An Examination of the Future Potential of CHP in Ireland"* comments on the economic and financial aspects of CHP, as well as CO_2 abatement costs, and identifies a set of measures to be considered for stimulating effective market uptake of CHP to meet the target laid out in the National Climate Change Strategy.

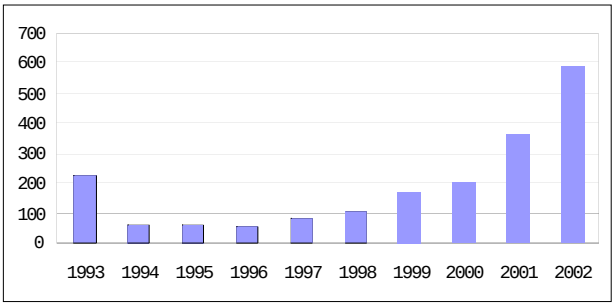
A point of note is that section 9 of the Electricity (Supply) (Amendment) Act 2001 opened the CHP market to all customers irrespective of the level of their annual consumption. This means that any electricity consumer may now purchase electricity from a licensed CHP supplier. However, this initiative has not resulted in an increase in the uptake of CHP in Ireland and the main constraint surrounding CHP remains the high price of gas.

3.3.1.6 Infrastructure Investment

The Electricity Supply Board (ESB) is currently undertaking a massive programme of investment aimed at providing sufficient capacity for economic and industrial development, improving voltage quality, reducing network losses and improving supply continuity. ESB has already significantly ramped up this programme by bringing forward the completion date for the Medium Voltage (MV) network by 5 years – from 2010 to 2005. The company completed renewal of 6,600km of the MV network in 2002 and aims to deliver 15,000km this year alone. The company also aims to have completed the refurbishment of the low voltage (LV) network by 2008 and to accelerate the programme of sub-transmission projects, in particular the refurbishment of the 38kV network and replacement of sub-stations.

Ireland's natural gas network has also recently undergone a major expansion, with the total length of pipe being virtually doubled within the last couple of years. There are now two gas interconnectors for the importation of gas through Scotland and the onshore transmission network is being developed to form a high-pressure transmission ring linking Dublin, Galway, Limerick and Cork. The investment in the gas network over the period 1993 – 2002 is illustrated in Figure 4, showing the level of increased investment in 1999 – 2002.

Figure 3.4: Bord Gáis Éireann Capital Expenditure €m



Source: Bord Gáis Eireann.

3.3.2 TRANSPORT SECTOR

Transport is generally proving to be the most difficult sector in which to achieve controls on greenhouse gas emissions in most countries. It is estimated that private vehicles contribute 60% of all transport sector greenhouse gas emissions and freight vehicles contribute 35%. Although fuel and emissions efficiencies within each class of car are increasing, there have been trends towards the purchase of larger vehicles, reducing the overall fuel efficiency of the fleet. Transport sector greenhouse gases are, accordingly, set to grow further, both in absolute terms and as a proportion of total greenhouse gas emissions.

In 1990, the transport sector contributed approximately 15.7% of Ireland's CO_2 emissions and 9.5% of base-year greenhouse gas emissions. However, transport sector greenhouse gas emissions are forecast to increase by almost 180% in the period from 1990 to 2010. Transport sector emission increases are responsible for an estimated 59.1% of the total emissions increase to 2010, and the proportion of the total basket of greenhouse gas emissions the sector will be responsible for in 2010 is estimated at 18.9%, just double the proportion in 1990.

No single policy measure is sufficient to significantly affect greenhouse gas emissions from transport. The range of policies to be applied should promote best environmental practices for all transport users, and inform their decisions towards the most greenhouse-gas efficient options appropriate within national transport policy. However, in common with other countries, Ireland faces a difficult challenge in attaining sustainable transport and, in particular, limiting the growth in greenhouse gas emissions. Accordingly, a broadly based package of mutually-reinforcing measures will tackle greenhouse gas emissions in the transport sector, and will be integrated both with one another and with complementary measures taken to achieve other policy priorities in the sector.

3.3.2.1 Roads Network and Investment

The quality of roads infrastructure in Ireland is comparatively poor; the National Road Needs Study (NRA, July 1998) indicated that by the end of 1999, 24% of the National Primary network and 14% of National Secondary Roads would fall below the required standard and that the position would worsen significantly by 2019 without additional investment. The National Development Plan 2000-2006 aims to bring the road network to an acceptable standard by 2006 and to do so as part of an integrated transport policy.

3.3.2.2 Economic and Social Infrastructure Operational Programme

The Economic and Social Infrastructure Operational Programme (ESIOP) is one of five Operational Programmes prepared within the framework of the NDP. The programme involves an overall investment of €26 billion in six infrastructural sectors - national roads, public transport, environmental infrastructure, sustainable energy, housing and health facilities - between 2000 and 2006.

The Programme aims to provide the physical infrastructure that will

- maintain economic growth and competitiveness;
- enhance the potential of all parts of the country to support and increase economic activity;
- improve capacity to protect and improve the environment;
- improve the quality of life.

Funding for the programme is derived from Exchequer, local authority and EU sources, as well as from the private sector through the Public Private Partnership (PPP) mechanism.

Some 31% of the total planned Operational Programme investment in Roads and Public Transport will be spent on public transport measures, mainly in urban areas. This compares to 9% and 24% of the roads and public transport total on the 1989-1993 and 1994-1999 programmes respectively. This substantial increase in investment will facilitate major improvements in public transport infrastructure and rolling stock. These improvements will be complemented by traffic management measures designed to promote a beneficial modal shift, particularly in urban areas. The investment programme also recognises that infrastructure development needs to be complemented by supporting measures in the areas of transport demand management and telematics.

3.3.2.3 National Roads Priority

A well-functioning road infrastructure is of critical importance in maintaining the competitiveness of the economy, achieving balanced regional development and minimising the adverse effects of transport activities on the environment. The principal objectives of the National Roads Sub-Programme are –

- to improve the reliability of the road transport system by upgrading major inter-urban routes to motorway / high quality dual carriageway standard, removing bottlenecks, remedying capacity deficiencies and reducing absolute journey times and journey time variance;
- to improve internal road transport infrastructure between regions and within regions, contribute to the competitiveness of the productive sector and foster balanced regional development;
- to facilitate better access to and from the main ports and airports with the main objective of offsetting the negative effects of peripherality;
- to contribute to sustainable transport policies, facilitating continued economic growth and regional development while ensuring a high level of environmental protection;
- to help achieve the objectives of the Government Strategy for Road Safety in relation to the reduction in fatalities and serious injuries caused by road accidents.

3.3.2.4 Fuel Economy Labelling: Information is now available to help car buyers see at a glance the CO_2 emissions of different new cars, and thus factor climate change into their purchasing decisions, and to compare fuel efficiency across models and makes. Since August 2001, regulations require all new passenger cars for sale to be individually labelled with fuel economy and CO_2 emissions information. Posters must also be displayed in showrooms giving the information for all models for sale, and fuel consumption and CO_2 emissions data must now be included in promotional material. A guide is produced and regularly updated by the Society of the Irish Motor Industry (SIMI) for all models of new passenger car offered for sale or lease in the State, and is available free of charge from showrooms or SIMI.

The impact of energy/CO_2 labelling on the entire car fleet's fuel consumption and CO_2 emissions is estimated at a 4% - 5% reduction over the next 10 years. This is equivalent to 380,000 tonnes CO_2 per annum by 2010.

3.3.2.5 Public Transport

Apart from meeting general transport objectives, a well-functioning public transport infrastructure is vital for making optimal use of road infrastructure, minimising the impact of transport on the environment, promoting balanced regional development, and making transport as widely accessible as possible.

The principal objectives of Public Transport Priority are –

In the Greater Dublin Area

- to address the projected growth in trip demand through a combination of investment in transport infrastructure and facilities and demand management measures;
- to reduce the relative attraction of commuting to work by private car, thereby curtailing congestion and vehicular emissions;
- to increase accessibility for all, particularly mobility-impaired and disabled people;
- to better reflect evolving commuter travel patterns by providing for a spatial distribution of public transport that addresses the requirements of the Strategic Planning Guidelines for the Greater Dublin; Area and the National Spatial Strategy.
- to support sustainable development.

Nationally

- to upgrade the mainline rail infrastructure, rolling stock and facilities so as to improve the safety of the network, increase the physical capacity of the railway to cater for growing passenger demand, and improve the quality, speed and reliability of services;
- to upgrade public transport services in the cities of Cork, Limerick, Galway and Waterford so as to tackle increasing congestion, provide an alternative to car commuting and support the local economies;
- to enhance the national bus network outside the main cities;
- to pilot rural public transport services.

Detailed implementation as follows:

- *Dublin Bus* – The fleet will be expanded by 275 additional vehicles over the period to 2006. To date, 93 additional buses (along with 299 replacement buses) have been delivered to Dublin Bus under the NDP. A further 32 additional buses are due for delivery in 2003. There has been a 23% increase in Dublin Bus peak hour capacity since the start of the NDP.
- Q-time, a real time passenger information system is in operation by Dublin Bus on routes served by its Conyngham Road Garage.
- *Construction of a new bus garage in Harristown, North Dublin commenced in September 2003.* The new garage, with capacity for 240 buses, will allow for further fleet expansion and the transfer of buses/routes from existing depots to alleviate capacity problems. It is expected that work will be completed before the end of 2004.
- *Bus Éireann* – NDP target is 450 new buses to upgrade rural transport fleets and 110 new buses to improve services in the urban centres outside Dublin. To date, 221 buses have been purchased, of which 58 are additional buses. Bus Éireann has also purchased 30 new buses in 2003 for their Expressway services. A further 38 buses are due to be delivered before the end of this

year. Bus Éireann has increased peak capacity by 40% on all main corridors into Dublin. Departure increases are up by 26% in Cork, 18% in Limerick, 35% in Waterford and 32% in Galway. The entire regular urban bus fleet in Cork, Limerick, Galway and Waterford is now low-floor. New bus stations in Athlone, and Skibbereen have been completed, with enhancements of Stranolar and Sligo Stations.

- *National Rail* - In 2002, under the National Rail Safety Programme, 138 kilometres of track were re-laid on a number of inter-city and branch lines. In addition, 16 bridges were upgraded, 48 high-risk level crossings were closed or upgraded and 57 lower risk crossings were closed. Cuttings and embankments works, mainly coastal protection, were carried out at Malahide Causeway, Sorrento Point, Killiney, Bray, Ballygannon and Kilcoole.
- Iarnród Éireann are taking delivery of 80 new diesel rail cars designed to both replace older rolling stock and to improve frequency and capacity on the network. These vehicles will all be in service by very early 2004. Contracts have also been placed for the delivery of 67 new mainline railway carriages for intercity routes. These vehicles will be delivered in 2005 and will enter service early in 2006. Design and planning work continues on the Heuston Station, DART enhancement and Kildare Route projects. When completed, these projects will significantly increase capacity on the entire railway network.

Greater Dublin Area Transportation Measures:

On account of its size and population density, efforts to limit CO_2 and other emissions from transport in Dublin will have an impact at national level. There is also a greater scope for the use of alternative modes of transport to the private car in Dublin than is the case in any other part of the country. The greater Dublin area has experienced major changes in the past 25 years. However, increasing traffic congestion, pollution, environmental degradation, inner city decline and, on the positive side, the success of the electric railway system (the DART) have provoked a reappraisal of the transport system.

Dublin Transport Initiative Strategy

In response to these developments, the Dublin Transportation Initiative (DTI) was established to investigate the transport system and to bring forward appropriate proposals. Following substantial public consultation, the DTI concluded in August 1995 that, in the absence of significant investment, travel would increase by about 19% in the ten years to 2001, the relative use of public transport would decline further, the level of accessibility to the city centre and other areas would also decline, and atmospheric pollution from private and public transport would increase substantially.

The DTI Strategy contained a combination of measures geared towards a shift away from private car use and towards sustainable modes of travel, such as public transport (Quality Bus Corridors and Light Rail), cycling and walking. The Final Report of the Dublin Transportation Initiative (DTI), was published in 1995. Key recommendations of the DTI Final Report were that the DTI Strategy (to 2011) should provide the planning framework for the development of the transport network in the Greater Dublin Area and that it should form the first phase of an ongoing transportation planning process.

The Dublin Transportation Office (DTO) was set up in 1995 to carry on that transportation planning process.

The functions of the DTO are to:

- co-ordinate and monitor the implementation of the DTI Strategy by various agencies, including collection of statistical and other survey data, and also co-ordinate such activities by any or all of the designated bodies;
- ensure public awareness and participation at all stages;
- provide a continuing input to an ongoing strategic planning process, including review and updating at regular intervals of the DTI Strategy;
- carry out modelling, evaluation, consultation and other technical services in relation to land use and transportation planning, and audit the transportation planning activities of the designated agencies; offer advisory and technical support services related to land use and transportation planning, and administer related grant schemes.

The DTO has carried out an update of the original DTI Strategy and published *A Platform for Change*, an integrated transport strategy for the Greater Dublin Area (GDA), in Autumn 2001. This comprehensive blueprint includes development of a new metro network, and enhanced bus, light rail and suburban rail networks, improved pedestrian and cyclist facilities, strategic but limited road construction, and traffic management measures. Implementation of this Strategy will reduce emissions by over 1 Mt of CO_2 per annum by 2016, a 41% reduction on projected emissions. Development of public transport infrastructure in the GDA must be carried out in keeping with *"A Platform for Change"*, where possible.

The benefits of implementation of the Strategy will include

- A transport system which will have adequate capacity to cater for all journeys;
- An extensive high quality public transport system extending over a large catchment area;
- An integrated public transport system;
- Halving of the levels of road congestion;
- Dramatic reduction in average journey times;
- Improved share of the travel market for public transport;
- 41% reduction in energy consumption and associated reductions in emissions; *(see table 3.2)*
- more effective organisation or roads space;
- increased competitiveness for the Greater Dublin Area as a place for locating employment.

The DTO is about to commence a review of the Strategy, to be completed in 2005.

Table 3.2 Transport Emissions and Energy Consumption Scenarios

Emission	Unit of Measure-ment	1997 Baseline	2016 without the Strategy	2016 with the Strategy
CO_2	Kilo Tonne	1,328	2,611	1,551
CO	Tonne	75,649	32,058	18,780
VOC	Tonne	12,209	5,321	3,142
No_x	Tonne	6,699	1,936	1,288
PM	Tonne	204	43	25
SO_2	Tonne	611	810	464
Energy	Tera Joule	18,356	36,694	21,830

The following rail based proposals are at the planning/construction stage at present:

- *Metro:* The Railway Procurement Agency (RPA) has held a preliminary public consultation on the Metro. The procurement process has been initiated, with a pre-qualification exercise for potential bidders

launched in mid-2002, which met with an enthusiastic international response - 18 companies have already been pre-qualified. In November 2002, the RPA submitted the Outline Business Case (OBC) for Phase 1 of the Metro. RPA has since submitted revised proposals and it is expected that proposals will be brought to Government by the end of 2003.

- *LUAS* (Light Rail for Dublin): Substantial progress has been made toward establishment of significant elements of the Luas network as set out in the DTO Strategy *" A Platform for Change"* (2000-2016). Work is on schedule for completion of the construction of the initial lines early in 2004.

  Line A/C – Tallaght to Connolly Station: A Light Railway Order was granted in March 1999 and construction commenced in September 1999. Construction will be completed in May 2004 with services commencing in August 2004.

  Line B - Sandyford Industrial Estate to St. Stephen's Green: A Light Railway Order was granted in September 1999. Construction will be completed in March 2004 with services commencing in June 2004.

  The full complement of 40 trams for both lines have been delivered and are being tested and commissioned at present.

  Line B1 - Sandyford Industrial Estate to Cherrywood: This Line is an extension of Line B. Public consultation aimed at identifying the best overall route alignment was initiated in November 2000. The Department of Transport are awaiting an outline business case from the Railway Procurement Agency.

  Line C1 - Connolly Station to Docklands: This Line is an extension of LineA/C. Public consultation took place in April 2003.

- *Reallocation of Road Space:* The DTO Strategy "A Platform for Change" anticipates that a comprehensive network of orbital and radial bus priority corridors will be provided in the Metropolitan Area of Dublin by the end of 2006. By then, the large majority of Dublin Metropolitan Area transport users should be within a 10 minute walk of a good quality bus service.

As a result of work by the DTO and the local authorities of the Greater Dublin Area, there are nine Quality Bus Corridors (QBCs) currently in operation – Malahide, Lucan, Stillorgan, Finglas, North Clondalkin, Rathfarnham, Tallaght, Swords and Blanchardstown. Results have been impressive, with bus journey times cut by up to 40% in some cases.

Further provision of QBCs and their development as a Quality Bus Network (QBN) is the responsibility of the QBN Project Office, established early in 2003 by Dublin City Council. This office will design and implement all remaining Quality Bus projects within the DTO Area.

In 2003, through the DTO Traffic Management Grants (TMG), approximately €19m in voted expenditure is being invested in Quality Bus Corridor/Network projects. This follows a total investment of €72m in QBC projects up to 2002. In 2004, assuming a total TMG budget of 40m, 35m will be invested in developing the Quality Bus Network in Dublin.

QBC rollout is a political priority: the Minister for Transport has publicly committed to double the number of QBCs in the short term.

QBC funding will remain a priority in the distribution of Traffic Management Grants. A QBC network will be developed in Dublin, and routes will be continually enhanced to provide optimum flow and minimum journey times for buses. The relative attractiveness of bus and other public transport travel, compared to private car use, will be increased with the introduction of real time passenger information and integrated ticketing.

Plans are also afoot to accelerate the provision of Quality Bus Corridors in other urban areas around the country. 8m is being made available in 2004 for the development of QBCs in Cork, Limerick, Galway and Waterford. Proposals are still awaited in respect of the latter two. The Department is in close contact with the Local Authorities in these cities to help them identify the key issues that need to be addressed on bus prioritisation.

- *Cycling:* Cycle routes are often provided in conjunction with the creation of bus priority lanes or corridors. Traffic Management Grant funding is also available to local authorities for the direct provision of cycle lanes and cycle parking facilities. In excess of 160km of cycle network and 3,000 cycle parking spaces have been provided to date.

- *Demand Management Study:* The DTO has initiated a study, to be completed early in 2004, on the implementation of Demand Management Measures in the Greater Dublin Area to reduce the growth in motorised travel, effect further modal transfer from private car to public transport modes, reduce peak hour car journeys forecast for 2016 to approximately 1997 levels, and assist in the development of the centres identified in the Strategic Planning Guidelines for the Greater Dublin Area.

Demand Management has the following objectives:

- To reduce the growth in overall distance travelled by motorised modes of travel in the Greater Dublin Area;
- To effect further modal transfer from private car to public transport modes over and above that achievable through the infrastructure and service enhancement measures described in *A Platform for Change;*
- To achieve a good level of service on the road network for essential road users;
- In the Metropolitan Area, as defined by the Strategic Planning Guidelines, to reduce peak hour car journeys forecast for 2016 to approximately 1997 levels (approximately 127,000 car journeys in the morning peak hour in the Metropolitan Area).

In the Hinterland Area, measures should be focused on the development centres identified in the Strategic Planning Guidelines, and should be designed to achieve sustainable modal split and trip length distributions for travel within the centres, and between the centres and other areas, at an early date.

Consultants will examine and develop potential demand management measures for

- Land use policies: including advice relating to the location, scale and mix of development; parking standards; appropriate development layout and densities; amd sustainable travel catchment areas.
- Economic/fiscal instruments: including vehicle and fuel charges and taxes; public transport fares – structure and levels; road pricing/ congestion charging; road tolling; parking charges, including charging for workplace parking.

- Management and control of public parking: on-street and public off-street parking control and management.
- Other traffic management measures.
- Mobility Management Plans – including IT related measures, and re-organisation of work practices.

Traffic Management

Park and Ride

- *A Platform for Change* recommends provision of Park and Ride facilities under the Integration aspect of the infrastructure strategy.

Progress on Park and Ride Facilities

Rail-based

- The Government provided specific funding in 1999 and 2000 to create an additional 2,300 parking spaces adjacent to DART and suburban rail stations in the Greater Dublin Area.

- The LUAS project also provides parking for 2,055 cars. The Park and Ride sites will provide for optimal integration with other public transport modes. Line A will have a total of 1,206 car parking spaces at two locations, Red Cow and Tallaght, and Line B will have 849 car parking spaces at two locations, Balally and Sandyford / Stillorgan.

- The independent advisor appointed by the Minister to make recommendations on the provision of access for road vehicles to the LUAS stop at the Red Cow roundabout reported in June. His recommendations, based on RPA at-grade access proposals, with DTO modifications, have been accepted.

- There will be a park and ride facility accommodating 450 cars adjacent to the Tallaght stop, serving Tallaght Square / Town Centre. These car spaces will be provided as part of the development of the former CIE site alongside the Square / Town Centre. Ongoing discussions are taking place between the developer and the planning authority with a view to having this facility available as soon as possible.

- The DTO has set up a Working Group consisting of CIE Group operating subsidiaries, the RPA and Local Authorities to bring forward proposals for provision of further Park and Ride facilities at rail stations, both existing and proposed (including Metro), and will submit proposals for funding and implementation in Autumn 2003.

Bus-based

- A recently completed study, commissioned by the DTO, found that the size of Dublin City limits the role for bus-based Park and Ride. The TAS Partnership, a leading consultant in the UK specialising in Park and Ride design and operations, concluded that bus-based Park and Ride is ideally suited to urban areas of less than 200,000 inhabitants, and the geographic size and spread, and therefore travel distances involved in Dublin militate against its effectiveness here. The size and planned development of the GDA may provide opportunities for Park and Ride in an alternative format, known as 'satellite P&R'. This format involves the provision of a series of smaller P&R car parks on existing public transport corridors, and is more appropriate where travel distances are great and demand is disparate. Notwithstanding this general conclusion, the consultant

identified a site that offers the optimum performance in terms of developing a pilot purpose-built bus-based Park and Ride site. Efforts are in hand to carry out this pilot.

Development Guidelines

- In August 1999, the Department of the Environment and Local Government issued local authorities with guidelines relating to the certification of qualifying park and ride facilities and residential development located at a park and ride facility.

Further guidelines on commercial development located at a park and ride facility were issued in July 2001.

Tax Incentives

- Tax incentives for private sector provision of park and ride car parking are available, in order to encourage such development.

- These tax incentives are provided for in the Finance Act 1999 and the Finance Act 2001. Essentially, the provider of a Park and Ride car park can write off the construction costs, excluding over 13 against tax. Some associated residential and/or commercial developments can be included in the overall proposal. The qualifying period for the incentives was extended to June 2004 in the Finance Act 2002. Any changes to the scheme are a matter for the Department of Finance.

Demand Management

Retail Planning Guidelines: The Government has a policy of encouraging more sustainable urban development, the avoidance of excessive suburbanisation and the promotion of higher density development in appropriate locations in harmony with improved public transport systems. *The Retail Planning Guidelines* published in January 2001 set a cap of 3,000 m^2 of net retail floorspace in supermarkets (3,500 m^2 in the Greater Dublin Area). They also provide that, insofar as is practicable, retail developments should be located near town centres, leading to reduced energy costs resulting from reduced transport demand.

Childcare Guidelines: These were published in July 2001 and should also lead to reduced transport demand as they recommend that the childcare facilities should be located as close as possible to where the demand for childcare arises (i.e. in housing estates, near workplaces etc).

The Planning and Development Act 2000 provides that planning authorities and An Bord Pleanála (The Planning Appeals Board) must have regard to the Guidelines in the performance of their planning functions.

Intelligent Transport Systems (Telematics): The National Roads Authority (NRA) is participating in telematics projects, INSTANT and STREETWISE.

The INSTANT project (Information and Management System for Multimodal Transport in Ireland, North and South of the border) based on a multimodal traffic management and information system for cross-border traffic between Dublin and Belfast, is examining three principal components –

- A pre-trip planning tool;
- Creation and dissemination of real-time traveller information;
- Traffic control and management.

The Feasibility Study phase began in August 2001 and was completed in September 2002.

The project is now in Design study phase, which is due for completion in November 2004.

STREETWISE aims at providing seamless and effective travel information on the Trans European Transport Network between Ireland, Northern Ireland, and the UK and will act as a bridge to form part of a pan-European network of services. This is a multi-annual programme which began in 2001 and will conclude in 2006. The programme for 2003 will study high quality traffic monitoring, journey time estimation, and data exchange between national authorities.

The NRA is also examining the use of telematics on the M50 motorway. As a first measure the grade-separated rotary junctions on the M50 are being converted to automatic controllers under the management of the Dublin City Council Traffic Control Centre (SCATS operation). This will mean that the traffic signals on the roundabouts will be controlled dynamically reflecting the changes in traffic volumes.

Vehicle Emissions

Ireland is fully up to date with implementation of EU-type approval directives concerned with emissions standards applicable to motor vehicles coming into service. In this regard Directive 70/220/EEC (as most recently amended by Directive 2001/1/EC) in relation to gas emissions from motor engines and Directive 88/77/EEC (as most recently amended by Directive 2001/27/EC) in relation to gaseous and particulate pollutants from diesel engines have been fully transposed into Irish law.

Vehicle Testing

Measures are in place to give full effect to Directive 96/96/EC in relation to the roadworthiness testing of vehicles and their engines. A properly tuned engine will reduce fuel consumption - the EU estimates the overall savings could be around 5% - and this has an overall beneficial effect on CO_2 emission levels. Roadworthiness tests are carried out on heavy commercial vehicles over one-year old on an annual basis and on light commercial vehicles over four years-old on a biennial basis. In 2000 roadworthiness testing was extended to passenger cars. Cars are required to be tested when they are four years old on a biennial basis. In excess of 700,000 vehicles of all categories were tested in 2002, with 91% passing the tests.

3.3.3 BUILT ENVIRONMENT & RESIDENTIAL SECTORS

The residential sector is responsible for approximately 29% of CO_2 emissions (1998) and 20% of all greenhouse gas emissions, when emissions from electricity for the sector are included. Emissions of greenhouse gases attributable to the sector are almost exclusively CO_2, from energy use consumed domestically for space heating etc., and electricity consumed in domestic appliances. Small amounts of CH_4 and N_2O associated with fuel use are also emitted. Implementation of a number of measures is underway to reduce emissions from this sector.

Building Regulations: In September 2001, consultation documents on the revision of Part L of the national Building Regulations relating to the conservation of fuel and energy were issued. These made provision for moving to improved standards in a single step, by 1 July 2002, rather than on a phased basis in 2002 and 2005 as originally proposed. The new standards are estimated to reduce the requirements for space and water heating by 23% to 33%, depending on the type and size of the dwelling. In the context of a requirement for 50,000 houses per annum to 2012, bringing forward the date of implementation means the greatest proportion of these new houses will benefit from the improved standards.

On current patterns of fuel use, a reduction of 300,000 tonnes CO_2 per annum for 2012 will be delivered by this measure, more than meeting the target of 250,000 tonnes CO_2 set in the Strategy

3.3.3.1 New Building Methods: To promote sustainable energy efficiency in housing, there are currently two pilot energy efficient schemes underway, which include elements of social housing.

At Brookview (Tallaght), 430 houses have been constructed based on a 'bio-climate' approach, which seeks to integrate local climate studies, the enhancement of local natural features, windbreaks, shelter belts and optimum orientation, with energy efficient estate layout and house design in a comprehensive and innovative neighbourhood approach towards energy efficiency. In addition, standard building specifications and current building practice were reviewed to increase the energy efficiency of individual housing units.

In Navan, 20 local authority "low energy houses" have been completed. These houses include solar heating voids collecting solar energy, used as a heating source for the houses. The houses have a number of other low energy features such as additional roof, wall and other floor insulation and high performance gas boilers.

3.3.3.2 Regeneration of Housing Areas: The regeneration programmes have a positive impact on greenhouse gas emissions, as all new units are to current standards and refurbished existing units are brought to a higher standard than heretofore.

In **Dublin** major redevelopment works are underway to inner city flat complexes, at a total cost of over €150m (2003 prices) spread over a five year period 1999-2003. In total, almost 900 new and replacement units and over 260 refurbished units will be provided.

The Area Regeneration Programme underway in Dublin to upgrade high density older housing complexes includes window replacement, the installation of central heating and roof replacement. Since 1997, new windows have been installed in over 5,000 dwellings, central heating installed in over 8,000 dwellings and roof replacement has been completed on 22 flat complexes.

Cork City Council are carrying out a regeneration project of the **Glen area**. Phase 1 is being carried out over an 18 month period at a cost of 18 million. The project commenced in 2002 and involves the demolition of one block of flats, refurbishment of two blocks of flats to provide 24 new accommodation units and the construction of 47 new dwellings. The cost of the entire Glen Regeneration scheme is estimated to be in the region of €47- €51 million. Expenditure in 2002 amounted to €8.939 million.

The local authority *Remedial Works Scheme* continues to upgrade, renovate and redevelop publicly owned housing stock, with some 16,000 dwellings refurbished since the scheme began. The extent of works carried out to dwellings varies from project to project. Where an extensive programme of refurbishment works is carried out, measures are taken to improve thermal insulation in accordance with the Building Regulations.

Ballymun Regeneration: Ballymun is the biggest housing regeneration project in the State. It includes the demolition of all the flat complexes in the area and their replacement by over 2,800 new housing units. The Government is committing €607m (2003 prices) to the regeneration of Ballymun over the coming years to fund housing and housing related elements.

To maximise energy efficiency and reduce CO_2 emissions, best practice is being employed in the construction and fitting out of all homes, with innovative and experimental measures in a proportion of homes to assess the applicability of these technologies for future use in Ireland. It is expected that CO_2 emissions will be reduced for all homes, 40% in the case of two bedroom dwellings, with site-wide reductions in CO_2 emissions in the region of 4,000 tonnes/year targeted by the estimated completion date of the project in 2010.

3.3.4 INDUSTRY, COMMERCIAL AND SERVICES SECTOR

The greenhouse gas emissions reduction target set for the Industrial, Commercial and Services Sectors under the National Climate Change Strategy is 2.175Mt CO_2, approximately 14% of total national emission reductions to be made. The Department of Enterprise, Trade & Employment has responsibility for a variety of actions in the areas of energy efficiency improvements, process substitution and industrial gas emissions. Initial work has focused on the following activities:

Research

A substantial research project was commissioned on the main instruments and mechanisms relating to achieving emission reductions in the industrial sector:

- Negotiated Agreements;
- Emissions trading;
- Taxation;
- Project-based mechanisms (JI & CDM).

This research was completed in March 2002 and will inform policy making in these areas.

The Irish economy has enjoyed rapid growth in recent years, which has helped to greatly expand overall productive capacity. At the time of publication of the NCCS, industry in Ireland accounted for 38% of GDP and is currently estimated at 40% of GDP. The industrial sector mainly contributes to greenhouse gas emissions through energy use including direct consumption of fossil fuels and use of electricity, and through direct emissions from a number of industrial processes – for example, cement manufacture (energy and process) which accounted for 2.8% of total CO_2 equivalent emissions in 1990, is projected to rise to 8% of gross emissions in 2010.

Emissions of greenhouse gases from manufacturing industry, including emissions as by-products of manufacturing processes (e.g. cement), accounted for 13.5% of emissions in 1990. Emissions associated with electricity production consumed by this sector were additional. Business as usual projections in the NCCS indicate that emissions from manufacturing industry will increase by 5.4 Mt CO_2 equivalent in the period from 1990 to the commitment period of 2008 – 2012.

The industrial sector is also the primary source of emissions of the industrial or fluorinated gases. Because of their use in the electronics sector, and the use of HFC as a replacement for CFCs in essential medical uses, growth in the emissions of these gases is expected to be exceptionally strong.

The remainder of the sector (commercial, small firms, services) is responsible for approximately 3.3% of greenhouse gas emissions, arising from energy consumption, in addition to electricity consumption by the sector. The services (non-traded) sector accounts for over 50% of total GDP. Much of its output is an intermediate input into the industrial sector, for example through personal services, consultancy, and financial services, but it also includes offices, entertainment, tourism and leisure facilities, shops, retail and warehouses and public services and amenities. Arising from increased automation, air conditioning, etc., electricity consumption by the commercial sector is expected to grow rapidly.

Study on cross-sectoral measures: A substantial research project was commissioned by the Department of Enterprise, Trade and Employment, with Forfás, on the implementation of the cross-sectoral measures (taxation and emissions trading) potentially impacting on enterprise. The project was undertaken by consultants Indecon and ERM, with Indecon dealing with the taxation and negotiated agreements elements and ERM focusing on the emissions trading and project-based mechanisms. A Steering Committee, with representation from relevant Departments and agencies and the business community, oversaw the research.

Negotiated Agreements: Under the NCCS, a series of negotiated agreements is proposed to achieve emission reductions in the areas of energy efficiency, process emissions and industrial gases. The Department of Enterprise, Trade and Employment established a group to co-ordinate work on developing and implementing negotiated agreements. Representation includes the Sustainable Energy Ireland (SEI), Enterprise Ireland, IDA Ireland, Forfás, Irish Business Employers Confederation (IBEC), An Taisce and relevant Government Departments. SEI is currently undertaking a pilot programme to develop negotiated agreements on energy efficiency with selected enterprises at individual firm level, at sectoral level and at horizontal level.

Investment Decisions: The Department of Enterprise, Trade and Employment has engaged with Enterprise Ireland and the Industrial Development Authority (IDA Ireland) to ensure the establishment of appropriate mechanisms for the assessment of the sustainable development dimension of inward and indigenous investment projects.

Licensing: All existing power generation plant have now been brought into the IPPC licensing system; coal and oil plant from March 2001, peat from January 2002. Arrangements are currently being made to update the legislation on IPPC licensing to bring it fully into line with EU Directive 96/61/EC on integrated pollution prevention and control. Among the amendments being made are the inclusion of specific provisions on energy efficiency and the reduction of greenhouse gas emissions.

Industrial Gases: In order to inform policy-making in this area, research is being undertaken to identify the sources of industrial gas emissions in Ireland.

3.3.5 AGRICULTURE SECTOR

Agricultural emissions of greenhouse gases are very significant in the Irish context. Greenhouse gas emissions in 1990 from the agricultural sector were 34.6% of total national emissions, the highest of all sectors. Agriculture was responsible for 84.1% of CH_4 emissions in 1990,

expected to rise to 92.3% by 2010 and 78.7% of N_2O emissions in 1990 (expected to be 79.4% in 2010). The high GWP of these gases, at 21 times and 310 times that of CO_2 respectively, means that their weight within the overall basket of gases increases accordingly. For most developed countries with a higher proportion of economic wealth arising from heavy industry and less from agriculture, CO_2 represents approximately 80% of the basket of gases. For Ireland, with a comparatively greater proportion of economic production from agriculture, CO_2 represented 58.7% of the national basket in 1990, with CH_4 and N_2O representing 40.8%.

3.3.5.1 CH_4 Emissions

A number of measures have been taken to reduce stocking densities on land, encouraging less intensive farming methods and lower CH_4 emissions.

- ***Extensification Premia:*** Payment from 2002 onwards has been on the basis of stocking density between 1.4 and 1.8 livestock units per hectare (ha) (lower rate of payment) and less than 1.4 units (higher rate of payment), 0.2 livestock units per ha lower than 2001.

- ***Special Beef Premium:*** The stocking density for qualifying animals was limited to 1.9 livestock units per ha in 2002 and to 1.8 livestock units per ha in 2003. The national quota for Special Beef Premium was reduced by 4.6% below 2001 levels for 2002 and 2003.

- ***Disadvantaged Areas Compensatory Allowances:*** Up to 2000, headage grants were paid on cattle, sheep, goats and horses in designated areas. Payments moved from animal based schemes to an area-based system in 2001. Farmers are now paid a flat rate per ha, removing the incentive to maximise stocking densities.

Younger animals produce less CH_4 emissions, and measures have been taken to reduce the age of the national herd.

- ***Suckler Cow Premium:*** From 2002, the rules forbidding more than 20% heifers in qualifying herds has been relaxed to 40%, and applications in respect of 14 or more animals must comprise at least 15% heifers. These provisions will facilitate a reduction in the numbers of suckler cows, lower the average age of the suckler herd and reduce the number of calves born leading to a reduction in CH4 emissions from the beef sector.

- ***Lower Age at Slaughter:*** As a result of the BSE crisis, higher prices at slaughter are now paid for cattle under 30 months, leading to a reduction in the number of cattle retained for slaughter over 30 months.

3.3.5.2 N_2O emissions

- ***Rural Environmental Protection Scheme (REPS)*** **(voluntary scheme designed to compensate and reward farmers for delivering environmental benefits):** The new REPS scheme is expected to increase active participants from 45,500 in 1999 to 70,000 by 2006, with an extra 25,000 farmers anticipated to be following nutrient management plans. This will lead to a more sustainable farming environment, improving the management of organic manures and chemical fertilisers and reducing N2O emissions. Farmers in REPS operate to standards that are higher than good farming practice.

- **Good Farming Practice:** All farmers in receipt of Compensatory Allowances, On-Farm Investment Schemes, Livestock Premia Schemes, Arable Aid and transferees under the Early Retirement Scheme must practice farming in accordance with the environmental requirements set out in the Good Farming Practice rules published in August 2001. Compliance with this code is compulsory, and over 100,000 farmers will be affected in the period 2000-2006. Penalties will be imposed for breaches of the Code up to a 100% maximum for serious non-compliance. Key aspects of the Good Farming Practice include nutrient management and restrictions on applications of organic and chemical fertilisers.

3.3.5.3 Environmental Legislation:

Proposals are being developed to provide a statutory basis for the application of good agricultural practice in all areas. Regulations are being drafted for this purpose. The Regulations will provide a higher level of protection for the environment, give further effect to EU directives in relation to waste and water quality, including the Nitrates Directive, and should lead to a reduction in N_2O emissions. Agricultural activities in certain areas are already subject to local bye-laws made by local authorities and IPPC licensing has been applied to intensive pig and poultry units.

3.3.5.4 Strengthening Relationship between Agricultural and Forestry Policy:

The administration of REPS now places greater emphasis on forestry as an option and the need for a closer integration between the forestry planting programme and 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.

3.3.5.5 Bio-energy

As outlined in the NCCS, the Department is currently examining the potential for the development of short rotation biomass and anaerobic digestion of slurry both as sources of renewable energy and in the context of their potential for reducing greenhouse gas emissions from agriculture.

3.3.6 FORESTRY SECTOR

Ireland's national forest policy is set out in *Growing for the Future*, the Government's forestry strategy. Over 273,000 ha were afforested and 84,000 ha reforested (after harvest) from 1990 to 2000. The total forest area in Ireland at the end of 2001 was 665,000 ha, which represents over 9% of the land area. An afforestation rate of 20,000 ha/year is current policy, to reach a national forest cover of 17% by 2030. While conifers, mainly Sitka spruce, still represent a considerable part of the estate there has been a marked increase in recent years in the planting of broadleaves, including native species. Today they comprise close on 30% of current planting.

In 2001 the wood harvest was 2.5 million cubic metres of roundwood, overwhelmingly comprised of conifers (97%), mainly Sitka spruce. The wood goes to make a range of products, from structural sawnwood to fencing and pallet products to panel products including OSB, MDF and door panels. COFORD, the National Council for Forest Research and Development, has recently forecast[8] a potential doubling of wood production to 5 million cubic metres per annum by 2015.

[8] Gallagher, G. and O'Carroll, J. 2001. Forecast of Roundwood Production from the Forests of Ireland 2001-2015. COFORD, Dublin.

The National Development Plan, 2000-2006, has made provision for €688 m to encourage greater participation in, and conversion of agricultural land to forestry, with an emphasis on afforestation as a complementary farm enterprise.

3.3.6.1 Carbon

In the Government's National Climate Change Strategy, forestry has been allocated a significant role in mitigating emissions. Forest sinks, resulting mainly from afforestation since 1990 (Article 3.3 of the Kyoto Protocol), are to remove 1.01 M tonnes of carbon dioxide annually. This represents 7% of the target annual reduction of 15.4 M tonnes of carbon dioxide[9]. It is now estimated that afforestation since 1990 can sequester over 1.5 M tonnes of carbon dioxide over the first commitment period, 2008-2012. These estimates will be further updated following the completion of the national forest inventory sampling phase (underway at end of 2003) and as further results come on stream from the R&D programme outlined below.

Carbon stocks in the national forest increased by an estimated 8.4 m tonnes of carbon dioxide (58.3 to 66.7 m tonnes carbon dioxide) over the period 1990 to 2000, with an annual storage of 4.4 m tonnes carbon dioxide in 2000 before harvest, and over 1 m tonnes after harvest. Forest soils represent a very significant carbon pool; current estimates are that this is in the region of 1101 m tonnes carbon dioxide.

A multidisciplinary team based at University College Dublin is carrying out work on refining the estimates of carbon sequestration. Further details are available at the COFORD web site www.coford.ie.

3.3.7 Waste Management

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 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.

Current waste prevention and recycling objectives include:

- Increasing bring bank density from one for every 3,000 people to one per 500 to 1,000.
- Increasing the number of Civic Amenity Centres from 40 to 85.
- Provision of segregated collection of waste to most urban centres over the next 5 years.

9 Mega tonnes: one mega tonne is one million tonnes

- The development of around 10 Material Recovery Facilities to cater for the reception, separation, pre-treatment and transfer to reprocessors of recyclable material.

A growing feature of waste management in Ireland in the future will be the increasing number of producer responsibility initiatives. This is based on the fundamental polluter pays principle of environmental policy. Producer responsibility initiatives were first introduced in 1997 for packaging waste and farm plastics. The recently established National Construction and Demolition Waste Council is a voluntary initiative by the construction industry designed to ensure a substantial reduction in construction and demolition waste going to landfill. Further producer responsibility schemes are in development for waste streams such as waste electrical and electronic equipment, tyres and newspapers.

A new Environment Fund will be financed by the levy on plastic bags, which has been hugely successful, and a levy on the landfilling of waste. The Environment Fund will support a wide range of recycling and other environmental issues. In particular, it is expected that the Environment Fund will be utilised to fund many smaller, community based initiatives, which would not receive funding under the NDP Grants Scheme. These initiatives and others that are proposed, including the introduction of national bans on the land-filling of specific recyclable materials, will lead to a reduction in the quantities of waste disposed at landfill and a consequential reduction in the emission of methane emissions.

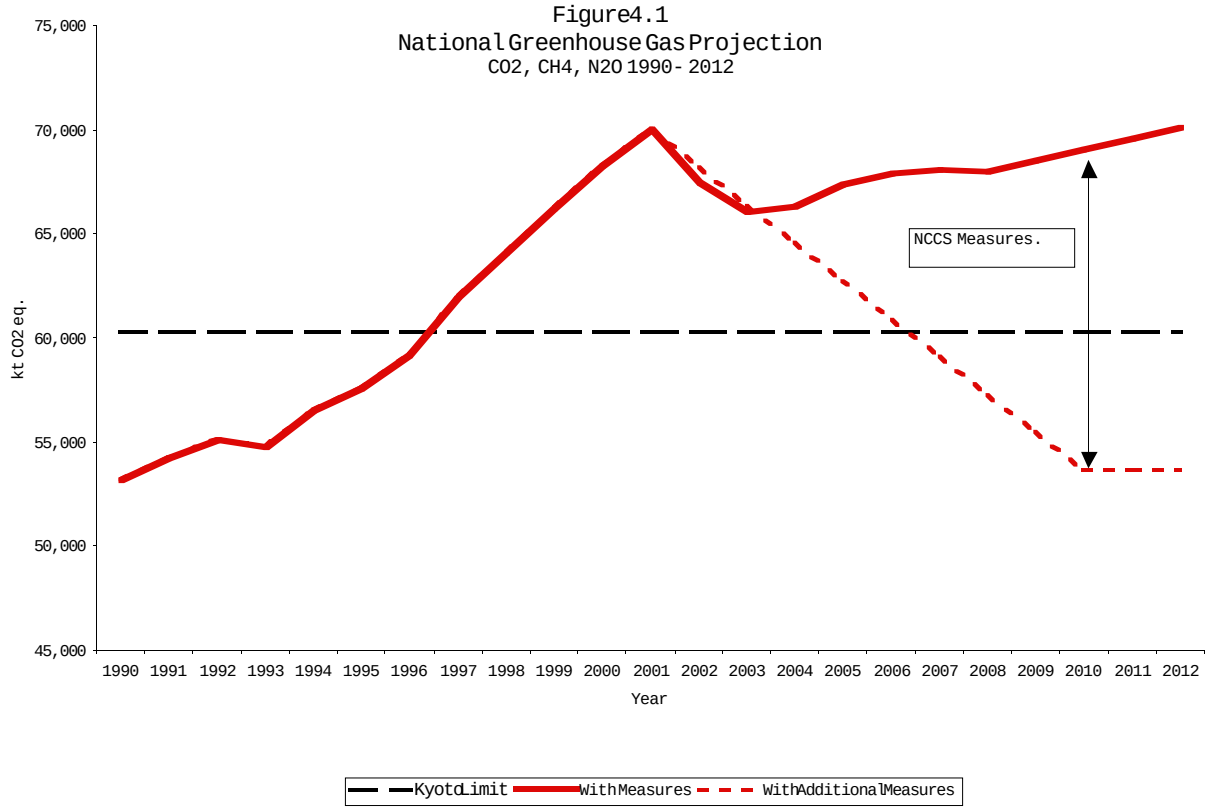
3.4 Monitoring and Evaluation of Policies and Measures

Under the National Climate Change Strategy, a cross- Departmental Climate Change Team was established at a senior policy level to secure early implementation of the measures in the strategy. The Climate Change Team has established consultative arrangements with key Social Partners and reports to the Environmental Network of Government Departments on a regular basis. The Climate Change Team is currently undertaking a review of the National Climate Change Strategy to identify whether further measures are required to ensure Ireland meets its Kyoto target.

4. Projections and the Total Effect of Policies and Measures

4.1 Introduction

The national greenhouse gas projections presented here have been developed as part of the biennial review of the National Climate Change Strategy and though substantially complete are provisional in some respects[1]. They incorporate several policy changes and developments which have occurred since the NCCS was published (Nov. 2000), notably, the reforms to the EU Common Agricultural Policy including the decision by the Ireland to opt for full 'decoupling' from 2005 and the closure of several large industrial installations not yet fully reflected in the inventories. These changes are incidental to national climate policy and the scenario presented is a 'with measures' projection. Application of the measures in the NCCS (set out in the Chapter 3) to this scenario provides the 'with additional' measures which will deliver Ireland's Kyoto target within the EU 'burden sharing' agreement. Figure 4.1 shows these scenarios and the data are presented using the NCCS sectoral breakdown for the years from 2002 through to 2012 in annex 4.

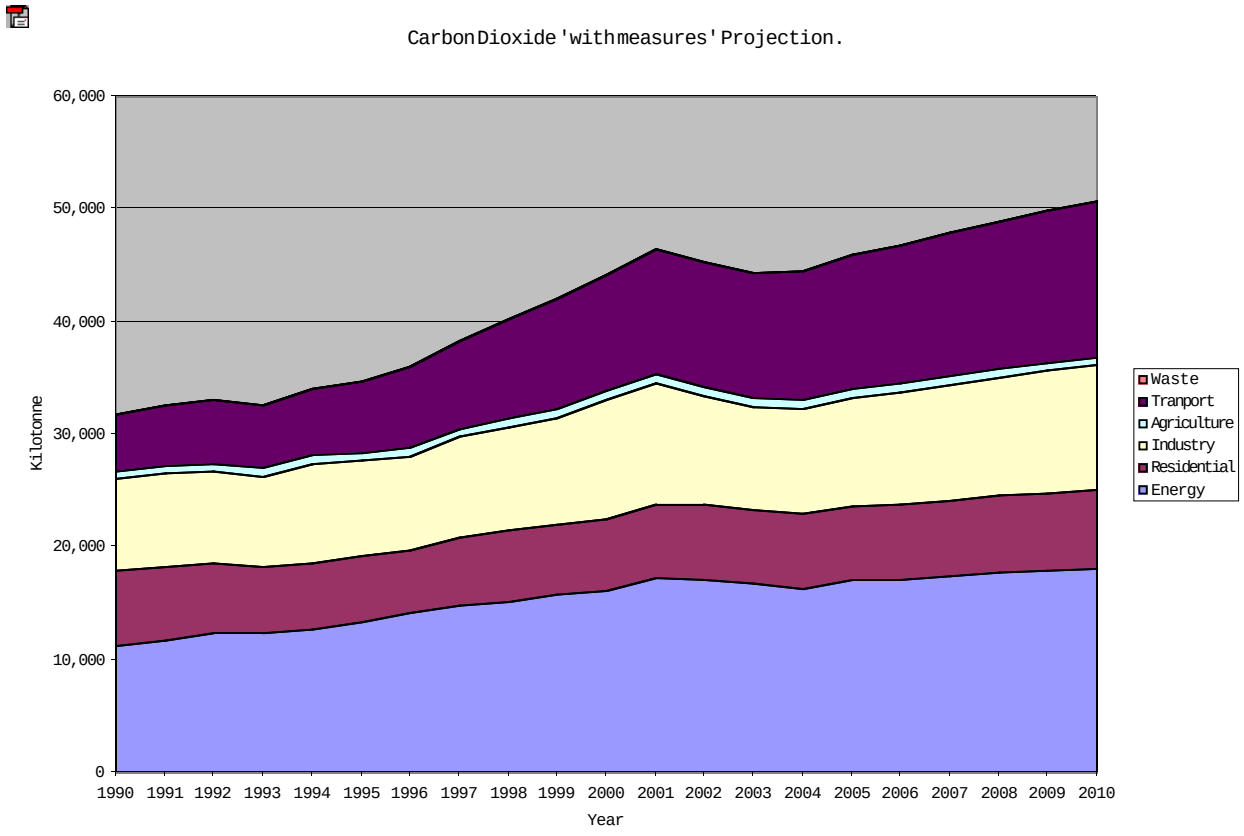


[1] Projections for the industrial sector are provisional and do not include the F gases nor finalised projections for certain subsectors i.e. cement sector.

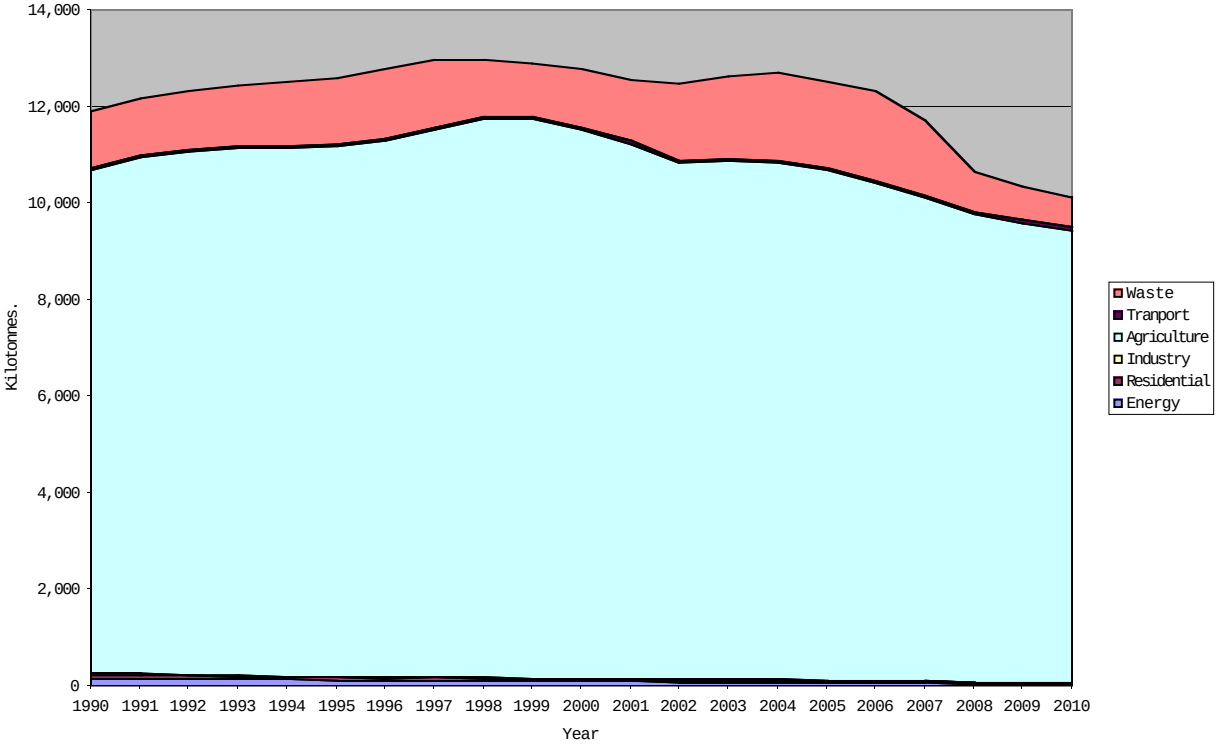
4.2 Overall Projected Trends.

Total greenhouse gas emissions (excluding net CO_2 from Land use Change and Forestry) for 2010 show an overall increase of 27.6 % on 1990 and a small drop of 2.8 % from 2001. The sector showing the largest overall increase is transport, showing an increase of 179.2 % increase on 1990 and a 24.6 % increase on 2001. The next largest increases are in the energy and industrial sectors, up 59.8 % and 19.4 % respectively since 1990. Residential emissions are projected to almost stabilise, up just 2% on 1990, whereas emissions from the agriculture and waste sectors are projected to fall by 10.5 % and 48.1 % respectively compared to 1990. Commentary on the individual sectors is presented below.

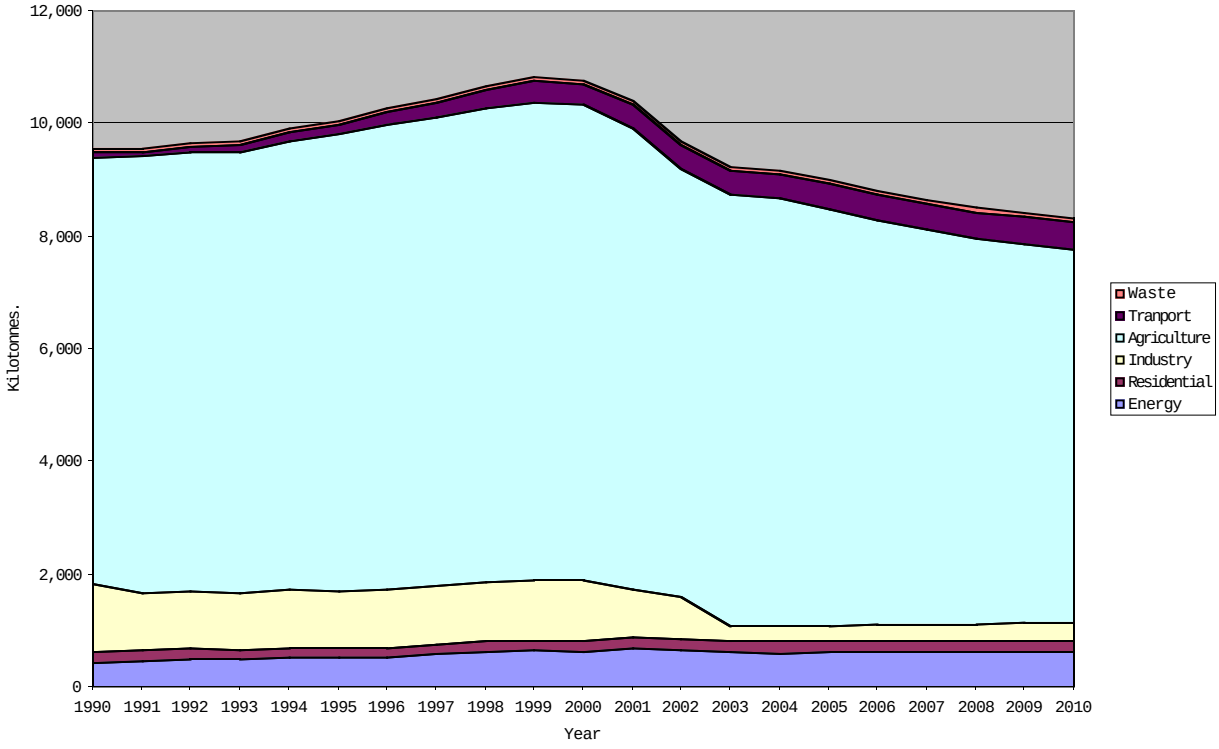
Of the three main greenhouse gases, carbon dioxide is the only one whose projected emission level in 2010 is above the 1990 level, and it is expected to show a further rise on its 2001 level, up 59% and 9% respectively (see figure 4.2). Emissions of methane in 2010 are projected to fall by 15% from its 1990 level and by 19% from its 2001 level (see figure 4.3). Emissions of nitrous oxide in 2010 are projected to fall by 13 % from its 1990 level and by 20 % from it level in 2001 (see figure 4.4).



Methane 'with measures' Projections.



NitrousOxide 'withmeasures' Projection.



4.2.1 Energy Industries

Emissions of greenhouse gases in the energy industries sector arise from three distinct sources - firstly, CO_2 and small amounts of N_2O from fuel combustion in electricity generation, secondly, CO_2 and negligible amounts of N_2O from the transformation of oil products and, lastly, CH_4 from leakages in the natural gas pipeline and CO2 from flaring and transmission of natural gas. Of these sources CO_2 from electricity generation is by far the most significant, contributing in excess of 93% of the sector's total emissions.

Over the period 1990 to 2001 total emissions from the sector rose by 53.3%, from 11.8 Mt CO_2e to 18 Mt CO_2e. In 2001 96.7% of sectoral emissions were produced as a by-product of electricity generation. These emissions are driven by the amount and type of fossil fuels consumed in production. Power generation emissions have risen from 11.3 Mt CO_2e in 1990 to 17.47 Mt CO_2e in 2001, a total increase of 54.5%. However total final consumption of electricity has grown by 76.8%, from 11.99TWh in 1990 to 21.2TWh in 2001, revealing a significant decoupling in emissions per unit of output. This has been achieved through a combination of efficiencies in generation and distribution and a switch towards less carbon intensive fuels.

The emission projections presented are based upon projections of economic activity and energy demand from the biennial economic forecast, the Medium Term Review (ESRI, 2003). Total emissions will fall as the penetration of renewables increases and thermal plant are replaced by more efficient generating technologies burning less carbon intensive fuels.

4.2.2 Residential

Greenhouse gas emissions in the residential sector arise from the combustion of fossil fuels for space heating, water heating and cooking. This combustion results in emissions of CO_2, N_2O and CH_4.

Emissions in the residential sector fell by 4.2% over the period 1990-2001, from 7 Mt to 6.7 Mt. This fall represents a significant shift away from solid fuel towards more efficient technologies and less carbon intensive fuels. This is also reflective of a more energy efficient housing stock. Total direct consumption of fuels rose by only 14.4%, from 1,834 ktoes in 1990 to 2,099 ktoe in 2001, reflecting higher insulation standards and more efficient energy conversation technologies. The share of carbon-intensive solid fuels (coal and peat) fell from 72.3% in 1990 to 28% in 2001, reflecting a switch to less carbon intensive fuels, partially driven by air quality regulations which ban the sale of 'smoky' coal in the larger urban areas.

The trends in efficiencies and fuel switching seen over the past decade are projected to continue between now and 2012, with total emissions projected to be 13.3% below 1990 levels. Total direct fuel consumption will rise to 2,039 ktoe reflecting continuing improvements in energy and building technologies. The share of solid fuels in this consumption is projected to fall to 12.3%.

4.2.3 INDUSTRY

Greenhouse gas emissions in the industrial sector arise from a range of sources. The predominant source is the combustion of fossil fuels for heating and process requirements, which gives rise to CO_2, CH_4, and N_2O. The

use of solvents results in small amounts of CO_2. The production of cement and lime both result in emissions of CO_2, while the production of fertiliser results in emissions of CO_2 and N_2O. F-gases arise predominantly from the industrial sector from various sources including the production of semiconductors, refrigeration and air conditioning units, electrical equipment and fire extinguishers.

Emissions from industrial fuel consumption rose by 23.3% in the period 1990 to 2001, while emissions from fuel consumption in the commercial and services sector rose by 32.7% over the same period. CO_2 emissions from solvent use rose by 18.6%. Process emissions arise in the production of cement, lime and synthetic fertilizer. Emissions from the production of cement rose by 122% from 0.75 Mt CO_2e to 1.65 Mt CO_2e. Emissions from lime production fell by 4.6%, from 191.42 kt CO_2e to 182.63 kt CO_2e. Combined CO_2 and N_2O emissions from fertiliser production fell by 19.9% in the same period.

Fuel combustion emissions will continue to rise at a similar rate over the next decade. Several major industrial installations have close since 2001and this is reflected in the data which show a sharp projected fall of almost 25% for the industrial sector between 2002 and 2003. However, it is anticipated that cement production will continue to rise while lime remains constant. The projection does not include the F-gases as a result of data constraints.

4.2.4 AGRICULTURE

Greenhouse gas emissions in the agricultural sector arise from four distinct processes. Firstly the combustion of fossil fuels results in emissions of CO_2, CH_4 and N_2O. Secondly, enteric fermentation in the digestive tracts of ruminant animals results in emissions of CH_4. Thirdly, management of animal manures results in emissions of $CH_4$and N_2O. Lastly, the use of natural and synthetic fertilisers and the production of certain crop types lead to emissions of N_2O from agricultural soils.

Total emissions from the sector rose by 7.9% over the period 1990 (18.6 Mt CO_2e) to 2001 (20.1 Mt CO_2e). This constitutes a 33% increase in combustion emissions, a 5% increase in enteric fermentation emissions, a 10% increase in emissions from manure management and an 8% increase in emissions from agricultural soils. These emissions are directly related to livestock numbers and fertilizer use. Synthetic fertiliser use increased by 7% over the eleven-year period from 1990 to 2001. Over the same period, cattle numbers were up 4.2%, sheep numbers down 15.7%, swine up 41%, and poultry up 1%.

Agricultural production is driven by a combination of the international food and commodity market and market supports. Under the EU CAP Reforms, Ireland has opted to fully decouple subsidies from production from 2005, and that future payments would be passed on production during the period 2000-2003. The effects of this policy of agricultural production have been assessed by the FAPRI-Ireland partnership at Teagasc and the projections presented here reflect the max decoupling scenario (i.e. full decoupling) assessed by Teagasc. In the case of fuel combustion the figures reflect the ESRI's Medium Term Review.

Fuel combustion emissions will fall by 13.8%, to 824 kt CO_2e, between 2001 and 2012. This is 14.6% higher than emission in the 1990 base year. Enteric fermentation will fall to 7.97 Mt

CO_2e, 13.2% below 1990 emissions. Emissions from the management of animal manures will fall by 9.5%, to 1.7 Mt CO_2e, while emissions from agricultural soils will fall by 15.5%, to 5.88 Mt CO_2e.

These figures reflect a fall in cattle numbers of 12.4%, a fall in sheep numbers of 36.6%, a rise in swine numbers of 40%, and a rise in poultry numbers of 1%. The use of synthetic fertilizer is projected to decrease by 14%.

4.2.5 TRANSPORT

Various forms of transportation contribute to emissions of CO_2, N_2O and CH_4 through the combustion of fossil fuels. The most significant of these is petrol and diesel consumption in road transportation. Fuel consumption in aviation[2], rail and water navigation also contribute to emissions. The other key source of emissions in the transport sector is the burning of natural gas in compressors to transport gas through the pipeline.

Transport is the fastest growing emission source in Ireland by sector. Total greenhouse gas emissions rose by 125% over the period 1990 to 2001, though this increase reflects the effects of fuel 'tourism' (see chapter 2). Within this overall growth road transport grew by 124%, internal civil aviation grew by 85%, rail transport grew by 185%, navigation grew by 47%, and gas transportation grew by 123%.

This growth reflects an increase in the stock of cars from 796,000 in 1990 to 1.38m in 2001.

4.2.6 WASTE

Greenhouse gas emissions in the waste sector arise primarily from the anaerobic digestion of organic matter, which produces methane. A small amount of nitrous oxide from human effluent is also reported.

Emissions in the waste sector increased by 10.1 % over the period 1990-2001 from 1.2 Mt to 1.3 Mt. This increase represents an increase in the volume of organic matter going to landfill over prior to and during the period, as maximum anaerobic activity is assumed to occur approximately four years after landfill.

In recent years there have been significant national moves to change waste management practices to reflect the waste hierarchy of reduce, reuse and recycle and specifically to divert the waste stream from landfill as many existing site are close to capacity. As a result it is projected that methane emissions from landfill will peak in 2006 at 1.9 kt CO_2 eq before falling sharply to 0.6 kt CO_2 eq in 2010.

4.2.7 FORESTRY

The total carbon stock in forest biomass (excluding soil carbon) is estimated to be circa 18 mega tonnes for the year 2000, with an annual storage of 0.9 mega tonnes after harvest. The national long term forestry strategic plan provides for 20,000 hectares of new afforestation per annum up to 2030 which, if achieved, will increase forest the area to 860, 000 hectares by 2010 and to 1.2 mega tonnes by 2030. The projection for carbon sequestration from forestry is developed by Coford on the basis of the planned planting and harvesting regime and is revised upward to 1.29 million tonnes CO_2 sequestration from the earlier estimate of 1.01 mega tonnes CO_2 in the NCCS.

[2] Emissions from international aviation are not included in the projections.

5. Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

5.1 Expected 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 a range of impacts which it is prudent to anticipate. In an EPA supported research programme, the National University of Ireland completed an assessment of the impacts of climate change in Ireland. The report presents an assessment of the magnitude and likely impacts of climate change in Ireland over the course of the present century. It approaches this by firstly establishing scenarios for Irish climate based on global climate model projections for the middle and last quarter of the present century. Secondly these projections are then used to assess probable impacts in key sectors such as agriculture, forestry, water resources, the coastal and marine environments and on biodiversity.

The purpose of the report is to firstly identify where vulnerability to climate change exists in Ireland, and what adjustments are likely in the operation of environmental systems in response to such changes. In many sectors, such as in agriculture, some new opportunities are likely to arise for optimising climatic resources. In other instances e.g. water resource management, long-term planning strategies will be necessary to avoid adverse impacts. Long lead-in times for adjustment characterise many sectors e.g. forestry and it is important to provide as much advance warning of likely changes as possible to enable adaptation to commence early. By anticipating change it is possible for a country such as Ireland to position itself better to minimise the adverse impacts and maximise the positive aspects that global climate changes may present.

5.2 Scenarios for Irish Climate

The climatic scenarios developed for Ireland for 2041 – 2070 and 2061 – 2090, in which some degree of confidence can be placed, suggest a general increase in January temperature of approximately 1.5°C by mid century, increasing to approximately 2.5°C by 2075. By mid century winters in northern Ireland and in the north midlands will be similar to those of Cork / Kerry during the 1961 – 1990 period. Since temperature is a primary meteorological parameter, secondary parameters such as frost frequency and growing season length and efficiency can be expected to undergo considerable changes.

General summer temperature increases of approximately 2°C are apparent by mid century with highest values to be found inland away from north and west facing coasts. This 'continental' effect is further enhanced in the 2075 scenario. Combined with reduced summer precipitation amounts, the principal impact of this is likely to manifest itself in increased evapotranspiration and increased occurrence of soil moisture deficits and drought stress.

The summer and winter temperature scenarios for 2041 – 2070 compared with 1961 – 1990 are in Figure 5.1.

Precipitation scenarios are less reliable than temperature, but suggest that winter increases in precipitation will be observed over most of

Ireland. On average these amount to 11%. The greatest increases are suggested for the north-west where increases of approximately 20% are suggested by mid-century. Little change is suggested as occurring on the east coast and in the eastern part of the Central Plain, though further work in these areas is required to corroborate this.

A more explicit signal is apparent for summer, with marked reductions in rainfall across eastern and central Ireland. Nationally, these are of the order of 25% with decreases of over 40% in some parts of the south-east suggested. Such decreases would have profound implications for agriculture and water resource management.

The magnitude and frequency of individual flood events will probably increase in the western half of the country. Seasonal flooding may occur over a larger area and persist for longer periods of time. Long term deficits in soil moisture, aquifers, lakes and reservoirs are likely to develop.

The summer and winter precipitation scenarios for 2041 – 2070 compared with 1961 – 1990 are in Figure 5.2.

Figure 5.1

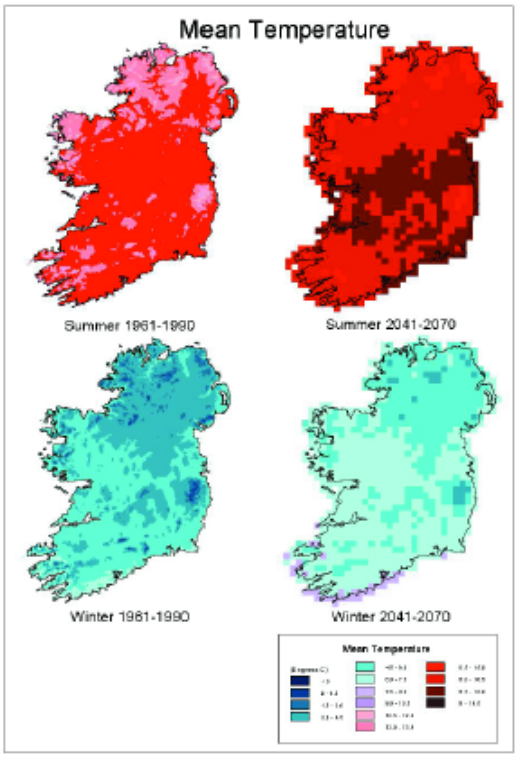
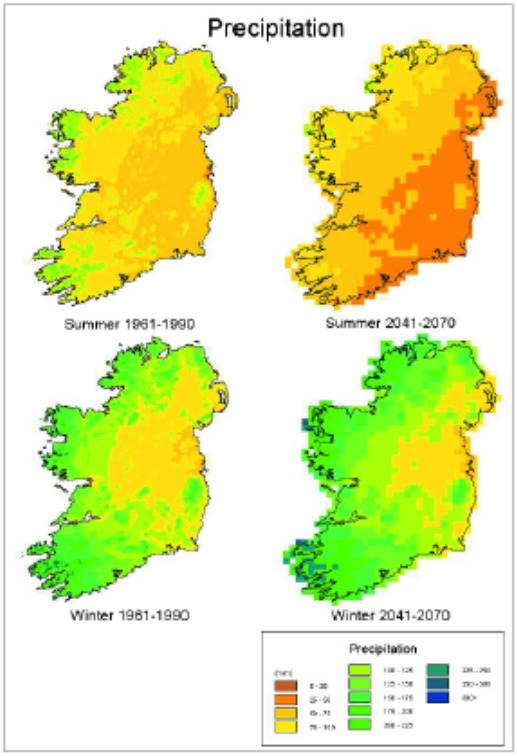


Figure 5.2



5.3 Impact on Agriculture

The simulation results after using the climate scenarios as input to crop simulation models show that the expected climate changes will have a major impact on Irish agriculture which, though significant, cannot be regarded as potentially catastrophic.

- For livestock production, the expectation of more frequent summer droughts will require significant supplementation of grazed grass.
- Maize silage is increasingly likely to replace grass silage, potentially increasing grazing land areas. At the same time, increased production of grain maize is expected.
- Barley is another potentially important source of energy for supplemental feeding of livestock. The expected increases in cereal grain production may be expected to reduce the cost of feed barley. However, the extra costs associated with irrigation may offset this if it proves necessary, thereby bringing the economic viability into question, especially if barley is in competition with maize as a forage crop.

- Soybean is an important supplemental source of livestock protein and is currently imported. Soybean has the potential to replace maize as the marginal crop in Irish agriculture.

Although warmer temperatures would be expected to result in shorter winter housing times for livestock, a trend towards wetter winters may result in problems of poaching and soil damage, which may negate this. The balance of grazing season length against winter rainfall will dictate the stored feed requirement, and the actual climate will dictate the choice of forage crop grown. Opportunities to spread slurry or dirty water in winter will be substantially reduced and increased slurry storage requirements are likely to be needed. Drought stress will become increasingly important.

- Irrigation will become important for all crops in the eastern half of the country. This will have a major impact on the economics, machinery requirement and labour demand in both tillage and livestock systems. Irrigation in dairying in the drought-prone southeast is currently justified economically only if water is available without charge and without the construction of farm reservoirs. With the projected scenarios, a much greater area of agricultural land will be affected by drought loss, and the quantities of water involved to compensate by irrigation will be large. Given that agriculture may have to compete for scarce summer water extraction with other users, the consequent economic effects may make crops with good potential uneconomical.
- For potato, drought stress will be the most important limiting factor determining its viability and it is likely that potatoes will cease to be a commercially viable crop over much of Ireland.
- Spring barley yield increases of approximately 25% are likely by 2055 with harvesting time earlier than today.
- Maize grain yields are expected to increase dramatically, in western areas by more than 150% on today's national average value. Later harvest dates may pose an increased risk factor.
- Soybean will remain a marginal crop with the projected changes in climate. Although temperature conditions become more favourable, precipitation changes mean that any gains could be negated by drier summers.

Irish agricultural land use distributions will alter in response to climate change. A sharpening of east-west contrasts is likely to occur with livestock production dominating more to the west, and arable production dominating east of the Shannon. Planning for irrigation is needed, particularly in the east, to ensure that water costs are acceptable and summer surface and ground water resources are not overused.

5.4 Impact on Water Resources

Using the climate scenarios as input to a hydrological model a number of likely impacts were suggested:

- A widespread reduction in annual runoff is likely that will be most marked in the east and south-east of the country.
- Winter runoff is predicted to increase in most of Ireland.
- All areas will experience a major decrease in summer runoff, particularly in the east of the country. These reductions are likely to average approximately 30% over large parts of eastern Ireland by mid century.
- The magnitude and frequency of individual flood events will probably increase in the western half of the country.
- Seasonal flooding may occur over a larger area and persist for longer periods of time. Areas such as the Shannon basin will be vulnerable to these changes
- Turloughs in western Ireland will also be particularly vulnerable to these changes.

- During the summer months, long term deficits in soil moisture, aquifers, lakes and reservoirs are likely to develop. It is likely that the frequency and duration of low flows will also increase substantially in many areas.

Since evaporative losses are also likely to increase during summer months, the water resource changes projected will have a significant effect on reservoir yields. Water supply infrastructure is expected to come under growing pressure particularly in the Greater Dublin Area and the strategic implications of this are profound for a number of areas, particularly spatial settlement strategy.

The projected changes in water availability pose potential problems for the dilution of water-borne effluent. With a greater frequency of low flow conditions, additional precautions will be required to ensure that concentrations of water pollutants do not give rise to acute effects. It is recommended that minimum flow constraints are determined more conservatively, particularly where new urban or agricultural discharges are envisioned. Greater incorporation of groundwater protection considerations is also recommended as aquifers assume increasing importance, since sources of water supply, when competition for reduced surface resources intensifies.

5.5 Impact on Forestry

Forests cover 9% of the land area of Ireland, a figure which is planned to double by 2030. In planning for the future, foresters must select species that will perform optimally over a full rotation of 40-50 years. The time span that the report addresses is therefore highly relevant in influencing decisions being taken today in the forestry area.

Increased CO_2 concentrations and warmer temperatures are expected to benefit Irish forest growth. Decreased summer rainfall, however, would negate this, as would any increase in storm frequency. Secondary effects of climate change on forest productivity are also expected to be considerable. Increased nutrient

mineralisation in warmer temperatures is likely, though so also are changes in pest and disease incidence. Increased fire damage and increased deer and squirrel populations may also constitute negative indirect impacts of climate change on forestry.

The interaction of different effects on forest growth is difficult to model, and different species will respond differently to changed climatic conditions. However, there is no reason to believe that Sitka Spruce will not continue to be viable as the mainstay of commercial forestry in Ireland. Despite this, there is a need to assess different provenances and species in long-term research trials. Particular attention should be given to alternative provenances for Douglas Fir and Western Red Cedar. It is also recommended that the national tree-breeding programme should be re-assessed in the light of current knowledge on potential climate change, with a view to the selection of traits that will accommodate and capitalise on these changes. The potential for the production and transplanting of containerised nursery stock should also be reassessed. Finally, it is urged that climate change scenarios should be included in the Forest Inventory and Planning System currently operated by the Forest Service in the Department of Communications Marine and Natural Resources.

5.6 Impact on Natural Ecosystems and Biodiversity

The projected increases in temperature, combined with a longer growing season, were found to have the potential to cause distributional and behavioural changes on Irish species.

Climate changes are also likely to result in significant alterations to habitat conditions, though movement of habitats in Ireland will be restricted by non-climatic considerations. Salt marshes and sand dune habitats are vulnerable to sea-level and climate changes and may experience significant changes in species composition. Montane heaths are suggested as being particularly sensitive to climate change, since many montane species are at the lower altitude/southern latitude edge of their distribution, with limited migration potential and an increase in temperature combined with summer drying may prove detrimental for this habitat in Ireland. Similarly, peatlands are expected to suffer considerably from summer drying. An increase in decomposition, a reduction in peat formation, more erosion, changes in species composition, loss of carbon storage and an increase in acid runoff may occur in this already fragile resource.

5.7 Impact on Marine Ecosystems

The existence of many marine species in the seas around Ireland is temperature controlled. However it is difficult to extrapolate predictions for land temperature increase to determine likely changes in sea temperatures, particularly for sub surface temperature changes which may be controlled by larger oceanographic circulation patterns. Thus, although species which are sensitive to climate change may be identified quite easily, the extent to which actual changes will happen is difficult to predict. Many of the impacts are likely to be indirect, where the reduction of one species allows for an increase in another through reduced competition. A notable impact exists with respect to salmon farming, however, where an increase in sea temperature may have serious consequences. Salmon are near the southern range of their distribution and any increases in temperature could harm the commercial viability of farms and render them subject to

increased algal bloom, pest and disease problems.

5.8 Sea-Level rise and the Irish Coast

The coast is a dynamic environment, which is constantly responding to processes operative on a range of time scales. The single most important control on these processes is sea level, which has varied considerably over the past 20,000 years. Global sea level is projected to rise by approximately 0.5 metres by the end of the century, predominantly due to warming and expansion of the ocean water body. In Ireland this figure will be modified by local land level changes, though a higher platform for wave attack will inevitably mean greater erosion of 'soft' coastlines, formed of glacial drift or unconsolidated materials. As a general approximation, about 1 metre land retreat can be anticipated on sandy coastlines in Ireland for every centimetre rise in sea level.

Inundation risk must also take into account storm surge events and high tide frequencies. A value of 2.6m for extreme water level presently occurs, with a return frequency of 12 years on the west coast and 100 years on the east coast. These return periods of extreme water level are likely to reduce considerably as sea levels rise. Combining these extreme water levels with a sea-level rise of 0.49m places approximately 300km2 of land in Ireland at risk of inundation.

The loss of agricultural land cannot economically be defended against, and should not be contemplated. Where infrastructure is at risk of inundation, cost-beneficial solutions may exist. This is particularly the case in the cities of Dublin, Cork, Limerick and Galway, and for assets such as railway lines, airports, power stations etc. 'Hard' engineering solutions should be viewed as a last resort outside of these categories, however, as the evidence suggests this type of engineering can have dramatic effects further along the coastline. Recommendations for coastal management policies to cope with sea-level rise would include the following:

- no building or development within at least 100 metres of 'soft' coastline;
- no further reclamation of estuary land;
- no removal of sand dunes, beach sand or gravel. Measures to protect and rehabilitate dune systems should be implemented;
- all coastal defence measures to be assessed for environmental impact;
- where possible the landward migration of coastal features such as dunes and marshes should be facilitated,

The Report concludes that climate changes over the next half century can be anticipated and their regional dimensions can be projected using statistical downscaling techniques. While considerable uncertainty remains, especially with respect to precipitation changes, forward planning is now required to accommodate climate change in Ireland. In key areas such as agriculture, water resources, coasts, marine and the natural environment, climate change impacts are likely to be considerable and significant adjustment of present management practices will be required to ensure a sustainable future.

5.9 Climate Change and Nature Conservation in Ireland and Britain

Climate change brings a new dynamic to existing plans and practices to conserve habitats and species and climate is one of the key determinants of species distribution. As climate changes, the distribution patterns of species and the composition of habitats will change. The

Department of Arts, Heritage, Gaeltacht and the Islands joined in a consortium of eleven nature conservation organisations in Ireland and Britain in 1999 to study possible outcomes of an assessment of how the likely changes in climate might impact on wildlife, geology and geomorphology.

It is the first comprehensive study applying to species and habitats in terrestrial, freshwater, coastal / marine environments and limestone landscapes on these islands. The study utilised existing meteorological data to identify zones of similar climatic characteristics, also using the UK Climate Impacts Programme (UKCIP) climate scenarios and data sets. Computer simulations were used to predict how species might respond to climate change in 20 and 50 years time and research is ongoing to examine particular habitats in greater detail.

The predictions include:

- Species with northerly distributions or found at altitude will be generally affected, as the area of suitable climate space will shrink and habitats become more fragmented or disappear;
- Species with more southerly distributions could spread over a wider area as the climate generally warms, depending on their ability to disperse or migrate and availability of suitable habitat;
- Limestone karst landscapes such as the Burren would experience modest increases in dissolution rates;
- Wetlands such as fens and raised bogs may suffer due to reduced summer rainfall, although blanket bogs and wet heaths could benefit from increased winter rainfall;
- Coastal habitats such as salt marshes, sand dune systems and vegetated shingle will be affected by the rise in sea level and increased storminess;
- Estuaries may be affected by rising sea levels with the impact on sediment composition,

Overall, the predictions arising highlight the necessity to look at existing plans and practices to conserve habitats and species in particular. In the light of the study changes are probably necessary to deliver conservation into the future.

5.10 Integrated Coastal Zone Management (ICZM)

ICZM Policy

A report on coastal Zone management policy *(Coastal Zone Management: A Draft Policy for Ireland),* prepared by consultants engaged by the then Department of the Environment and Local Government, the Department of, Marine and Natural Resources and the Department of Arts, Heritage, Gaeltacht and the Islands was published in 1997.

The priority focus in subsequent years has been on the introduction of new legislation and frameworks in relation, inter alia, to planning and development, aquaculture licensing and regulation, dumping at sea, and on locally based initiatives and pilot schemes including the Bantry Bay Coastal Zone Charter and co-ordinated Local Aquaculture Management Systems (CLAMS).

This work has established the basis for the development of new models that will address interactions between sectors, agencies and legal frameworks relevant to the coastal zone and deliver a more integrated strategic approach to Coastal Zone Management. This will be taken forward on a collaborative basis by the Government Departments and agencies concerned, taking account of national and international research and experience to date. Account will be taken also of the terms of the

draft Recommendation on Integrated Coastal Zone Management proposed by the European Commission and under consideration by the Institutions of the European Community.

The draft Recommendation asks Member States to draw up their own national strategies based on the results of national stocktaking to identify the laws, main actors and institutions exerting an influence on planning and management of coastal zones in all the relevant sectors in order to gain an accurate picture of how coastal zones are used and managed in each country.

5.10.1 ICZM and the Planning System/Planning & Development Act, 2000

The planning system also has an important role to play in ensuring that we have an effective and integrated system for the management of the Irish coastal zone. 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.

5.10.2 Other ICZM Measures

Numerous individual measures are being advanced by Ireland which are influenced by, and will facilitate achievement of, the principles of ICZM at a local, Regional/River Basin, National and EU level. These include:-

- A major programme of investment in Waste Water Treatment Plants, especially in the larger, coastal urban centres such as Cork, Drogheda, Dublin, Dundalk, Limerick, Galway, Waterford;

- Establishment of River Basin Management Projects in relation to all inland and coastal waters, which will facilitate integrated planning and management, ensure co-ordinated application of EU and National legislation, ensuring collaboration with actors in neighbouring counties and resolve cross-border issues.

- Facilitating the collecting of information, involving local stakeholders, developing

consensus, and developing bottom up initiatives similar to the Bantry Bay Charter [http://www.ucc.ie/ucc/research/crc/life.html].

- The Local Government Act 2001, provides that the maritime boundary of a local authority shall be the high water mark for the time being.

- Bye-laws under the Local Government Water Pollution Act can now relate to the foreshore.

6. Financial Resources and Transfer of Technology

The Irish Government's national programme of assistance to developing countries, Development Cooperation Ireland, was established in 1974. While the programme has grown steadily over the past three decades, the rate of growth increased dramatically in recent years. Total spending on official development assistance is expected to reach €450 million in 2003 compared to €158 million in 1997, an increase of €292 million or 186% over the period. It is evident therefore, that much of Ireland's Development Assistance expenditure can be considered "new and additional".

Rapid economic growth in the late 1990s meant that despite substantial increases in funding, limited progress was made towards the UN target for ODA of 0.7% of GNP.

In 1997, ODA stood at 0.31% of GNP. Notwithstanding the fact that total ODA more than doubled between 1997 and 2001, an increase of just two percentage points had been recorded over the period. Substantial progress was made in 2002 with an increase of more than €100 million enabling Ireland to reach 0.41% of GNP. This achievement has been maintained in 2002 and 2003 despite difficult economic circumstances. In percentage terms, Ireland is now one of the world's leading donors: we were ranked in seventh place among OECD DAC member states in 2002 and well above the EU average.

Table 6.1 below illustrates the rapidity of the growth in funding in recent years:

ODA Volumes 1997 – 2003

Year	TOTAL ODA	Of which Vote 39 €m	ODA as % GNP
1997	158	116	.31
1998	177	127	.27
1999	230	148	.31
2000	255	173	30
2001	320	236	.33
2002	422	343	.41
2003	450	374	.41

2003 figures reflect allocations. Other ODA is estimated at €80 million. GNP estimate is subject to ongoing revision. Vote 39 (middle column) is disbursed by development Cooperation Ireland.

As part of Ireland's increasing Development Assistance, the following contributions were made to the Global Environment Facility:

Table 6.2 Financial Contributions to the Global Environment Facility (GEF)

	Contribution (Millions of US Dollars)					
	1997	**1998**	**1999**	**2000**	**2001**	**2002**
Global Environment Facility	1.4	0.5	1.3	1.0	1.1	1.4

Table 6.3 Financial Contributions to Multilateral Institutions and Programmes[10]

Institution or Programme	**Contribution (Millions of US Dollars)**					
	1997	**1998**	**1999**	**2000**	**2001**	**2002**
Multilateral Institutions						
1. World Bank	6.4	6.1	7.5	9.7	9.4	9.2
2. IFC	0.2	0.2	0.2	0.3	0.3	0.4
3. ADB						
4. Asian Dev Bank						
5. EBRD						
6. I-A DB						
7. UNDP	2.2	2.8	3.1	4.0	6.0	9.2
8 UNEP	0.02	0.03	Nil	Nil	Nil	1.0
9. UNFCCC Supplementary Fund						0.03
10. Other						
Multilateral Scientific Technological and Training Programmes	Nil	Nil	Nil	Nil	Nil	Nil

10 All figures are rounded to the nearest $100,000.

6.1 Assistance provided to Developing Country Parties that are particularly vulnerable to the adverse effects of Climate Change with reference to Table 6.4 below:

Hydrology: Engineering Hydrology is a discipline of crucial importance in monitoring the impact of climate change and in planning relevant adaptation. It enables governments to monitor rainfall, run-off from catchment areas, river flows etc. and to forecast maximum 50 or 100 year flood levels. Ireland supported the development of engineering hydrology capacity in developing countries over a period of 10 years. University College Galway, which has a world-renowned Department of Engineering Hydrology, developed an M.Sc. programme specifically aimed at students from developing Countries. Its core costs were financed by Development Cooperation Ireland, as were the costs incurred by students attending the course. The capacity to deliver the M.Sc. course was developed at the University of Dar es Salaam and again, major costs were met by Development Cooperation Ireland, up to and including 1998.

Coastal Zone Management: Development Cooperation Ireland supports the implementation of a Coastal Zone Management Programme in Tanga, Tanzania. The programme is implemented by IUCN in partnership with the Government of Tanzania. Community management of the coastal fisheries and mangrove swamps has been very successfully promoted. Tanga is the only region of Tanzania in which the area under mangrove has increased over the past ten years. Fish stock levels have improved and dynamite fishing has virtually been eliminated. The health of the coral reefs is constantly monitored. Coral bleaching, which is thought to be related to climate change, has been observed but to date the reef has recovered from such events in a matter of weeks.

Watershed Management: Watershed Management forms a major component of Area-based Programmes supported by Development Cooperation Ireland in Ethiopia. Catchment areas of at least 500 hectares are identified in densely populated and eroded areas of the country. In such areas, a vicious circle arises from food shortages resulting from low productivity, forcing communities to engage in unsustainable utilization of resources from the forest, which in turn causes erosion and nutrient depletion thereby creating the poverty / resource degradation cycle.

Rehabilitation of the watershed involves both technical and institutional interventions such as soil and water conservation, gully stabilization, hillside terracing, tree planting, area enclosures and plantings, irrigation, fruit production and integrated pest management. Institutional interventions result in the development of community management of the watershed and its natural resources. Dramatic results have been achieved in terms of soil conservation and rehabilitation, improved crop yields and better water resource management. Dry springs begin to flow and new springs have emerged in places. Communities as a result are considerably less vulnerable to extreme weather events such as drought and their natural resource base is protected from the destructive effects of extremely heavy rain.

6.2 UNEP: This expenditure is shown on Table 6.3 above. Since 2002, Development Cooperation Ireland is providing $1million annually to UNEP. These funds can be used by UNEP, in Sub-saharan Africa and will focus on the following four priority areas:

- Protection of freshwater resources (in follow-up to the Dublin Statement on Freshwater – 1992 and the Bonn Conference on Freshwater - 2001);
- Access to environmental information for decision-making (in follow-up to the Dublin Statement on Access to Environmental Information – 2000);
- Protection of coastal and marine environment (with an emphasis on coastal and marine fisheries management);
- Conservation of biological diversity (with an emphasis on monitoring of land cover, protected areas, and indigenous vegetation change).

Table 6.4a. Bilateral and Regional Financial Contributions related to the Implementation of the Convention
1997
(Millions of Dollars)

	Mitigation	Adaptation		
Recipient Country/ Region		**Capacity Building**	**Coastal Zone Management**	**Other Vulnerability Assessments**
Tanzania	Nil	0.2	0.6	
Africa / Asia / Latin America	Nil	0.6		
Ethiopia	Nil			0.5
Sudan	Nil	0.08		

Table 6.4b. Bilateral and Regional Financial Contributions related to the Implementation of the Convention

1998
(Millions of US Dollars)

	Mitigation	Adaptation		
Recipient Country/ Region		**Capacity Building**	**Coastal Zone Management**	**Other Vulnerability Assessments**
Tanzania	Nil	0.2	0.8	
Africa / Asia / Latin America	Nil	0.4		
Ethiopia	Nil			0.6
Sudan	Nil	0.1		

Table 6.4c. Bilateral and Regional Financial Contributions related to the Implementation of the Convention

1999
(Millions of US Dollars)

	Mitigation	Adaptation		
Recipient Country/ Region		**Capacity Building**	**Coastal Zone Management**	**Other Vulnerability Assessments**
Tanzania	Nil		0.7	
Africa / Asia / Latin America	Nil	0.4		
Ethiopia	Nil			0.7

Table 6.4d. Bilateral and Regional Financial Contributions related to the Implementation of the Convention

2000
(Millions of US Dollars)

	Mitigation	Adaptation		
Recipient Country/ Region		**Capacity Building**	**Coastal Zone Management**	**Other Vulnerability Assessments**
Tanzania	Nil		0.3	
Africa / Asia / Latin America	Nil	0.2		
Ethiopia	Nil			0.85

Table 6.4e. Bilateral and Regional Financial Contributions related to the Implementation of the Convention

2001
(Millions of US Dollars)

	Mitigation	Adaptation		
Recipient Country/ Region		**Capacity Building**	**Coastal Zone Management**	**Other Vulnerability Assessments**
Tanzania	Nil		0.5	
Ethiopia	Nil			0.8

Table 6.4f. Bilateral and Regional Financial Contributions related to the Implementation of the Convention

2002
(Millions of US Dollars)

	Mitigation	Adaptation		
Recipient Country/ Region		**Capacity Building**	**Coastal Zone Management**	**Other Vulnerability Assessments**
Tanzania	Nil		0.7	
Ethiopia	Nil			0.8

6.3 Technology Transfer

Ireland's support for the transfer of climate change–related technologies has been limited to those relevant to adaptation such as watershed and coastal zone management. In the case of the former, Development Cooperation Ireland became aware of the technology through the academic literature and in 1997, invited a consultant from India to visit Ethiopia and make presentations to our partners in Regional governments. Following considerable debate, Tigray Region agreed to try the approach on a pilot basis and the consultant was contracted to train 60 regional technical officers. A further 16 technical people received additional training on watershed management project design and implementation in India. Capacity building, however, is not limited to government institutions, but also focuses on building the capacity of local communities to sustainably manage their own natural resources and to maintain the physical structures such as stone-faced trench bunds, hillside terraces and gabions which they themselves had constructed under the programme.

Coastal Zone Management is a broadly similar approach but applied to coastal areas. Again community management of the natural resources is at the core of the approach but local government administrations must have the competencies, skills and knowledge to help the community monitor the health of the coral reefs, breeding grounds, mangrove swamps etc. and to monitor fish stock levels. This programme was implemented in Tanzania by the International Union for the Conservation of Nature (IUCN) in partnership with the Government of Tanzania and financed by Development Cooperation Ireland. IUCN provided the required technological expertise and trained the staff of our partners in local government and in the communities.

7. Research and Systematic Observation

7.1 General Policy on funding of research and 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) who provide 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.

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).

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.

An ad hoc liaison committee consisting of:, Coford, Department of Agriculture and Food (research), the EPA, the Irish Research Council for Science Technology and Engineering and the Marine Institute discuss funding for cross cutting areas such as climate change. The Irish Climate Change Committee (ICCC) is a largely an academic group providing independent commentary in relation to climate change research and observation requirements.

7.2 Exchange of data and information

The absence of a climate change data and an 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 this 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.

A project on the re-evaluation of historical research and monitoring data in relation to their relevance to factors and parameters, which reflect or influence changes to the atmospheric radiation balance, will be completed in 2003. Where appropriate, data identified by this project will also be available through the above National archive.

Meteorological data for climate change related research 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

A number of significant research efforts are being undertaken in the area of climate change. Current research work within Ireland can be described under the following subject area headings.

- 7.3.1 Regional climate model development
- 7.3.2 Indicators of climate change
- 7.3.3 Impacts of climate change
- 7.3.4 Paleoclimate studies
- 7.3.5 Greenhouse gases emission inventories and the carbon cycle
- 7.3.6 Factors influencing the radiation balance
- 7.3.7 Economic and social impacts

7.3.1 Regional climate model development

The national meteorological service Met Eireann is in the process of developing a regional climate model by operating the HIRLAM forecast model in climate mode. This development will greatly increase the national capacity in this area and will consolidation and add to ongoing national atmospheric research efforts. The EPA and SEI are co-funding this work.

7.3.2 Indicators of climate change

An EPA funded project on indicators of climate change by NUI Maynooth was completed in 2002. In this work an analysis of meteorological, ecological, social and economic data was undertaken in order to identify signals or influences of climate change. This work suggests that signals consistent with those projected under climate change scenarios are apparent from both the meteorological data and some ecological data, e.g., a prolongation of the growing season is evident from some phenological observations.

7.3.3 Impacts of climate change

An EPA funded project on future impacts of climate change for Ireland by NUI Maynooth will be published in 2003. This analysis is based on statistical downscaling of Global Climate model output and provides for analysis of planning needs for future climate scenarios. Areas of water supply management have been identified as key issues. This work will be refined in a follow up project also funded by the EPA. This work will progress in tandem with the regional climate model project work.

7.3.4 Paleoclimateology

The University of Limerick and NUI, Galway are participating in EU funded TIMECHS(www.gsf.fi/paleo/timechs/) study. This aims to study Holocene climate change at the Atlantic fringe of Europe through the

detailed study of laminated, calcareous sediments. The study has provided insights into environmental development and vegetation dynamics in Ireland over the Holocene period. Diatom analysis is used to reconstructing salinity fluctuations and climate change. Fossil diatoms from An Loch Mór are expected to contain a record of ocean storminess and also sea-level change. It is envisaged that the fossil diatom record will reflect changes in limnological conditions that relate to changes in the catchment areas.

7.3.5 Factors influencing the radiation balance

An extensive range of atmospheric composition and other atmospheric measurements are carried out at the Mace Head Atmospheric Research Station, operated by the National University of Ireland, Galway. The Mace Head station is a Global Atmospheric Watch (GAW) baseline site: whose siting provides for observation of trends and changes in greenhouse gases and other radiatively important species in mid-latitude North Atlantic air masses. This facility has attracted considerable national and international funding for long and short-term projects / studies. Current nationally funded projects include EPA funded greenhouse gas studies and EPA and EI funded studies of aerosol composition and fluxes.

7.3.6 Greenhouse gases (GHG) inventories and the carbon cycle

In the European context, Ireland has a number of unique features in relation to GHG emissions and factors that influence the carbon cycle. These include a large agricultural sector, a low level of forest coverage and high percentage of peatland which constitute areas of special interest with regard to the atmospheric carbon balance. A wide range of GHG and carbon cycle studies are underway in these areas. These are outlined below;

(i) University College Dublin is leading studies of agricultural CH_4 and N_20 emissions, These utilise SF_6 tracer technique to improve understanding CH_4 emission by livestock and includes studies to determine methods by which these can be reduced. Chamber techniques are used to determine N_20 emissions under different fertiliser regimes and soil types. This work is being partially co-funded by Teagasc. These studies will improve reporting of national GHG gas inventories.

(ii) Teagasc is carrying out an 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 EPA funded study by University of Limerick will contribute to understanding of carbon build up in, and removal from, soils.

(iii) On a larger scale, a combined Queens University Belfast and University College Dublin(UCD) study, funded by the EPA, is being carried out on land use and land use change from satellite and other analyses in order to determine changes to carbon storage in Ireland. This is linked to a separate UCD model and satellite study of peatland carbon fluxes. On a micro-level scale NUI Galway is carrying microbial studies of methane emission peatland.

(iv) COFORD is funding integrated studies of carbon dioxide sequestration by Irish forest ecosystems. This focuses on Sika Spruce and involves the use of mico-meteorological flux methods. Similar flux studies are being carried out over grassland, peatland and arable land.

These studies will be linked to similar international studies, e.g. GREENGRASS, CarboEurope. More advanced detection techniques will be used to study of N_20 and CH_4 fluxes. These are part of an EPA capacity development project to establish a network such flux study sites.

(v) At a macro-scale work on the application of inverse modelling techniques have 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.

7.3.7 Economic and social impacts

The EPA and IEI 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.

7.4 International participation

Ireland recognises the international nature of climate change and the need to participate in global efforts. The Irish Committee for the International Geosphere -Biosphere Programme (IGBP) has been restyled as the Irish Committee on Climate Change. This body continues to co-ordinate international IGBP activities. Ireland also participates in the Global Climate Observing System (GCOS).

7.5 Systematic Observation

A number of National bodies/organisations are engaged in systematic observations. 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.

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 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

Met Éireann is currently at an advanced stage in the development in-house of a logger-based on-line AWS for The Unified Climatological and Synoptic Observational Network (TUCSON).

7.5.2 Ozone and Solar Radiation Monitoring Network

Ground level ozone, total column, are monitored at Valentia along with ozonesonde ascents. The EPA monitors ozone at a network of 6 sites through out the country. Ground level ozone is also monitored at Mace Head.

Global and diffuse visible solar radiation are measured at 7 stations. The calibration is traceable to the Meteo-France standard. The UV spectrum is measured by a Brewer Spectrophotometer at Valentia Observatory. Stand-alone broadband sensors monitor UV at Malin Head and Mace Head (NUI, Galway,)

7.5.3 Terrestrial observation systems

There are four phenological gardens in Ireland. These are part of the International Phenological Gardens network. Four carbon flux study sites have been established. These are currently operational in research mode by groups in UCD, TCD and UCC and are linked to Fluxnet.

7.5.4 Participation in the Global Atmospheric Observing System (GCOS)

Table 7.1 Atmospheric Observations

	GSN[1]	GUAN[2]	GAW[3]
Number of stations	2	1	2
Operating Now	2	1	2
Operating to GCOS standards	Yes[3]	Yes	
Expected to be operating in 2005	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

35 GCOS standards and being extracted from GTS.

Table 7.2 Oceanographic observations

	VOS	SFC	DRIFTERS	MOORED BUOYS
Platforms for which NMS responsible	5	2*	2**	
Providing data to international centres	5	2	2	
Expected operating in 2005		13	2	5

Notes

* Sea Surface Temperature only

** Operated by Met Éireann in conjunction with the Irish Marine Institute

Terrestrial Observations

Four fixed carbon flux sites are currently operational in research mode and are linked to the CarboEurope and Fluxnet groups.

8. Education, Training and Public Awareness

8.1 Communications and Awareness

In view of the need to heighten public awareness of climate change through a specific campaign to help public identification of necessary actions to tackle climate change, The National Sustainable Development Partnership (Comhar), which is the forum for national consultation and dialogue on all issues surrounding Ireland's pursuit of sustainable development, prepared initial proposals on how best to communicate the NCCS in 2001.

The national Environmental Awareness Campaign, which is built around ten key steps to protect the environment, has been extended for 2002. It will now incorporate a significant climate change element building on the recommendations made by Comhar. Over 1.2 million is provided for the overall campaign during 2002, and the climate element of the campaign will provide the basis for further actions to address awareness over the coming years.

8.2 The Environment Information Service of the Department of Environment and Local Government (ENFO): In addition to the ongoing work of the environmental information service in relation to public awareness of environmental issues, ENFO hosted two climate change related exhibitions in 2001.

- The IEC Exhibition to promote Energy Awareness Week in 2001. To coincide with the exhibition the IEC and ENFO ran a series of workshops, which explored the connections between climate change and energy use.
- A major international photographic exhibition, entitled “Images Beyond the Naked Eye”, prepared by the Worldwide Fund for Nature. Professional photographers from around the world contributed photographs showing their artistic interpretation of the impact that climate change could have on the world around us.

GLOSSARY OF TERMS

AER V	Alternative Energy Requirement - Fifth Competition
AER VI	Alternative Energy Requirement - Sixth Competition
AWS	Automatic Weather Stations
CAP	Common Agricultural Policy
CFC	Chlorofluorocarbon
CH_4	Methane
CHP	Combined Heat and Power
Comhar	National Sustainable Development Partnership
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COFORD	Council for Forest Research and Development
CRF	Common Reporting Format
DART	Dublin Area Rapid Transit
DTI	Dublin Transportation Initiative
DTO	Dublin Transportation Office
ENFO	Environment Information Service of the Department of Environment and Local Government
EPA	Environmental Protection Agency
EIA	Environmental Impact Assessment
EMS	Environmental Management Systems
ESIOP	Economic and Social Infrastructure Operational Programme
ESRC	Economic and Social Research Council
ESRI	Economic and Social Research Institute
ET	Emissions Trading
EU	European Union
GCOS	Global Climate Observation System
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Giga Grammes (1,000 tonnes)
GIS	Global Information System
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IBEC	Irish Business and Employers Conference
ICAO	International Civil Aviation Organisation
IDA	Industrial Development Authority
IEA	International Energy Agency
IEC	Irish Energy Centre
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control

LUAS	On Street Light Rail
METRO	High Capacity Segregated Light Rail
MtC	Million Tonnes of Carbon Equivalent
MtCO2	Million Tonnes of Carbon Dioxide Equivalent
MWe	Megawatt
NDP	National Development Plan 2000-2006
NCCS	National Climate Change Strategy
NRA	National Roads Authority
N_2O	Nitrous Oxide
NOx	Nitrogen Oxides
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PFC	Perfluorocarbon
QBC	Quality Bus Corridor
REPS	Rural Environmental Protection Scheme
PPP	Public Private Partnership
RPA	Rail Procurement Agency
SEI	Sustainable Energy Ireland
SF_6	Sulphur Hexafluoride
SO_2	Sulphur Dioxide
SOx	Sulphur Oxides
TUCSON	The Unified Climatological and Synoptic Observational Network
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compound
WMO	World Meteorological Organisation

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ANNEX 1
National Greenhouse gas inventory, 1990-2001
Summary tables

TABLE 10 EMISSIONS TRENDS (CO_2)
(Sheet 1 of 5)

Ireland
2001
Final Submission 2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	(Gg)												
1. Energy	29,775.05	29,775.05	30,488.58	31,055.10	30,707.92	31,876.45	32,619.76	33,851.24	35,945.71	37,894.33	39,804.07	41,406.05	43,481.85
A. Fuel Combustion (Sectoral Approach)	29,636.15	29,636.15	30,346.28	30,914.35	30,548.01	31,713.80	32,452.96	33,690.51	35,804.69	37,786.48	39,687.01	41,335.23	43,347.85
1. Energy Industries	11,057.48	11,057.48	11,542.71	12,224.03	12,232.57	12,573.77	13,239.33	13,959.31	14,643.48	15,047.24	15,727.89	16,016.45	17,144.75
2. Manufacturing Industries and Construction	3,833.08	3,833.08	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
3. Transport	5,019.62	5,019.62	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
4. Other Sectors	9,725.97	9,725.97	9,696.24	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
5. Other	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
B. Fugitive Emissions from Fuels	138.90	138.90	142.30	140.75	159.91	162.65	166.80	160.73	141.02	107.85	117.06	70.82	134.00
1. Solid Fuels	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
2. Oil and Natural Gas	138.90	138.90	142.30	140.75	159.91	162.65	166.80	160.73	141.02	107.85	117.06	70.82	134.00
2. Industrial Processes	1,930.59	1,930.59	1,954.19	1,964.74	1,877.72	2,141.05	2,040.62	2,002.56	2,263.98	2,250.17	2,222.41	2,576.32	2,870.03
A. Mineral Products	941.42	941.42	923.61	961.77	932.26	1,085.24	1,067.62	1,080.10	1,189.77	1,192.07	1,279.32	1,693.03	1,832.63
B. Chemical Industry	989.17	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
C. Metal Production	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
D. Other Production	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
E. Production of Halocarbons and SF$_6$													
F. Consumption of Halocarbons and SF$_6$													
G. Other	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
3. Solvent and Other Product Use	91.58	91.58	92.21	93.48	94.66	96.45	98.30	100.15	102.76	105.32	106.79	109.17	108.59
4. Agriculture	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
A. Enteric Fermentation	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
B. Manure Management	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
C. Rice Cultivation	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
D. Agricultural Soils [2]	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
E. Prescribed Burning of Savannas	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
F. Field Burning of Agricultural Residues	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
G. Other	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
5. Land-Use Change and Forestry [3]	-65.66	-65.66	-61.60	-9.46	-71.50	-113.07	-54.83	-4.06	-30.54	-161.11	-121.61	-47.46	-628.72
A. Changes in Forest and Other Woody Biomass Stocks	-450.11	-450.11	-422.95	-318.05	-380.85	-407.25	-428.68	-420.15	-497.91	-573.62	-500.51	-407.33	-1,007.02
B. Forest and Grassland Conversion	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
C. Abandonment of Managed Lands	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
D. CO_2 Emissions and Removals from Soil	384.45	384.45	361.35	308.59	309.35	294.18	373.85	416.09	467.37	412.51	378.90	359.87	378.30
E. Other	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
6. Waste	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
A. Solid Waste Disposal on Land	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
B. Waste-water Handling	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
C. Waste Incineration	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
D. Other	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
7. Other *(please specify)* ---	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
Total Emissions/Removals with LUCF[4]	31,731.56	31,731.56	32,473.38	33,103.86	32,608.80	34,000.88	34,703.85	35,949.89	38,281.91	40,088.71	42,011.66	44,044.08	45,831.75
Total Emissions without LUCF[4]	31,797.22	31,797.22	32,534.98	33,113.32	32,680.30	34,113.95	34,758.68	35,953.95	38,312.45	40,249.82	42,133.27	44,091.54	46,460.47
Memo Items:													
International Bunkers	1,115.21	1,115.21	1,258.42	1,296.26	1,490.04	1,228.14	1,453.29	1,703.59	1,742.37	1,798.14	2,084.23	2,042.57	2,376.20
Aviation	1,058.95	1,058.95	1,151.59	1,242.73	1,318.99	1,104.42	1,085.39	1,206.12	1,258.16	1,295.52	1,541.63	1,565.96	1,986.45
Marine	56.26	56.26	106.83	53.53	171.05	123.72	367.90	497.47	484.21	502.62	542.60	476.61	389.75
Multilateral Operations	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
CO_2 Emissions from Biomass	502.00	502.00	506.60	451.34	474.36	474.36	819.78	644.77	640.16	653.98	622.11	644.77	773.66

[1] Fill in the base year adopted by the Party under the Convention, if different from 1990.
[2] See footnote 4 to Summary 1.A of this common reporting format.
[3] Take the net emissions as reported in Summary 1.A of this common reporting format. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).
[4] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

TABLE 10 EMISSIONS TRENDS (CH_4)
(Sheet 2 of 5)

Ireland
2001
Final Submission 2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	(Gg)												
Total Emissions	566.66	566.66	580.16	587.82	592.44	595.50	599.77	608.04	616.89	617.62	613.56	608.79	598.23
1. Energy	14.32	14.32	14.01	13.04	12.27	11.20	10.89	10.62	11.01	10.59	10.07	10.22	10.19
A. Fuel Combustion (Sectoral Approach)	7.14	7.14	7.06	6.36	5.68	4.84	4.70	4.61	5.20	5.42	5.03	5.36	5.27
1. Energy Industries	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
2. Manufacturing Industries and Construction	1.15	1.15	1.19	0.81	0.74	0.20	0.24	0.23	0.25	0.25	0.24	0.26	0.28
3. Transport	1.77	1.77	1.82	1.97	1.87	1.87	1.90	2.03	2.11	2.27	2.37	2.60	2.59
4. Other Sectors	4.22	4.22	4.04	3.57	3.07	2.76	2.56	2.35	2.83	2.89	2.42	2.50	2.40
5. Other	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	7.18	7.18	6.95	6.68	6.59	6.36	6.19	6.01	5.81	5.17	5.04	4.86	4.92
1. Solid Fuels	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
2. Oil and Natural Gas	7.18	7.18	6.95	6.68	6.59	6.36	6.19	6.01	5.81	5.17	5.04	4.86	4.92
2. Industrial Processes	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
A. Mineral Products	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
B. Chemical Industry	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
C. Metal Production	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
D. Other Production	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
E. Production of Halocarbons and SF_6													
F. Consumption of Halocarbons and SF_6													
G. Other	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
3. Solvent and Other Product Use	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
4. Agriculture	497.19	497.19	509.62	516.50	519.70	521.71	523.90	529.84	540.27	551.87	551.98	540.49	527.27
A. Enteric Fermentation	437.15	437.15	448.21	454.12	456.52	457.84	459.34	464.25	473.19	483.06	482.96	472.62	460.81
B. Manure Management	60.04	60.04	61.41	62.38	63.18	63.87	64.56	65.59	67.08	68.81	69.02	67.87	66.46
C. Rice Cultivation	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
D. Agricultural Soils	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
E. Prescribed Burning of Savannas	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
F. Field Burning of Agricultural Residues	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
G. Other	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
5. Land-Use Change and Forestry	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
A. Changes in Forest and Other Woody Biomass Stocks	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
B. Forest and Grassland Conversion	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
C. Abandonment of Managed Lands	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
D. CO_2 Emissions and Removals from Soil	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
E. Other	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
6. Waste	55.15	55.15	56.53	58.28	60.47	62.59	64.98	67.58	65.61	55.16	51.51	58.08	60.77
A. Solid Waste Disposal on Land	55.15	55.15	56.53	58.28	60.47	62.59	64.98	67.58	65.61	55.16	51.51	58.08	60.77
B. Waste-water Handling	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
C. Waste Incineration	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
D. Other	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
7. Other *(please specify)* ---	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
Memo Items:													
International Bunkers	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.03
Aviation	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.03
Marine	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
Multilateral Operations	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
CO_2 Emissions from Biomass													

TABLE 10 EMISSIONS TRENDS (N_2O)
(Sheet 3 of 5)

Ireland
2001
Final Submission 2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	(Gg)												
Total Emissions	**30.78**	**30.78**	**30.85**	**31.12**	**31.23**	**31.96**	**32.42**	**33.11**	**33.62**	**34.36**	**34.93**	**34.71**	**33.55**
1. Energy	**3.07**	**3.07**	**3.22**	**3.33**	**3.35**	**3.64**	**3.63**	**3.81**	**4.18**	**4.55**	**4.91**	**4.85**	**5.33**
A. Fuel Combustion (Sectoral Approach)	3.07	3.07	3.22	3.33	3.35	3.64	3.63	3.81	4.18	4.55	4.91	4.85	5.33
1. Energy Industries	1.39	1.39	1.51	1.62	1.59	1.68	1.68	1.73	1.85	2.00	2.06	1.95	2.19
2. Manufacturing Industries and Construction	0.34	0.34	0.34	0.35	0.33	0.39	0.38	0.37	0.43	0.42	0.45	0.50	0.50
3. Transport	0.28	0.28	0.30	0.33	0.45	0.54	0.56	0.71	0.86	1.03	1.26	1.21	1.33
4. Other Sectors	1.06	1.06	1.07	1.03	0.98	1.03	1.01	1.00	1.04	1.10	1.14	1.19	1.31
5. Other	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
B. Fugitive Emissions from Fuels	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
1. Solid Fuels	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
2. Oil and Natural Gas	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
2. Industrial Processes	**3.34**	**3.34**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**2.62**	**1.89**
A. Mineral Products	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
B. Chemical Industry	3.34	3.34	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	1.89
C. Metal Production	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
D. Other Production	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
E. Production of Halocarbons and SF_6													
F. Consumption of Halocarbons and SF_6													
G. Other	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
3. Solvent and Other Product Use	**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**
4. Agriculture	**24.18**	**24.18**	**24.81**	**24.97**	**25.06**	**25.50**	**25.97**	**26.48**	**26.62**	**26.99**	**27.19**	**27.03**	**26.12**
A. Enteric Fermentation	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
B. Manure Management	2.02	2.02	2.07	2.10	2.11	2.16	2.15	2.19	2.25	2.31	2.31	2.26	2.20
C. Rice Cultivation	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
D. Agricultural Soils	22.16	22.16	22.74	22.87	22.95	23.34	23.82	24.29	24.37	24.68	24.88	24.77	23.92
E. Prescribed Burning of Savannas	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
F. Field Burning of Agricultural Residues	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
G. Other	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
5. Land-Use Change and Forestry	**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**
A. Changes in Forest and Other Woody Biomass Stocks	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
B. Forest and Grassland Conversion	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
C. Abandonment of Managed Lands	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
D. CO_2 Emissions and Removals from Soil	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
E. Other	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
6. Waste	**0.19**	**0.19**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.21**	**0.21**	**0.21**
A. Solid Waste Disposal on Land	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
B. Waste-water Handling	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21
C. Waste Incineration	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
D. Other	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
7. Other *(please specify)* ---	**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**
Memo Items:													
International Bunkers	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.05**	**0.05**	**0.07**
Aviation	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.07
Marine	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
Multilateral Operations	**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**
CO_2 Emissions from Biomass													

TABLE 10 EMISSION TRENDS (HFCs, PFCs and SF_6)
(Sheet 4 of 5)

Ireland
2001
Final Submission 2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	(Gg)												
Emissions of HFCs[1] - CO_2 equivalent (Gg)	**20.710**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**20.706**	**58.043**	**78.623**	**104.138**	**151.700**	**190.085**	**230.902**
HFC-23	0.159						0.159	0.252	0.377	0.302	0.844	1.027	0.998
HFC-32	0.052						0.052	0.069	0.695	2.019	2.886	2.026	2.244
HFC-41	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
HFC-43-10mee	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
HFC-125	0.643						0.643	5.378	7.011	8.955	15.063	17.433	20.285
HFC-134	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
HFC-134a	7.333						7.333	9.595	17.008	30.653	34.402	43.851	60.093
HFC-152a	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
HFC-143	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
HFC-143a	0.690						0.688	5.807	6.824	7.291	11.983	16.467	19.358
HFC-227ea	1.676						1.676	1.878	2.097	2.300	2.592	2.882	3.203
HFC-236fa	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
HFC-245ca	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
Emissions of PFCs[1] - CO_2 equivalent (Gg)	**75.382**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**75.382**	**103.085**	**130.823**	**61.870**	**195.933**	**305.406**	**296.502**
CF_4	1.916						1.916	2.774	3.636	2.300	4.068	5.887	7.280
C_2F_6	6.840						6.840	9.245	11.651	5.100	18.423	29.037	27.085
C_3F_8	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
C_4F_{10}	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
$c\text{-}C_4F_8$	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
C_5F_{12}	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
C_6F_{14}	0.000						0.000	0.000	0.000	0.000	0.000	0.000	0.000
Emissions of SF_6[1] - CO_2 equivalent (Gg)	**83.053**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**83.052**	**101.026**	**132.092**	**90.593**	**63.456**	**51.893**	**66.748**
SF_6	3.475						3.475	4.227	5.527	3.791	2.655	2.171	2.793

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10mee	1300
HFC-125	2800
HFC-134	1000
HFC-134a	1300
HFC-152a	140
HFC-143	300
HFC-143a	3800
HFC-227ea	2900
HFC-236fa	6300
HFC-245ca	560
PFCs	
CF_4	6500
C_2F_6	9200
C_3F_8	7000
C_4F_{10}	7000
$c\text{-}C_4F_8$	8700
C_5F_{12}	7500
C_6F_{14}	7400
SF_6	23900

[1] Enter information on the actual emissions. Where estimates are only available for the potential emissions, specify this in a comment to the corresponding cell. Only in this row the emissions are expressed as CO_2 equivalent emissions in order to facilitate data flow among spreadsheets.

TABLE 10 EMISSION TRENDS (SUMMARY)
(Sheet 5 of 5)

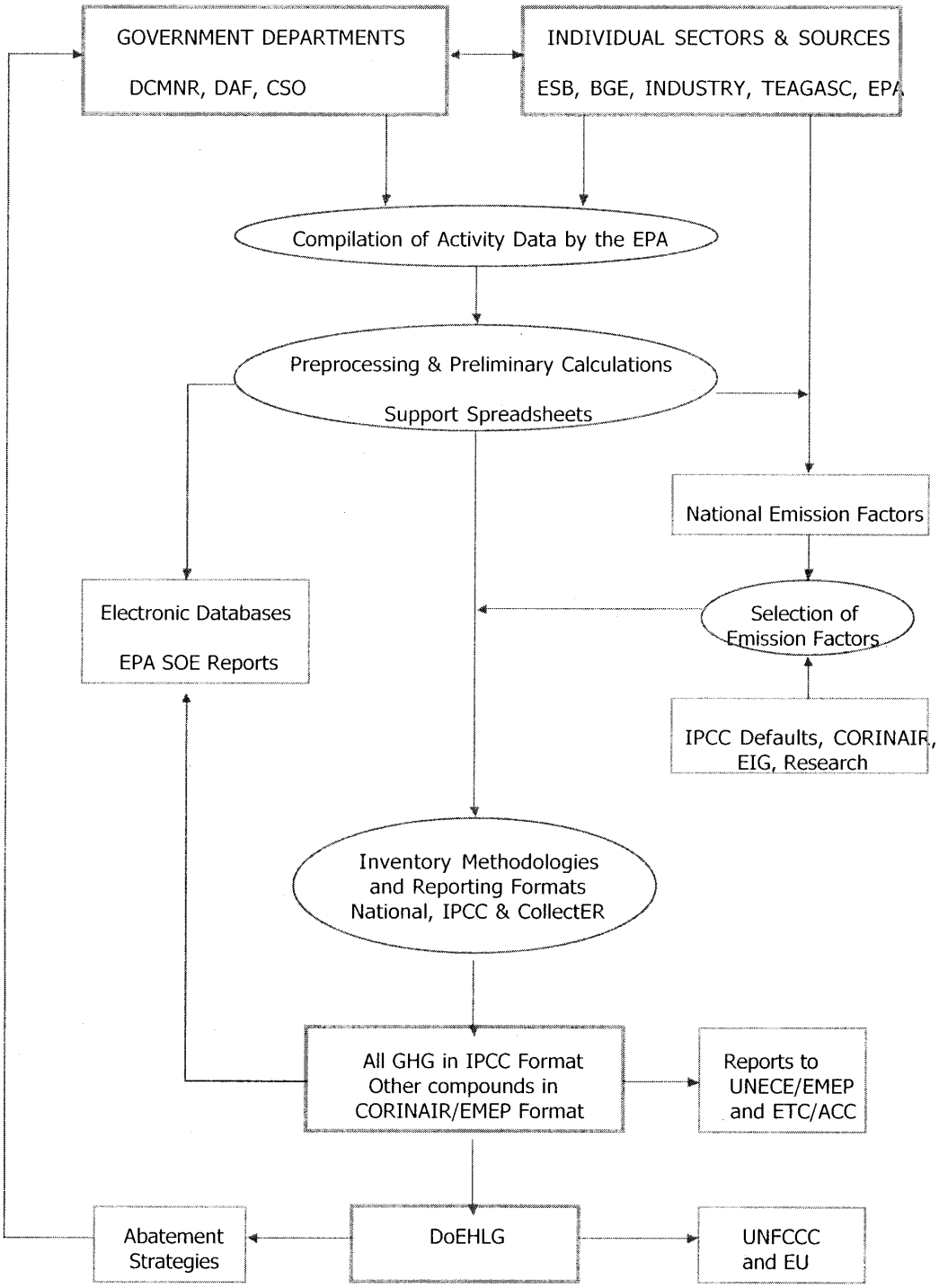
Ireland
2001
Final Submission 2003

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	CO2 equivalent (Gg)												
Net CO2 emissions/removals	31,731.56	31,731.56	32,473.38	33,103.86	32,608.80	34,000.88	34,703.85	35,949.89	38,281.91	40,088.71	42,011.66	44,044.08	45,831.75
CO2 emissions (without LUCF)[2]	31,797.22	31,797.22	32,534.98	33,113.32	32,680.30	34,113.95	34,758.68	35,953.95	38,312.45	40,249.82	42,133.27	44,091.54	46,460.47
CH4	11,899.86	11,899.86	12,183.36	12,344.22	12,441.24	12,505.50	12,595.17	12,768.84	12,954.69	12,970.02	12,884.76	12,784.59	12,562.83
N2O	9,541.80	9,541.80	9,563.50	9,647.20	9,681.30	9,907.60	10,050.20	10,264.10	10,422.20	10,651.60	10,828.30	10,760.10	10,400.50
HFCs	20.71	0.00	0.00	0.00	0.00	0.00	20.71	58.04	78.62	104.14	151.70	190.08	230.90
PFCs	75.38	0.00	0.00	0.00	0.00	0.00	75.38	103.09	130.82	61.87	195.93	305.41	296.50
SF6	83.05	0.00	0.00	0.00	0.00	0.00	83.05	101.03	132.09	90.59	63.46	51.89	66.75
Total (with net CO2 emissions/removals)	**53,352.36**	**53,173.22**	**54,220.24**	**55,095.28**	**54,731.34**	**56,413.98**	**57,528.36**	**59,244.98**	**62,000.34**	**63,966.93**	**66,135.81**	**68,136.15**	**69,389.23**
Total (without CO2 from LUCF)[2]	**53,418.02**	**53,238.88**	**54,281.84**	**55,104.74**	**54,802.84**	**56,527.05**	**57,583.19**	**59,249.04**	**62,030.88**	**64,128.04**	**66,257.42**	**68,183.61**	**70,017.95**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	CO2 equivalent (Gg)												
1. Energy	31,027.47	31,027.47	31,780.99	32,361.24	32,004.09	33,240.05	33,973.75	35,255.36	37,472.72	39,527.22	41,537.64	43,124.17	45,348.14
2. Industrial Processes	3,145.13	2,965.99	2,766.39	2,776.94	2,689.92	2,953.25	3,031.96	3,076.91	3,417.72	3,318.97	3,445.70	3,935.90	4,050.08
3. Solvent and Other Product Use	91.58	91.58	92.21	93.48	94.66	96.45	98.30	100.15	102.76	105.32	106.79	109.17	108.59
4. Agriculture	17,936.79	17,936.79	18,393.12	18,587.20	18,682.30	18,860.91	19,052.60	19,335.44	19,597.87	19,956.17	20,020.48	19,729.59	19,169.87
5. Land-Use Change and Forestry[3]	-65.66	-65.66	-61.60	-9.46	-71.50	-113.07	-54.83	-4.06	-30.54	-161.11	-121.61	-47.46	-628.72
6. Waste	1,217.05	1,217.05	1,249.13	1,285.88	1,331.87	1,376.39	1,426.58	1,481.18	1,439.81	1,220.36	1,146.81	1,284.78	1,341.27
7. Other	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

[1] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO2 emissions and removals from Land-Use Change and Forestry.
[2] Net emissions.

ANNEX 2
Institutional Arrangements for Compilation of Inventory



DCMNR : Department of Communications, Marine & Natural Resources
DoEHLG : Department of Environment, Heritage & Local Government
DAF : Department of Agriculture & Food
CSO : Central Statistics Office
ESB : Electricity Supply Board
EPA : Environmental Protection Agency
BGE : Bord Gáis Éireann
EIG : Emissions Inventory Guidebook
ETC/ACC : European Topic Centre Air & Climate Change
SOE : State of the Environment

Inventory Institutional and Procedural Arrangements

ANNEX 3
Quantified Indicative Reductions of National Climate Change Strategy

Energy	
Fuel switching to gas	*4.15Mt CO_2*
Moneypoint	*3.4Mt CO_2*
Oil	*0.75Mt CO_2*
CHP	*0.25Mt CO_2*
Renewables	*1.0Mt CO_2*
Efficiencies	*0.1Mt CO_2*
DSM	*0.15Mt CO_2*
Total	***5.65Mt CO_2***
Transport	
Vehicle Efficiency Improvements	*0.77 Mt CO_2*
Fuel Measures (displace bunkering)	*0.9 Mt CO_2*
VRT, Taxes	*0.5 Mt CO_2*
Labelling	*0.1 Mt CO_2*
Public Transport Measures	*0.15 Mt CO_2*
Traffic Management	*0.2 Mt CO_2*
Freight	*0.05 Mt CO_2*
Total	***2.67 Mt CO_2***
Built Environment & Residential	
Building Regulation Standards	*0.25 Mt CO_2*
Existing Buildings	*0.4 Mt CO_2*
Fuel Mix	*0.25 Mt CO_2*
Total	***0.9 Mt CO_2***
Industry, Commercial, Services	
"No regrets"/low cost energy efficiency gains	*0.75 Mt CO_2*
Up to £75 tonne CO2 efficiency measures	*0.25 Mt CO_2*
Process Substitution for Cement	*0.5 Mt CO_2*
Industrial Gases	*0.5 Mt CO_2 equivalent*
Commercial and Services	*0.175 Mt CO_2*
Total	***2.175 Mt CO_2 equivalent***
Agriculture	
Reduction of CH_4 from national herd	*1.2 Mt CO_2 equivalent*
of which Feeding Regimes	*0.5 Mt CO_2 equivalent*
Fertiliser Use	*0.9 Mt CO_2 equivalent*
On-Farm Forestry Sequestration	*0.25 Mt CO_2*
Manure Management	*0.06 Mt CO_2 equivalent*
Total	***2.41 Mt CO_2 equivalent***
Sinks	***0.76 Mt CO_2***
Waste	***0.85 Mt CO_2 equivalent***
Overall Total	***15.415 Mt CO_2 equivalent***

ANNEX 4

Sectoral Breakdown of National Greenhouse Gas Projections

Carbon Dioxide	*2000*	*2001*	*2002**	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Energy	16,087	17,279	17,123	16,718	16,366	17,039	17,136	17,459	17,753	18,006	18,150	18,468	18,748
Residential	6,346	6,479	6,623	6,657	6,663	6,665	6,687	6,730	6,788	6,855	6,927	6,946	6,930
Industry	10,653	10,787	9,727	9,062	9,238	9,572	9,904	10,222	10,531	10,810	11,071	11,274	11,454
Agriculture	862	853	836	820	805	790	781	768	756	745	735	726	719
Tranport	10,211	11,063	11,053	11,084	11,482	11,900	12,313	12,692	13,100	13,448	13,796	14,104	14,379
Waste	0	0	0	0	0	0	0	0	0	0	0	0	0
Forestry Sinks	0	0	0	0	0	0	0	0	1,291	1,291	1,291	1,291	1,291
Subtotal	44,160	46,460	45,362	44,342	44,554	45,966	46,820	47,871	48,929	49,862	50,678	51,519	52,231
Methane													
Energy	102	103	80	83	85	61	65	69	37	40	42	44	46
Residential	47	45	44	42	40	38	36	35	34	32	31	30	29
Industry	10	10	10	10	11	11	11	11	12	12	12	12	12
Agriculture	11,351	11,074	10,701	10,736	10,698	10,571	10,300	9,998	9,692	9,503	9,352	9,223	9,106
Tranport	55	54	53	52	53	53	54	54	56	57	58	60	61
Waste	1,220	1,276	1,598	1,706	1,822	1,773	1,865	1,536	838	709	632	553	485
Forestry Sinks	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	12,785	12,563	12,487	12,630	12,709	12,507	12,332	11,704	10,669	10,353	10,128	9,922	9,739
Nitrous Oxide													
Energy	605	677	639	617	595	606	608	613	618	622	624	629	634
Residential	196	200	211	210	210	209	208	207	207	205	203	199	193
Industry	1,078	844	746	259	264	272	281	289	297	304	310	316	321
Agriculture	8,444	8,199	7,613	7,649	7,602	7,405	7,198	7,000	6,827	6,714	6,616	6,543	6,476
Tranport	374	414	412	413	430	442	455	462	481	494	508	521	532
Waste	64	66	65	66	66	66	67	67	68	68	69	69	69
Forestry Sinks	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	10,760	10,400	9,686	9,214	9,167	9,000	8,816	8,638	8,496	8,408	8,331	8,277	8,225
Industrial Gases	547	594	0	0	0	0	0	0	0	0	0	0	0
Total	68,252	70,018	67,535	66,186	66,429	67,474	67,968	68,213	69,384	69,914	70,428	71,008	71,486

*Projections from 2002. F-gases not included.