Ireland's Pathway to Kyoto Compliance

Review of the National Climate Change Strategy

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Foreword by Minister

Almost six years ago, the Government's National Climate Change Strategy set out the framework for Ireland's response to global warming.

The concept of partnership was central to the Strategy. At the domestic level, it identified necessary changes right across society. Every sector of the economy, and each of us as individuals, had a part to play.

At the international level, the Strategy recognised that we must work closely with our fellow EU Member States in seeking to find consensus among the nations of the world on the actions necessary to solve our shared problem.

Now, as we approach the 2008-2012 period, in which Ireland and the other developed country parties to the Kyoto Protocol have committed themselves to specific limits on their national emissions of greenhouse gases, we need to take stock of our progress and identify what more we need to do.

Ireland's emissions peaked in 2001. Since then, we have achieved a significant reduction, despite the continuation of steady economic growth. Structural changes in industry, agriculture and electricity production have contributed to this. The most recent emissions data for Ireland show that, in 2004, we were 23% above the level for 1990 (the base-year for Kyoto targets).

In Kyoto, the EU adopted an ambitious overall reduction target of 8%, on the basis that the individual targets for the then 15 Member States would be differentiated to reflect different economic and other circumstances. Ireland's target is to limit the growth of emissions to 13%. The 2004 data show that almost all of these 15 countries are still a considerable way off target – Ireland stands in the mid-range of the 15 in terms of percentage points above target – so there is considerable work to be done individually and collectively.

The Government is fully committed to meeting our Kyoto target. We fully support the proactive position adopted by the EU in response to global warming and we take very seriously the commitments we have made in ratifying the Kyoto Protocol.

Since 2004, our efforts to reduce emissions across all sectors have intensified. Our main carbon-emitting installations are participating in the EU Emissions Trading Scheme. The 2006 Budget provided major incentives for households and businesses to support investment in renewable energy technologies, and very substantial excise

relief for biofuels. New building regulations provide for higher standards of energy conservation; improvements in public transport will address emissions on our roads.

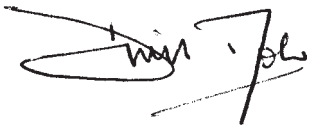
The rapid growth of both our economy and our population inevitably makes meeting our Kyoto target uniquely challenging. We need therefore to look at the scope for new measures that will enable all of us to play our part in achieving the necessary reduction in greenhouse gas emissions between now and 2012. In reducing the overall carbon-intensity of the economy, we will also set good directions for the post-2012 era.

The Government has decided to publish a revised National Climate Change Strategy before the end of 2006. To facilitate a public consultation on the key issues, we are first publishing this Paper. In addition to a review of progress to date, the Paper identifies a range of other measures that might be considered for inclusion in the new Strategy.

The new measures identified in the Paper do not, at this point, represent final policy proposals or commitments by the Government. Rather, they are put forward in order to allow the general public and any relevant interests have an opportunity to consider them and to give us the benefit of their views.

I would like to receive comments on any aspects of the issues covered – or indeed, any proposals for measures which have not been addressed in the Paper itself.

I believe firmly that the process of policy formulation in this most important area will benefit from the widest possible public consultation. I therefore give a commitment that very careful account will be taken of all responses when the Government comes to finalise the measures for inclusion in the revised Strategy.



Dick Roche TD
Minister for the Environment, Heritage and Local Government

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Executive Summary

Purpose of this review

The National Climate Change Strategy (NCCS) was published in October 2000 as a basis for Government policy and action in relation to climate change. This review takes stock of developments since then and examines options for achieving further abatement of greenhouse gas emissions in the future. It is being published to allow for a public consultation prior to the preparation of a revised National Climate Change Strategy over the coming months.

Guiding principles of the NCCS

The National Climate Change Strategy was based on a number of fundamental guiding principles:

- the promotion of sustainable development;
- maximisation of economic efficiency including a preference for 'no regret' and 'least cost measures';
- sectoral equity with relative costs and effort equalised across the economy;
- protection of economic development and competitiveness, utilising market-based instruments with the exploitation of new markets and opportunities;
- generating an impetus for early action.

The NCCS set out how emissions reductions should be achieved through an integrated approach utilising the full range of policy options, including:

- the use of economic instruments such as taxation and emissions trading with broad sectoral and/or cross-sectoral application;
- a broad range of policies and measures tailored specifically to relevant sectors;
- a vigorous and appropriate pursuit of common and co-ordinated policies and measures implemented at EU and wider international levels;
- participation in international emissions trading.

Ireland's target and its international context

The ultimate objective of the 1992 United Nations Framework for the Convention on Climate Change (UNFCCC) is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous man-made interference with the climate system. Acknowledging that change in the Earth's climate and its adverse effects are a common concern of humankind, the Convention reflects the determination of the Parties to protect the climate system for present and future generations. Thus, the Convention sets the context and provides the basis for ongoing development of global action to tackle climate change. Ireland is a Party to both the Convention and the Kyoto Protocol, which was adopted in December 1997.

The EU has been to the forefront in promoting international cooperation to tackle climate change. Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total emissions in the period 2008–12. **Ireland's contribution to the EU commitment is to limit its greenhouse gas emissions to no more than 13% above 1990 levels in 2008-2012.** The NCCS was adopted to provide a framework for Ireland to meet this commitment. The target is extremely challenging in view of Ireland's exceptional economic growth and increase in population over the past sixteen years. This level of growth, evidenced for example in a historically high rate of house completions and a fourfold increase in industrial production, has nevertheless been achieved in a context of significant decoupling of economic growth from growth in greenhouse gas emissions. By 2004, emissions per unit GDP were 48% of their level in 1990.

Although presenting a major challenge to the Parties with emissions targets, the Kyoto Protocol is widely recognised as just a first step, albeit an important one, in the global response to climate change. Within the EU, the European Council, recognising that climate change is likely to have major negative global environmental, economic and social implications, has concluded that global annual mean surface temperature increase should not exceed 2°C above pre-industrial levels. To achieve this long-term objective, the Council has signalled the need for developed country parties to consider reduction pathways in the order of 15-30% by 2020 compared to 1990 levels. The ambition of EU Heads of State and Government lays down a marker for forthcoming international negotiations on commitments beyond 2012.

Developments since 2000

The international climate change agenda, which provides the backdrop and basis for coordinating a global response to climate change, has changed significantly since the NCCS was published in 2000. One of the most important milestones was the coming into effect of the Kyoto Protocol in February 2005, as a result of which emission reduction targets agreed by developed countries, including Ireland, are now binding. As well as triggering binding commitments, the entry into force of the Protocol also introduced three mechanisms - international emissions trading, joint implementation and the clean development mechanism – to assist Parties in meeting their emissions reduction targets.

Since the Strategy was published, the national policy context has also changed significantly. A range of new policies and measures have been introduced. Some of these were envisaged by the Strategy while others derive from measures adopted by the European Union. Elsewhere, reforms and restructuring, for example in the electricity sector and in agriculture, have had a positive impact on the policy options

available to individual Member States in meeting their individual targets. Other proposals in the Strategy have not been implemented in light of further analysis as to their suitability in an Irish context. For example, the proposal to cease coal-fired electricity generation at the ESB's Moneypoint station did not go ahead because of the need to ensure the security of our energy supply by maintaining fuel diversity.

This review reports on the changed policy context affecting the sectors which contribute to greenhouse gas emissions and sets out a basis for the preparation of a new national climate change strategy to guide Ireland's future efforts both towards meeting its existing Kyoto target and preparing for more stringent greenhouse gas emission reduction requirements in the period beyond 2012.

Sectoral overview

The review sets out progress achieved in each sector included in the National Climate Change Strategy. Each chapter addresses a single sector and:

- summarises trends and projections of sectoral greenhouse gas emissions based on policies and measures already in place;
- assesses progress in the implementation of sectoral measures proposed in the Strategy;
- outlines the policies and measures that will be implemented in the coming years and that will deliver benefits over the period 2008 – 2012; and
- sets out areas that have potential to deliver further reductions in emissions and measures that could be implemented to achieve those reductions.

Where possible, the discussion also includes quantification of the potential emission reductions that might be achieved from these options. Options for further measures are identified, which are not adopted Government policies but are set out here for discussion purposes.

In many cases, economic activity in particular sectors will contribute to emissions reductions that can be attributable to other sectors. For example, the sequestration of CO_2 by afforestation will be attributed to sinks but is made possible through policies adopted in relation to the agriculture sector. Policies in this sector also promote the production of carbon-neutral fuels such as those derived from energy crops; whereas these will deliver emission reductions in other sectors as they displace fossil fuel consumption.

Meeting our Kyoto Commitments

The estimated annual reduction in greenhouse gas emissions from existing measures - those adopted or under implementation prior to March 2006[1] - over the 2008 - 2012 period is calculated to be approximately 8 million tonnes. However, even with existing policies and measures already implemented or expected to be implemented up to 2012, projections show that Ireland will continue to face an average annual shortfall in its Kyoto target of some 7.174 million tonnes of CO_2e in the 2008-2012 period. In summary, this shortfall (which is referred to as the distance to target) is capable of being met through:

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

The Government has already decided on the proportion of Ireland's distance to target that will be borne by participants in the EU Emissions Trading Scheme. This decision was required so that the National Allocation Plan (the distribution of emission allowances among the participants) could be finalised by the mid-year deadline for submission to the European Commission. As shown in Table ES-1 below, this sector will be responsible for 3.02 million tonnes per annum of the national distance to target, through a combination of internal emissions reductions or the purchase of allowances.

Million tonnes per annum	Emissions Trading Sector	Rest of economy	TOTAL
Average annual emissions 2008-2012 without any action	25.658	44.548	70.206
Share of reduction	3.02	4.154	7.174
Target	22.638	40.394	63.032

Table ES-1: Approach to meeting Ireland's Kyoto Protocol target

[1] Updated projections for greenhouse gas emissions to 2012 across all sectors included in the National Climate Change Strategy were completed in March 2006 and are published in the report *Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012*, by ICF Consulting & Byrne Ó Cléirigh. The report is available to download from http://www.environ.ie

The Table shows that the balance of the distance to target, i.e. 4.154 million tonnes per annum, is to be the responsibility of the rest of the economy. Any emission-reducing measures that are adopted in the various sectors concerned, over and above those already adopted, will count towards this. Whatever balance remains will be met by the purchase of carbon allowances by the Government. The flexible mechanisms of the Kyoto Protocol enable Governments to make rational economic choices between domestic emission reductions or purchases of allowances for reductions elsewhere in the world.

In assessing possible future measures, such as those set out in this paper's sectoral analysis or any which emerge in the course of the consultation, the Government will take careful account of the guiding principle of maximising economic efficiency that underlies the National Climate Change Strategy. It is recognised that, in some sectors, the costs associated with achieving emission reductions are high relative to the cost of purchasing credits in lieu of emissions reductions. It will therefore be important to explore those policy options that deliver cost-effective reductions so that a disproportionate burden is not placed on individual sectors of the economy.

The sectoral analysis also shows that there are various measures available which will deliver synergies across a number of sectors. For example, the diversion of biodegradable waste from landfill to waste-to-energy is a primary objective of waste management policy on the grounds of environmental efficiency, but will also contribute to a net reduction in emissions. Assessments of the costs and benefits of potential measures will therefore have to take account of their impact across all relevant sectors.

1. Introduction

1.1 UNFCCC and the Kyoto Protocol

As the most threatening environmental problem facing the world today, climate change demands a comprehensive and concerted international response. Developed countries, including Ireland, are primarily responsible for the historical build-up of greenhouse gas emissions in the atmosphere (some 80%), and therefore have a particular responsibility to control and reduce their emissions as part of the overall response. In 2000, developed countries accounted for 54% of global greenhouse gas emissions with only about 20% of the world's population. However, the contribution of developed countries to global greenhouse gas emissions is expected to decline to 28% by 2050.

The ultimate objective of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic or man-made interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure food production is not threatened and to enable economic development to proceed in a sustainable manner. Thus, the Convention sets the context and provides the basis for ongoing development of global action to tackle climate change.

Under the Convention, industrialised countries were regarded as having contributed the most to human-induced climate change and were expected to take the lead in modifying longer-term trends in emissions. However, commitments by industrialised countries to stabilise their greenhouse gas emissions at 1990 levels by the year 2000 were not legally binding. Although an important breakthrough in terms of addressing climate change at a global level, the Parties decided, at their first meeting in Berlin in 1995, that non-binding targets for industrialised countries were not adequate in the context of the objective of the Convention. A further round of negotiations led to the adoption of the Kyoto Protocol in 1997. The Protocol provides for individual, legally-binding targets to be achieved by industrialised countries, with the aim of achieving an overall reduction of at least 5% in net emissions of a basket of six greenhouse gases[1] over the 2008-2012 commitment period.

Adoption of the Protocol and its subsequent entry into force in 2005 were milestones in mobilising an international response to human induced climate change. However, the Protocol's target to reduce emissions for developed countries by 5% represented just a first step towards addressing a longer-term, complex and significant challenge.

[1] Carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Scientific evidence points to the need for further, more significant greenhouse gas emissions reductions in the short and medium term. The Intergovernmental Panel on Climate Change (IPCC) has indicated that in the longer term global emissions of greenhouse gases would need to be reduced by up to 70% compared to 1990 levels.

The eleventh Conference of the Parties to the UN Framework Convention on Climate Change, incorporating the first Meeting of the Parties to the Kyoto Protocol, took place in Montreal in November and December 2005. As well as formally adopting the Marrakech Accords – the rulebook for the Kyoto Protocol – the conference reached agreement on a package of measures to initiate negotiations on global efforts to tackle climate change in the period up to and following 2012, when the first commitment period of the Kyoto Protocol expires. This package of agreements, collectively known as the Montreal Plan of Action, includes separate processes to discuss future commitments of industrialised countries under the Kyoto Protocol; an overall review of the Protocol, and a dialogue under the auspices of the Convention on strategic approaches for long-term global cooperative action. All three processes are seen as interdependent and will inform each other as negotiations progress in the coming years. The EU recognises that to meet the objectives of the Convention, emissions by all major emitting economies will need to be addressed, including enhanced mitigation efforts by all industrialised economies, whether or not they have ratified the Kyoto Protocol, and also by the more advanced developing economies that have no quantified emissions limitation commitments under the Protocol

1.2 The European Union and Climate Change

The EU has been to the forefront in promoting international cooperation to tackle climate change through mitigation efforts to control greenhouse gas emissions, and through promoting adaptation measures to counter the adverse effects of climate change that are inevitable due to historic and present emissions. Under the Kyoto Protocol, the 15 Member States then in the EU have an emission reduction target of 8% from 1990 levels to be achieved over the period 2008–12. At Kyoto, the EU adopted this overall target on the basis that reduction commitments for individual Member States would be differentiated to reflect differing economic circumstances among the Member States. Council Decision 2002/358/EC subsequently set out legally binding differentiated reduction targets for each Member State. According to this burden-sharing agreement, Member States have either to reduce their emissions to an agreed percentage above 1990 levels or limit their emissions to an agreed maximum above 1990 levels. Ireland's target is to limit its emissions to no more than 13% above its 1990 levels.

The European Climate Change Programme (ECCP)[2] is the European Union's strategy to implement the Kyoto Protocol, complementing the efforts of Member States. Effective common and co-ordinated policies and measures under the ECCP, as well as being an important avenue for the EU to meet its overall commitment, are also an important element of Member States' strategies to achieve the required emission reductions. In October 2005, the European Commission launched a new phase of the ECCP, to explore further opportunities to exploit cost-effective emissions reduction options, building on existing initiatives, but also examining the potential contribution of carbon capture and storage, controlling emissions from aviation and an integrated approach to reducing CO_2 emissions from light vehicles.

1.3 Future Action

At its Spring meeting in 2005, the European Council reiterated the view of the EU that climate change is likely to have major negative global environmental, economic and social implications. It confirmed the political consensus, originally reached by the Council in 1996 that, with a view to achieving the ultimate objective of the UN Framework Convention on Climate Change, global annual mean surface temperature increase should not exceed 2ºC above pre-industrial levels. To underline this long-term objective, the European Council proposed that the EU should explore with other parties, strategies for achieving necessary emissions reductions and that, in this context, developed country parties should consider reduction pathways in the order of 15-30% by 2020 compared to 1990 levels. The ambition of the EU Heads of State and Government lays down a marker for forthcoming international negotiations on commitments beyond 2012.

1.4 Meeting Ireland's target

Ireland's target for the purposes of the Kyoto Protocol, to limit the increase of emissions to 13% above 1990 levels, can be met through:

- a variety of measures to reduce emissions throughout the economy, including those set out in the National Climate Change Strategy and measures adopted subsequently by Government;
- emissions reductions, or purchase of carbon allowances in lieu of reductions, by installations participating in the EU Emissions Trading Scheme; and
- use of the Kyoto Protocol flexible mechanisms by Government to purchase carbon allowances.

[2] http://europa.eu.int/comm/environment/climat/eccp.htm

(1) National Climate Change Strategy

Since the National Climate Change Strategy was published, the policy context for all greenhouse gas emitting sectors has changed significantly. New policies and measures have been introduced, some of which were envisaged by the Strategy, while others derive from measures adopted by the European Union. Other proposals in the Strategy have not been implemented in light of further analysis as to their suitability in an Irish context. Examples include the decisions not to proceed with a proposed carbon tax at a national level and to continue coal firing at the ESB's Moneypoint power station. As such, this review does not measure progress against the sectoral targets included in the Strategy, which were set with reference to the policy mix available and proposed at the time.

Table 1.1 sets out the contribution of significant currently adopted policies and measures. The estimates of emissions reductions from these measures are based on revised projections of greenhouse gas emissions to 2012 across all sectors included in the National Climate Change Strategy, which were completed in March 2006 and are published in the report 'Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012' by ICF Consulting & Byrne Ó Cléirigh[3].

Measure	Average annual reduction 2008-2012 Mt CO_2e
CAP reform – full decoupling	2.40
Afforestation	2.08
Renewable Energy Directive[4]	1.30
Landfill gas power generation or flaring	0.70
EU – car manufacturers voluntary agreement	0.48
Building Regulations Part L & EPBD[5]	0.30
Dublin traffic measures (e.g. Port Tunnel)	0.27
Biofuel excise relief	0.25
Implementation of Landfill Directive[6]	0.06
Modernisation of natural gas network	0.06
Motor taxation / fuel labelling	0.05
Total	**7.95**

Table 1.1: Annual reduction of adopted measures on full implementation

3 The report is available to download from http://www.environ.ie

4 Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, which requires Ireland to derive 13.2% of its electricity from renewable sources by 2010.

5 Directive 2002/91/EC on the energy performance of buildings.

6 Directive 99/31/EC on the landfill of waste.

Since the completion of revised projections, additional measures have been adopted for which emissions reductions have been calculated. These include the alignment of spatial planning and transport investment through the National Spatial Strategy and *Transport 21*, the Greener Homes Scheme and the Commercial Bioheat Scheme. Described in more detail in the sectoral analysis, these measures are estimated to reduce emissions by a further 0.25Mt CO_2e per annum over the 2008-2012 period.

This review reports on the changed policy context across all the sectors which contribute to greenhouse gas emissions and sets out a basis for the preparation of a new national climate change strategy to guide Ireland's future efforts both towards meeting its existing Kyoto target and preparing for more stringent greenhouse gas emission reduction requirements in the period beyond 2012.

(2) Emissions Trading In Ireland

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

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

Since November 2005, firms in the scheme have been able to purchase credits, with some exceptions, from the Kyoto Protocol's project-based mechanisms, Joint Implementation (JI) and the Clean Development Mechanism (CDM), to provide a cost-effective way of achieving compliance with their target under the Scheme[7]. As well as being able to purchase credits, firms can now invest in projects to reduce

[7] European Communities (Greenhouse Gas Emissions Trading) Amendment Regulations 2005, (S.I. 706 of 2005).

emissions inside or outside the EU through JI or CDM and convert the credits they earn from those projects into allowances that can be used for compliance under the EU scheme. Only credits earned from CDM projects can be used for compliance during the first trading period (2005-2007). Credits from both JI and CDM projects may be used by firms in the Scheme once the Kyoto Protocol commitment period commences in 2008[8].

The Government has recently set directions for the next period (2008-2012) of the EU Emissions Trading Scheme and a National Allocation Plan for this period has been prepared by the Environmental Protection Agency. Confirmation by the European Commission of the Plan is expected before the end of 2006.

(3) Government use of the Kyoto Protocol Flexible Mechanisms[9]

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

The National Treasury Management Agency (NTMA) has been designated as purchasing agent on behalf of the State and it is intended that the purchasing activities of the Agency will be underpinned by Exchequer funding provided through a Carbon Fund. Legislation is currently being prepared to provide a statutory footing for the Carbon Fund. An initial provision of €20 million for the purchase of allowances by the Agency has been made by the Government and will be supplemented, as necessary, up to and throughout the commitment period.

The Government does not propose to stipulate the type of allowance that the NTMA should purchase or to direct the NTMA to purchase allowances from a particular

8 The Environmental Protection Agency has been designated as Focal Point and National Authority for Joint Implementation (JI) and Clean Development Mechanism (CDM) projects, respectively. The role of the Agency will be to approve participation by private or public entities in JI or CDM project activities. The Agency will publish guidelines setting out its approval procedures for participation by Irish entities in JI and CDM projects.

9 The Kyoto Protocol provides for three flexible mechanisms to lower the overall costs of achieving emissions targets: Joint Implementation (Article 6), the Clean Development Mechanism (Article 12) and International Emissions Trading (Article 17).

project type or host country. It is envisaged, however, that the activities of the Agency in its role as the purchasing agent for the State will be directed by a number of guiding principles. The primary objective will be to provide for the timely purchase of sufficient carbon allowances to allow Ireland to meet its target for the purposes of the Kyoto Protocol in the commitment period 2008-2012.

1.5 Joint Implementation in Ireland

As an Annex I Party under the Convention, Ireland cannot host clean development mechanism projects, but may elect to host joint implementation projects. Joint implementation anticipates that there may be situations where, due to lack of capital or technical capacity, a country is unable to pursue cost-effective abatement measures. In this situation a project developer would be able to share a proportion of the emission reductions with the project host country in the form of credits for reduced emissions.

As set out in the National Climate Change Strategy, the current policy in relation to proposals for investment in JI projects in Ireland is that such projects would add to the overall economic cost of compliance with Ireland's Kyoto Protocol obligations[10]. In recognition of this position, the Environmental Protection Agency may only approve participation in JI projects outside of Ireland. Given Ireland's current greenhouse gas emissions profile and the requirement for a JI project to ensure that reduced emissions are additional to reductions expected under existing policy obligations, there are likely to be few opportunities for JI projects in the future. The potential for a JI-type domestic carbon offset scheme to be introduced in Ireland over the longer term may be considered as one of the options to stimulate reductions in certain sectors on a reduced-cost basis. In assessing any proposed scheme, it will be necessary to have regard to the range of supports that already exist in sectors where such a scheme may be feasible and to the potential costs for projects associated with project assessment, monitoring and verification.

1.6 Local Action

Local authorities have an important role in contributing to reduced greenhouse gas emissions, through their functions in relation to planning, transport, housing and waste disposal. It is recognised that local authorities can contribute both directly and indirectly to reducing emissions. The role of local authorities, where relevant, is

[10] Credits issued for Joint Implementation projects must be taken from the 'budget' of allowances available to countries that have targets under Kyoto Protocol. As this reduces the number of allowances available to the country to achieve compliance with its target, only those countries that are expected to achieve emissions reductions beyond their Kyoto Protocol targets are considering Joint Implementation investments.

addressed in the appropriate sectoral chapter. Local authorities are supported in their role by local energy agencies. There are 16 local energy agencies in Ireland, including three in Northern Ireland.[11] Established by respective local authorities with co-financing from the EU, the agencies provide advice on energy-related matters to households, businesses and to the public sector. They also promote renewable energy and energy efficiency at local and regional levels. A number of agencies have established targets for energy conservation and the use of renewable energy technologies within their respective regions; these are derived from the anticipated impact of national policy contexts and programmes. Such local initiatives point towards current and future engagement of both energy agencies and local and regional authorities on climate change mitigation issues.

1.7 Awareness

Since publication of the National Climate Change Strategy in 2000, the reality of global warming due to greenhouse gas emissions and its potential impacts have received extensive coverage across the whole media spectrum, including news reporting and documentaries. Awareness of and access to information on climate change have increased enormously in that time. The Department of the Environment, Heritage and Local Government has communicated the message of climate change in the context of the national Environmental Awareness Campaign. This focused primarily on improving the general public's awareness of the negative effect of increasing greenhouse gas emissions. The climate change element of the campaign communicated straightforward steps that individuals can take to contribute to reducing greenhouse gas emissions.

In addition, the contribution that individuals and businesses can make to reducing greenhouse gas emissions is being addressed through awareness initiatives at a sectoral level. For example, Sustainable Energy Ireland (SEI) provides a range of advice to promote energy awareness and efficiency for the industrial and commercial sectors, as well for other energy users. SEI provides advice to residential customers towards reduction of their energy consumption, including a home energy survey to identify areas in which the greatest energy savings can be made. For 2005, the SEI energy awareness week was themed on the potential of energy awareness to help combat climate change.[12]

[11] See http://www.aiea.ie

[12] See http://www.combatclimatechange.ie

The Government is actively engaged in discussions at EU level to examine how best to take forward the proposals set out in the European Commission's Green Paper on Energy Efficiency. The Department of Communications, Marine and Natural Resources is preparing a major national energy efficiency campaign, to be launched in Autumn 2006, which will aim, through changing energy consumption behaviours, to reduce waste, use more energy-efficient equipment and processes, and use energy more wisely.

As an integral part of *Transport 21*, the Government is planning a public awareness campaign that will focus on the benefits of eco-driving and its potential to deliver major results in terms of CO_2 emissions while also benefiting the consumer in terms of fuel savings. A major public awareness campaign, sustained over a period of time, could deliver substantial CO_2 reductions over the period 2008 – 2012.

In its submission on the current National Climate Change Strategy, COMHAR, the National Sustainable Development Partnership, identified communication of the Strategy, policies and implementation programmes as a critical success factor in determining whether the necessary behavioural change will be effected. COMHAR subsequently submitted a comprehensive paper to the Minister for the Environment, Heritage and Local Government on the communications issue[13]. The Minister proposes to invite COMHAR to review and update its paper as part of this consultation.

[13] See http://www.comhar-nsdp.ie/COMHARDocs/Recommend2_2001.doc

2. Emissions Trends and Projections

2.1 Trends in greenhouse gas emissions 1990-2004

Inventories of greenhouse gas emissions are compiled and published annually by the Environmental Protection Agency. The latest inventory covers the period 1990 - 2004 and is published in *National Inventory Report 2006*[1]. This report shows that emissions have fallen from a peak of 26.9% above 1990 levels in 2001 to 23.1% above 1990 levels in 2004. In absolute terms, emissions in 2004 were 68.5 Mt, 5.5 Mt in excess of Ireland's Kyoto Protocol target of 63 Mt per annum. Figure 2.1 illustrates the contribution of each sector to emissions in 2004.

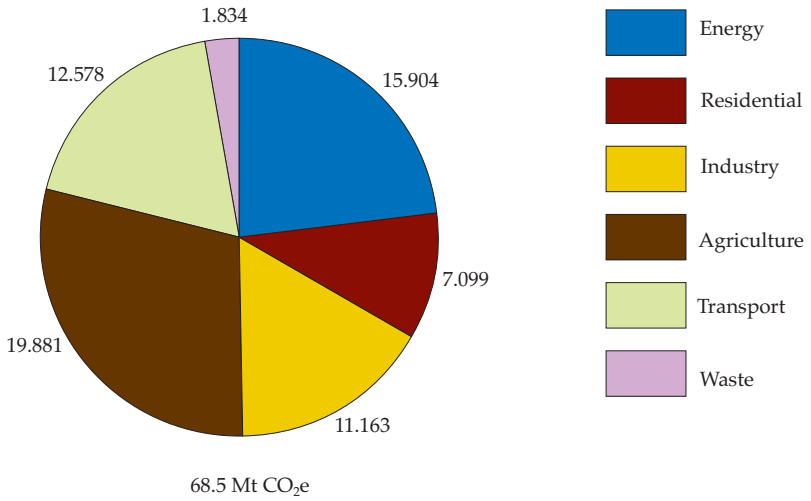

Figure 2.1: Sectoral contribution to greenhouse gas emissions in 2004

The recent decline can be attributed, inter alia, to:

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

Figure 2.2 illustrates emissions trends across relevant sectors from 1990 to 2004 and projections of emissions to 2012. Actual emissions have increased from 55.6 million tonnes in 1990 to 68.5 Mt in 2004. Figure 2.3 tracks the change in the relative contribution of respective sectors between 1990, 2004 and 2008-2012.

[1] See http://coe.epa.ie/ghg/

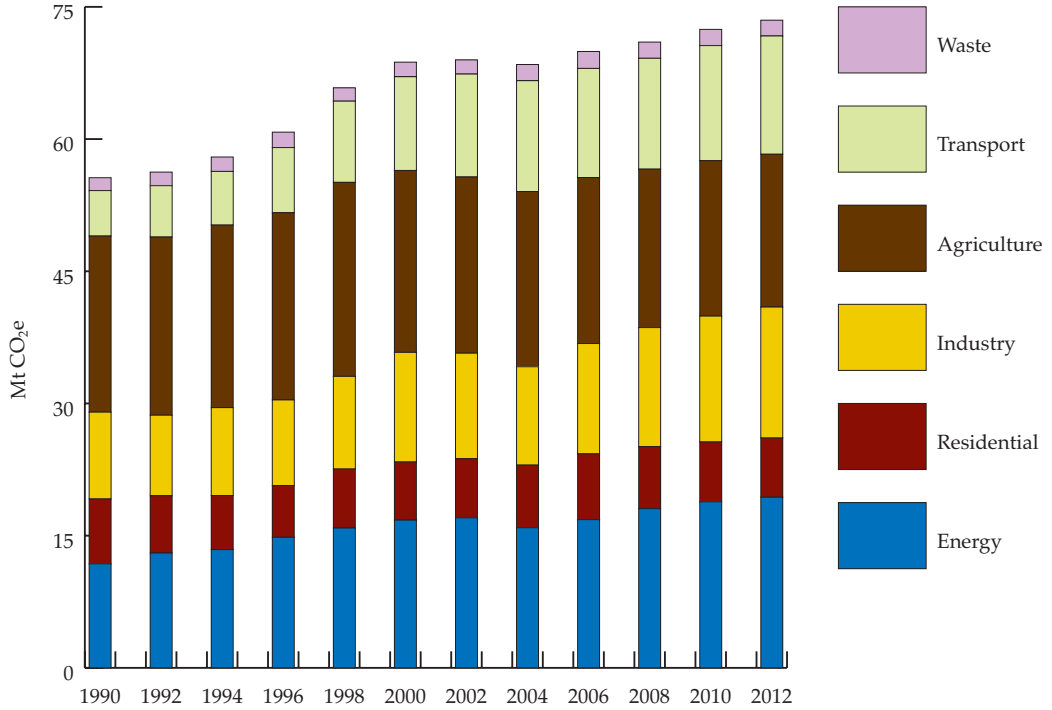

Figure 2.2: Trends and projections in sectoral emissions 1990-2012

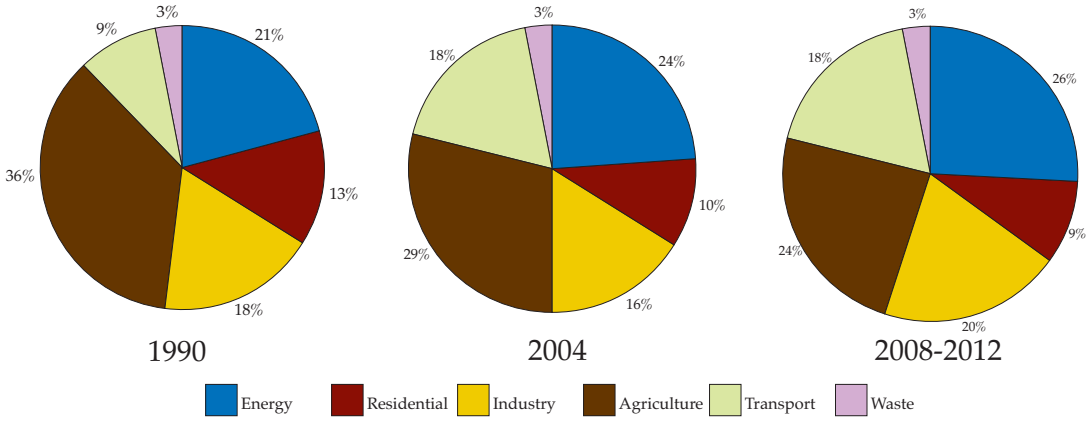

Figure 2.3: Sectoral emissions as percentage of total in 1990, 2004 and 2008-2012

Over the period since 1990, long-term trends in individual sectors are evident. The transport sector, in particular, has seen sustained increases over the period, with total emissions in the sector increasing by 144% between 1990 and 2004. The increase is almost entirely attributable to road transport, annual emissions from which have increased from 4.79 Mt to 12.13 Mt over the period.

In the energy sector - predominantly power generation - emissions increased by approximately 35% between 1990 and 2001. A downward trend has, however, been evident since 2001.

In agriculture, emissions increased on a steady basis throughout much of the 1990s but began to decline in 1999 arising from reduced livestock numbers and fertiliser use. Emissions in the sector were slightly lower in 2004 in comparison to 1990 emissions.

In the residential sector, while total energy consumption including electricity consumption has been increasing, direct emissions, which exclude electricity consumption have fallen by 4% between 1990 and 2004. This fall is a result of shifting fuel consumption from solid fuel towards cleaner fuels such as natural gas, as well as the adoption of strengthened energy efficient standards for new buildings.

Figure 2.4 expresses the trend and projection between 1990 and 2012 in terms of the main sources of greenhouse gas emissions. Greenhouse gas emissions derive from four distinct sources - fossil fuel combustion; agricultural production and land use; industrial processes and F-gases; and waste management. By far the largest of these sources is fuel combustion, which accounted for 65% of emissions in 2004 and is forecast to increase to an average of 68% during the Kyoto commitment period, 2008-12. For the EU as a whole, the average level of fossil fuel combustion was 80% in 2004. The difference reflects Ireland's proportionately larger agricultural base, with emissions from agriculture accounting for 29% of total emissions in 2004. However emissions from this sector have fallen from 35% in 1990 and are set to decline further, both in real terms and as a proportion of total emissions, in the period 2008-2012.

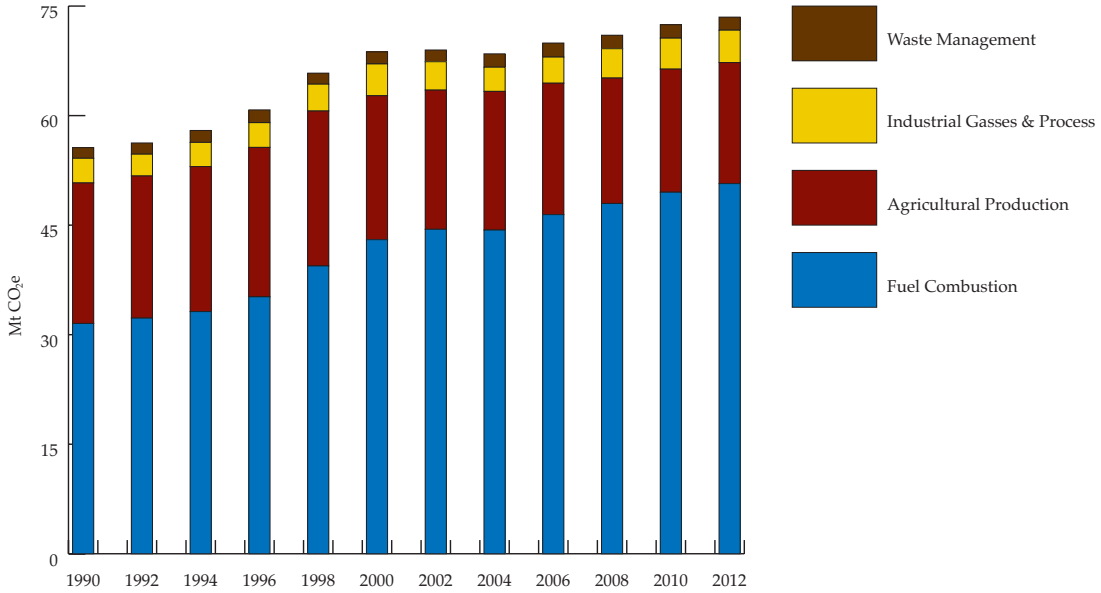

Figure 2.4: Total emissions by source category 1990-2012

Appendix 2 sets out a generic list of emissions reduction strategies for each emissions source. Examination of each emissions source provides a framework within which options to further reduce emissions may be considered.

2.2 Projections of greenhouse gas emissions

Updated projections of greenhouse gas emissions to 2012 across all sectors included in the National Climate Change Strategy were completed in March 2006 and are published in *Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012*, by ICF Consulting and Byrne Ó Cléirigh.[2]

It is expected that, without any additional action, the recent downward trend in annual emissions will be reversed over the Kyoto Protocol commitment period (2008 – 2012) due to projected economic growth and consequent increased demand for energy, construction materials and transport services.

Based on policies and measures already implemented or expected to be implemented up to 2012, projections show that Ireland will face an average annual shortfall in its Kyoto target of some 7.174 Mt of CO_2e. This updated distance to target takes into account all adopted and/or implemented policies and measures to March 2006. Projections to 2012 are predicated on existing policies and measures delivering

[2] *Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland*, ICF Consulting and Byrne Ó Cléirigh Consulting, March 2006. Available to download from http://www.environ.ie.

expected emissions reductions over this period. The projected distance to target depends also on macro-economic forecasts underpinning the projections, any deviation from which will have an effect on projected emissions. Figure 2.5 sets out the projected average annual emissions from individual sectors over the 2008 – 2012 period, including the contribution of sinks during the 2008-2012 period, which is calculated to reduce emissions by an average of 2 Mt CO_2e per annum.

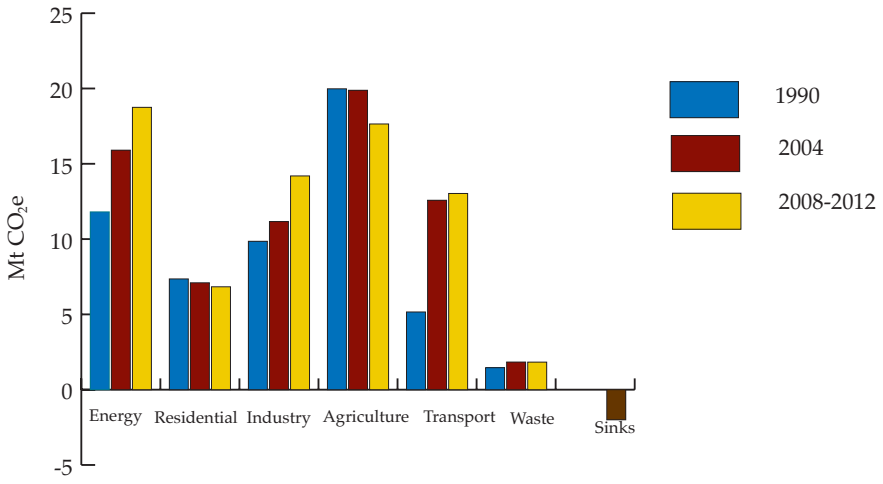

Figure 2.5: Total greenhouse gas emissions by sector 1990, 2004, 2008-2012

2.3 Greenhouse gas emissions and economic growth

Ireland is amongst the most successful Member States in achieving a decoupling of emissions growth from economic growth since 1990. In 2004, emissions per unit of GDP were 48% of their level in 1990. Despite this success, Ireland's per capita emissions remain significantly higher than other EU Member States: in 2004 emissions per capita were 17 tonnes in comparison to an EU-15 average of 11 tonnes. This can be attributed, inter alia, to Ireland's high reliance on fossil fuels for power generation, the size and nature of the agriculture sector, very high per capita cement production and a relatively high level of international fuel bunkering. Figure 2.6 illustrates the decoupling of Ireland's greenhouse gas emissions growth from its economic growth since 1990.

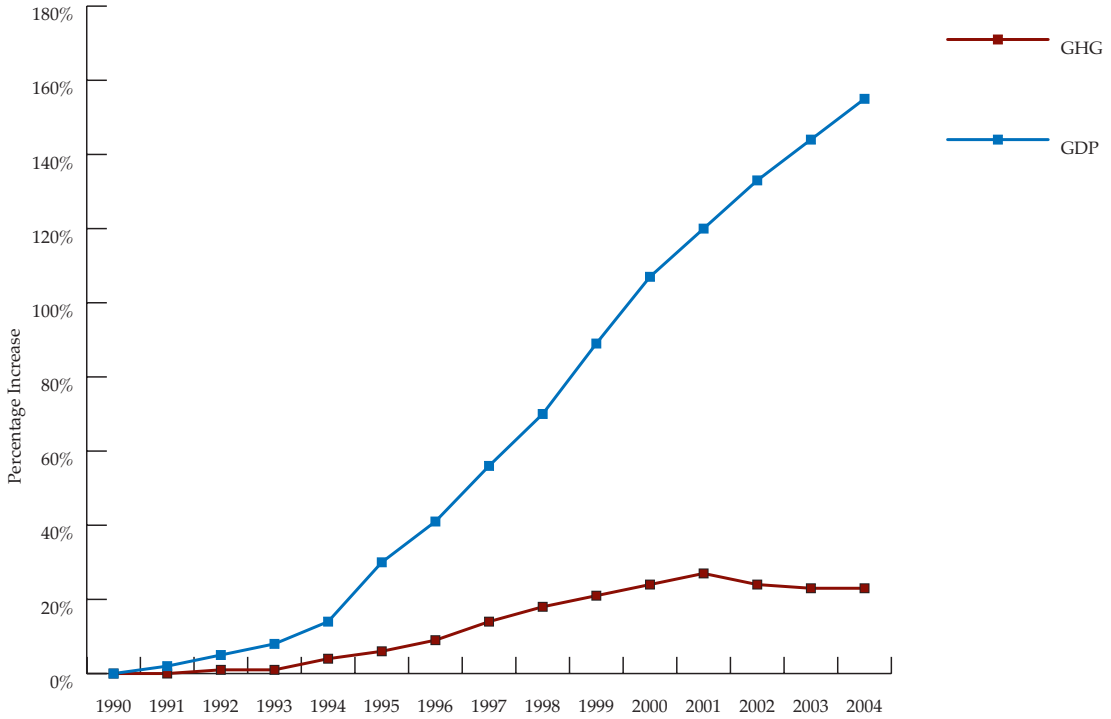

Figure 2.6: Relationship between economic growth and CO_2 emissions

2.4 Meeting our Kyoto Commitments

The Government has decided on the proportion of Ireland's distance to target for the 2008-2012 period that will be borne by the sectors of the economy covered by the EU Emissions Trading Scheme. The emissions trading sector in total will address a minimum 3.019 Mt per annum of the national distance to target, through a combination of internal emissions reductions, or the purchase of allowances through the EU Scheme. The remainder of the national distance to target will be met through the introduction of additional measures elsewhere in the economy and Government's use of the Kyoto Protocol flexible mechanisms. Table 2.1 below illustrates this apportionment.

Million tonnes per annum	Emissions Trading Sector	Rest of economy	TOTAL
Average annual emissions 2008-2012 without any action	25.658	44.548	70.206
Share of reduction	3.02	4.154	7.174
Target	22.638	40.394	63.032

Table 2.1: Approach to meeting Ireland's Kyoto Protocol target

3. Impacts and Adaptation

3.1 Adaptation

The primary international response to climate change has focused on mitigation – defined in the Third Assessment Report of the IPCC as: 'an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases'. Mitigation policies are aimed at reducing emissions of greenhouse gases to levels that would prevent dangerous human induced interference with global climate systems. Mitigation also includes measures to increase the carbon store in forests and other land uses through the use of sinks.

The second main response to climate change is adaptation, which is defined in the same IPCC report as: 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation'. The Parties to the UN Framework Convention on Climate Change are developing a five-year programme of work on adaptation to assist all Parties, in particular developing countries, to improve understanding and assessment of impacts, vulnerability and adaptation, and to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound, scientific, technical and socioeconomic basis, taking into account current and future climate change and variability.

To date, national policy has focused primarily on mitigating greenhouse gas emissions, i.e. reducing or limiting emissions in line with Ireland's commitment for the purposes of the United Nations Framework Convention on Climate Change and the Kyoto Protocol. While mitigation action is important in terms of delaying and reducing the impact of climate change, some degree of change is inevitable due mainly to current and historic levels of greenhouse gas emissions. In this regard, mitigation action by Ireland alone or indeed the EU alone will not be sufficient to eliminate the need for adaptation – emissions, be they historic or current, are not country specific. Even if significant progress can be made in reducing global greenhouse gas emissions in the short to medium term, current and historic emissions will continue to cause changes in the climate system for the foreseeable future. The need for action on adaptation is therefore beyond question. The Government recognises this need and proposes to broaden national climate change policy to address both mitigation and adaptation.

In developing appropriate policies to adapt to the impact of climate change in Ireland, a key consideration will be the factoring of predicted climatic changes into policymaking. Assessment of the impact of climate change must become integrated

into the formulation and development of policy in all sectors. The impact scenarios provided through existing research programmes underline the importance of considering climate change impacts in policy-making. Unless the potential impacts of climate change are integrated into key policy areas, Ireland runs the risk of undermining its international competitiveness in the years ahead, as well as bequeathing a landscape and quality of life to succeeding generations inferior to what might have been the case.

In developing policy on adaptation to climate change, a key objective will be to guide future integration of climate change considerations in policy-making and to provide policy-makers with a framework to factor the climate change impacts into policy proposals. It is envisaged that policy-making will ultimately be required to have regard to the potential climate change impact, in much the same way as existing policy proposals must consider the potential impact on operational and insurance costs.

3.2 Climate Change Impacts in Ireland

The Environmental Protection Agency, through the Environmental Research, Technological Development and Innovation (ERTDI) research programme, has provided some €6.4m towards climate change research in Ireland in the areas of mitigation, adaptation, basic science and observations. Specific objectives for the investment in climate change adaptation research include the provision of analyses of projected climate change and its impacts for Ireland and development of analytical capacity in this area. Reports published to date include *Climate Change: Scenarios and Impacts for Ireland*[1], and *Climate Change: Regional climate model predictions for Ireland*[2].

Climate change research has been undertaken in a number of thematic areas, including modelling, data management, and development of scenarios and impacts. Work in these areas is guided by priorities identified in the National Climate Change Strategy and in *Ireland's Environment: a Millennium Report*[3] as well as priorities identified by the research community and wider stakeholders. Research funded by

1 *Climate Change: Scenarios and Impacts for Ireland.* Report for the Environmental Protection Agency by the Department of Geography, NUI Maynooth and the Department of Botany, TCD, 2003. Funded under the Environmental RTDI Programme 2000 – 2006.

2 *Climate Change: Regional climate model predictions for Ireland.* Report for the Environmental Protection Agency by Community Climate Change Consortium for Ireland, 2005. Funded under the Environmental RTDI Programme, 2000-2006.

3 See EPA Website for a detailed summary of climate change research under the Environmental Research Technological Development and Innovation (ERTDI) Programme http://www.epa.ie.

ERTDI is primarily carried out by universities and institutes within Ireland, but funding has also been provided for studies in the UK, European institutions and the US.

The approach to climate change impacts research has been to provide analysis of current trends in climate change indicators. Development of future climate scenarios with high spatial resolutions (typically high resolution products are based on downscaling of coarse resolution global climate models) is required. Analysis of impacts based on these outputs and identification of vulnerabilities will inform future policy on adaptation.

The *Climate Change: Indicators for Ireland*[4] report shows climate change-associated trends are evident in the meteorological and ecological records. These include increasing average temperature, changes in rainfall patterns and an increasing growing season.

Climate Change: Scenarios and Impacts for Ireland is a major assessment of the possible impacts of climate change on Ireland. It examines the possible magnitude and likely impacts over the course of the 21st century by:

- establishing scenarios for future Irish climate based on statistical downscaling of global climate model projections for the middle and last quarter of the century, and
- using projections to assess probable impacts on key sectors such as agriculture, forestry, water resources, coastal and marine environments and on biodiversity.

The study identifies areas of vulnerability to climate change and addresses likely adjustments in the operation of environmental systems in response to such change. It concludes that, in sectors such as agriculture, some new opportunities may arise through increases in certain crop yields. In other areas such as water resource management, long term planning strategies will be necessary to adapt to adverse impacts. Long lead-in times for adjustment characterise many sectors, for example in forestry, and the study highlights the importance of advance warning arrangements to trigger appropriate responses. By anticipating change, the study concludes that it may be possible to adopt adaptation strategies that minimise the adverse impacts and maximise the positive aspects of global climate change.

[4] *Climate Change: Indicators for Ireland.* Report for the Environment Protection Agency by the Department of Geograpyh NUI Maynooth and the Department of Botony TCD, 2002. Funded under the Environmental NTDI Progamme 2000-2005.

The study poses specific scenarios that suggest significant climate change can be anticipated in Ireland over the next half century. These scenarios anticipate that by 2050 there will an increase in January temperatures of 1.5^{o}C, winter conditions in Northern Ireland and the north midlands will be similar to those currently experienced along the south coast; July temperatures will increase by approx 2.5^{o}C, and there will be marked reductions in summer rainfall by 25 – 40%. Furthermore, the study highlights possible impacts of these scenarios in key areas such as agriculture, water supply, marine coastline and the natural environment. In terms of agriculture, this may result in droughts and the need for increased irrigation that will affect farming generally including the viability of crops such as potatoes. Other impacts highlighted include pressures on the water supply infrastructure in the Greater Dublin Area, the likelihood of increased frequency of flooding in the West, general effects to the marine environment as a result of higher water temperatures, threats to the coastline due to higher sea levels, and general threats to ecosystems and biodiversity.

While many of the climate change impacts identified in the study are likely to occur despite mitigation and adaptation measures that might be put in place now, Ireland must ensure that foreseeable and avoidable future damage does not occur as a result of inaction in the present. The study underlines the importance of developing and implementing mitigation policies at international and national level, and adaptation measures at national and local levels.

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

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

- ***Temperature:*** General warming with mean monthly temperature increasing by between 1.25^{o}C and 1.5^{o}C. The largest increase will occur in the South East and East, with the greatest warming occurring in July.

- ***Precipitation:*** Most significant changes will occur in June and December. Rainfall in June will decrease by about 10% compared to the present while December values show increases ranging between 10% in the south-east and 25% in the north-west.

- ***Storms:*** Increased frequency of storms over the North Atlantic in the vicinity of Ireland by about 15% compared to current conditions.

The first report from the c4i project confirms and expands on the findings in the *Climate Change: Scenarios and Impacts for Ireland* study. Established in 2003, c4i has enabled the development of a regional climate modelling facility in Met Éireann. The new capacity will contribute to national efforts in climate change research, will support the community of environmental scientists and will assist policy makers in planning to adapt to climate change.

Further analysis of climate scenarios is being conducted under the auspices of c4i which will examine the impacts for agriculture and water management, focusing on river basin districts. This analysis is being carried out by Met Éireann and the National University of Ireland (Maynooth) and will become available in 2006. This will be further developed in subsequent years. Ongoing work includes analysis of river and coastal flooding (storm surges) as well as analysis of change in surface wind for the wind energy community.

Increasing attention is also being given to the occurrence of extreme events. The impacts of extreme floods, storms and heat waves have been observed globally in recent years. They can be more damaging than gradual or average changes, which are more easily predicted by climate models. New approaches to statistical and probabilistic analysis of extreme events are being developed to better inform decision making on associated risks and likely impacts.

3.3 Existing Measures

The potential for climate change impacts are already being addressed in a number of policy-making areas. The 2004 report of the Flood Policy Review Group,[5] established following serious flooding in parts of the country in the latter part of 2002, recognised the need to devise a clearly defined and comprehensive policy approach to flooding

[5] http://www.opw.ie/whatsnew/PDF/Published%20Report.pdf

nationally and a precise definition of the roles and responsibilities of the various stakeholders involved. Climate change is identified as one of the important elements that need to be addressed when assessing future flood relief measures in Ireland. Following the report, the Government appointed the OPW as the lead agency to implement flooding policy in Ireland and the OPW is currently developing a strategy to manage flood risk in conjunction with other relevant state agencies. The strategy is likely to involve non-structural measures such as storage and better flood forecasting and warning, but will also include structural works particularly where flooding is already a problem. OPW has a programme of flood defence schemes at different stages of development. One aspect of this strategy is the need to raise awareness about how to prepare for potential flooding. A website launched this year[6], will soon be augmented with details of available flood records since the early 1900s which will provide a public record of flood risk areas.

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

3.4 Further Action

Other policy areas, such as energy, health, biodiversity, water quality and supply, transport and agriculture, as well as building and infrastructure investments will also face adaptation challenges as part of the overall national response to climate change. This is evidenced by existing research specific to Ireland and analysis of the impacts of climate change by the Intergovernmental Panel on Climate Change (IPCC). This research will help to inform long-term policy development, to allow the expected impacts of climate change to be integrated into policy formulation and investments in adaptation to be optimised in order to adapt to changing climatic conditions and consequent global warming.

6 http://www.flooding.ie

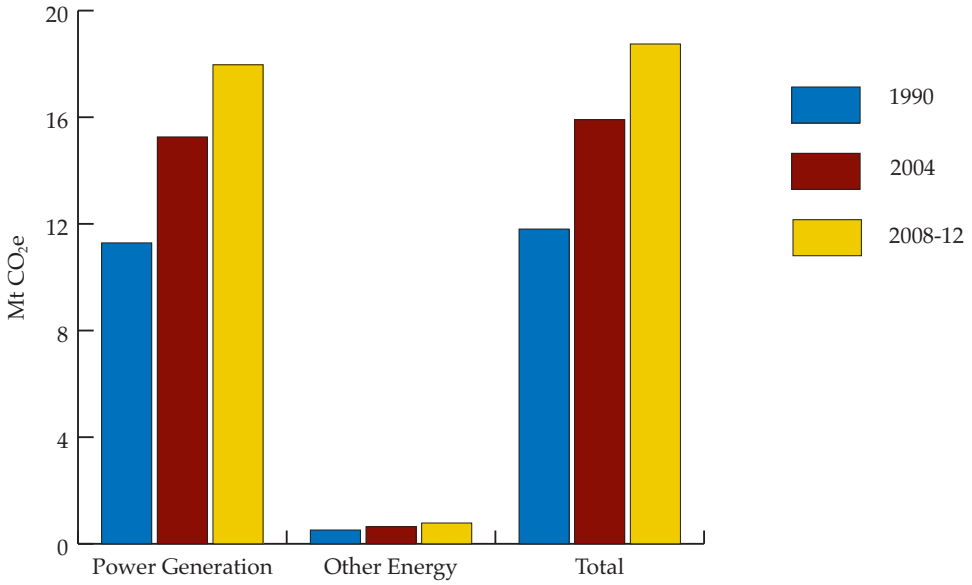

Figure 4.1: Energy emissions by source Mt CO_2e

4.1 Trends and Projections

Emissions from this sector arise from electricity generation, oil refining, gas production and distribution[1] and solid fuel production. Of these, electricity generation accounted for 96% of total emissions from the sector in 2004, with CO_2 from power generation making up 93% of total energy sector emissions. Electricity demand and therefore emissions have risen rapidly in line with economic growth since 1990, with total emissions for the energy sector increasing by 35% between 1990 and 2004. Based on latest available projections, greenhouse gas emissions from the sector are forecast to increase from 11.81 Mt CO_2e in 1990 to an average of 18.75Mt CO_2e during the period 2008 – 2012. While these projections include all adopted and implemented policies, including national targets for the contribution of renewables to electricity supply, the effect of the EU Emissions Trading Scheme is not included in these projections.

4.1.1 CO_2 intensity of Electricity

Despite the increased electricity demand over the period since 1990, in recent years there has been a degree of decoupling between electricity demand and emissions growth, due to the increased contribution of high efficiency electricity generation such as natural gas powered plants and of renewables to electricity generation. The downward trend in CO_2 intensity continued in 2004 arising from the closure of the

[1] This does not include emissions from gas transmission, a high-pressure network in which fuel is combusted. Emissions from this activity are included in transport emissions. Emissions from gas distribution relate to losses due to leakage of methane from pipes.

older, less efficient, Shannonbridge and Lanesboro peat-fired power plants and the increased contribution of wind to electricity generation. A 22% increase in the renewables contribution to electricity generation in 2004, which brought its overall share to 5.2%, was primarily due to the new connections of wind farms to the national grid. The carbon intensity of electricity has therefore fallen (particularly since 1994) from 925g CO_2/kWh in 1990 to 624g CO_2/kWh in 2004[2], reflecting the increase in the efficiency of electricity supply. This is illustrated in the graph below.

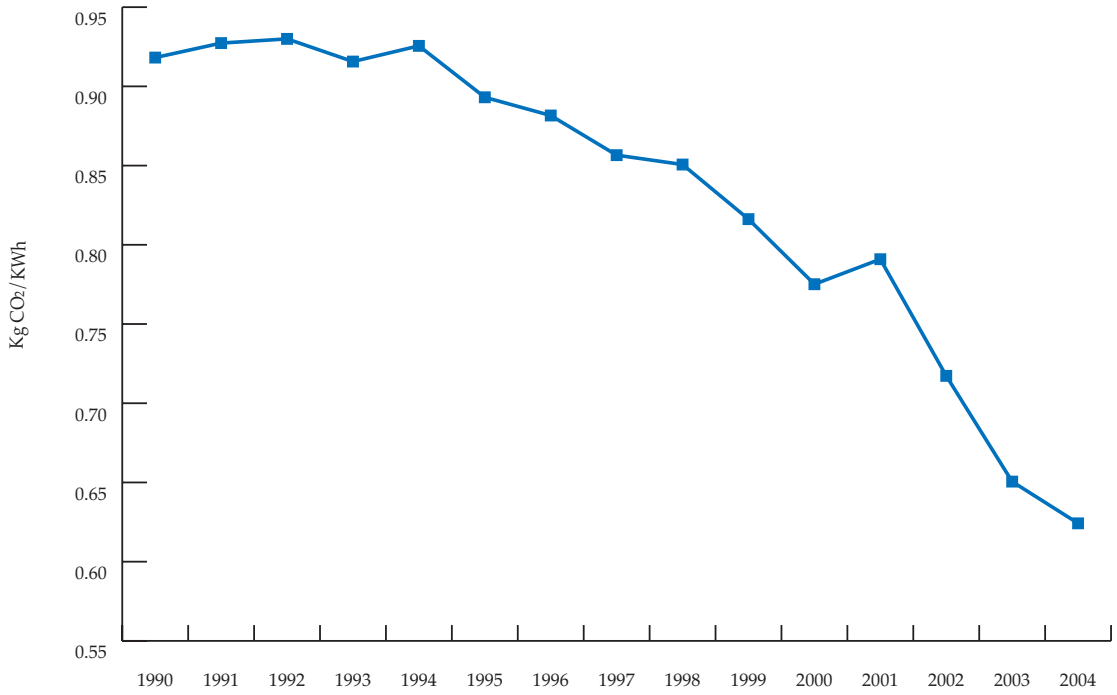

Figure 4.2: CO_2 intensity of electricity

4.2 Policies and Measures

4.2.1 Current Energy Policy Context

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

Projections by Sustainable Energy Ireland show Ireland's total energy needs[3] growing by an estimated 38% between now and 2020, and total electricity generation

2 Source: Sustainable Energy Ireland, *Energy In Ireland 1990-2004.*

3 This includes energy for electricity generation and energy requirements across all other sectors of the economy. Source: *Energy in Ireland 1990 – 2004* SEI, January 2006.

growing by 27.5%. Ireland's high dependency on fossil fuel imports, particularly oil and natural gas, is expected to continue with oil and natural gas contributing almost 87% to total energy supply in 2020 and gas contributing 71% to fuel used in electricity generation by 2020. The contribution of more CO_2 intensive fuels such as peat and coal to Ireland's total energy requirements is expected to decline to just under 7% by 2020.

A key component of Ireland's energy policy in the years ahead will therefore be the need to place increasing emphasis on the measures to further encourage energy consumption using less CO_2-intensive fuels. Equally, it will be important to strengthen energy efficiency measures in order to reduce overall energy consumption and to ensure that Ireland's demand for electricity does not exceed the available generation capacity. These issues are also being informed by wider international developments in energy policy including the recent publication of EU green papers on energy efficiency[4] and on a European strategy for sustainable, competitive and secure energy[5].

The European Commission's green paper on energy efficiency concludes that the EU as a whole could save 20% of energy consumption by 2020 resulting in savings estimated at €60 billion. Half of the savings identified in the green paper could be reached by full implementation of already adopted legislation on energy efficiency in buildings, domestic appliances and energy services. The green paper points out that the capital and running costs of energy efficiency measures to save 1 megawatt of electricity are many times cheaper than those of generating an additional megawatt of power and notes that higher employment from efficiency measures and ongoing savings will boost the economies of Member States. The Government is actively engaged in discussions at EU level to examine how best to take forward the proposals set out in the Green Paper and is preparing a major national energy efficiency campaign, to be launched in the Autumn, which will aim, through changing energy consumption behaviours, to reduce waste, use more energy-efficiency equipment and processes, and use energy more wisely.

4.2.2 Fuel switching

This includes a broad set of measures aimed at using less carbon intensive fuels throughout the economy including in power generation, through substituting for

4 Green Paper on Energy Efficiency or Doing More With Less, European Commission, 2005. COM (2005)265.

5 A European Strategy for Sustainable, Competitive and Secure Energy, European Commission, 2006. COM(2006)105.

coal, peat and oil; expansion of combined heat and power and renewables; and expansion of the gas supply network. Emissions from the energy sector are influenced by the Government's policy of ensuring fuel security in electricity generation through fuel diversity. This has led the Government to decide to continue coal-fired electricity generation at Moneypoint and to approve the commissioning of three new peat-fired power plants supported by a Public Service Obligation (PSO) levy. The opportunities for switching away from coal and peat-based generation in the short term are therefore limited and the Government will instead ensure that the generation of electricity using these fuels is as clean and efficient as possible. The Government has already approved a €360 million retrofit of Moneypoint to help meet the particle emission requirements of the Large Combustion Plant Directive.

The replacement of the last of the remaining older peat-fired power stations with three new peat power stations by December 2005 provided about 350Mw of generating capacity. While burning peat contributes about 10% of greenhouse gas emissions arising from electricity generation, the existence of new plant means that peat is currently being burned in the most efficient way possible.

Emissions Trading Scheme

All fossil fuel electricity generation plants in Ireland are included in the EU Emissions Trading Scheme. The operation of the scheme is described in more detail in chapter 1. When the industry sectors covered by the scheme are included, it will address approximately 3 Mt CO_2 of Ireland's projected distance to its target for the purposes of the Kyoto Protocol during the 2008-2012 period. The scheme provides flexibility to firms in meeting the caps placed on individual installations and if internal emission reductions are not cost-effective, firms may purchase additional allowances that become available due to reduced emissions elsewhere in order to meet their obligations under the scheme. For the sectors covered by the scheme, Government action will therefore be aimed at supporting firms in the Scheme to deliver emissions reductions cost-effectively, in so far as this is possible.

Gas production and distribution

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

Approximately 90% of the Bord Gáis Éireann (BGÉ) distribution network comprises new polyethylene pipe. The network now extends to 9,316 kilometres, compared with the 3,000 kilometres when BGÉ took over from the former town gas companies. The remaining cast iron mains in the distribution networks are in the greater Dublin area. BGÉ and the CER have put in place an agreed timeframe wherein all the remaining cast-iron pipes will be replaced by 2009. Fugitive emissions from the network are expected to fall despite continued expansion of the network, due to the replacement of older cast-iron piping on the network. Total fugitive emissions are projected to be 0.046Mt of CO_2e by 2009 compared with 0.103 Mt in 2001.

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

Renewable Energy

Ireland is required to ensure that 13.2% of gross national electricity consumption comes from renewable sources by 2010[6]. Achieving this target will play an important role in Ireland's pathway to Kyoto compliance, although this contribution must be viewed in the context of continued growth in the overall demand for electricity over the Kyoto commitment period. When achieved, the target will represent about 1450Mw of installed capacity, of which 846Mw is currently in place, including 574 Mw of wind capacity, and a further 630Mw with grid connection agreements. The Government's recent decision to move to a new Renewable Energy Feed in Tariff (REFIT), which replaces the previous competitive tendering programme, will help to stimulate further development of the renewables market, not just for wind energy, but for a range of other technologies, including biomass and biomass-powered CHP. This new support structure complements initiatives such as the new grid code connection conditions and enhanced technical grid control to accommodate the increased number of wind-generated electricity suppliers on the system. This support structure is complemented, for wind energy, by the publication of Wind Energy Development Guidelines in June 2006. The Guidelines provide a context within which planning authorities may consider the development of wind energy projects through the development plan process on a consistent basis throughout the country. Building on Ireland's existing EU target, the Government recently signalled its intention to set a new national renewable energy target of 15% by 2010 and to build upon this with more ambitious targets for 2020.

6 Directive 2001/77/EC

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

Combined Heat and Power

There is currently 282Mw of installed Combined Heat and Power (CHP) capacity in Ireland, including 150Mw at Aughinish Alumina. As a proportion of national electricity consumption, Ireland has one of the lowest CHP deployment in the EU. In the absence of additional support to assist CHP penetration, capacity had been expected to continue to grow slowly and perhaps even contract, due to a range of factors including unfavourable fuel prices, high connection charges and investment uncertainty. Recognising this problem, the Government recently announced an €11 million scheme to promote the deployment of CHP in the industrial, commercial and public services sector, including CHP using both fossil fuel and sources such as biomass. The programme will provide capital grant support for the installation of CHP units and metering technologies, and is designed to encourage fossil fuel-fed CHP up to 1 MW in size and any size biomass-fed CHP. It is intended that this scheme will be the primary instrument for promoting the development of CHP. Separate initiatives to promote more widespread deployment of CHP include an examination by the Commission for Energy Regulation of potential physical and regulatory barriers to becoming a CHP generator and work by SEI on a substantial information campaign on the benefits of CHP.

4.2.3 Improving generation efficiency

Efficiency of electricity supply

The efficiency of electricity supply is a measure of the amount of fuel inputs required to provide a unit of electricity for final consumption. In Ireland, electricity supply efficiency is currently (2004) at 41%, meaning that 59% of the potential energy contribution from fuel input at the generation stage is lost. While a small proportion of this is as a result of the generating plants' own use, the majority of the energy potential is lost through transmission losses and electricity transformation. There has been a sharp increase in electricity generation efficiency since 2001, with a rise from 35% to 41% due to the replacement of older generating plant with more-efficient gas and peat plants, and the increasing contribution of renewables to electricity

generation. Further efficiencies can be expected in the future as additional high efficiency gas-fired power plants comes on line and continue to displace less efficient generating capacity. Three new plants in total are either planned or in construction since the 2004 generation efficiency figures were published. While some of this new capacity will meet forecasted increased demand for electricity, it will contribute greater overall efficiency in electricity generation.

Transmission and distribution losses

The remainder of losses in energy potential arising from electricity generation result from transmission and distribution losses. Transmission losses are incurred on the transmission system as electricity is transported from generators across the electricity grid. The cost of transmission losses acts as an incentive for generators to locate where losses are low; transmission losses are paid for by the generators, based on estimated losses and on their location on the grid. This system therefore benefits distributed generation such as wind farms, which are located nearer to the electricity end user.

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

Demand Side Management

The establishment of Sustainable Energy Ireland (SEI) in 2002 means there is now a dedicated body to promote and assist environmentally and economically sustainable production, supply and use of energy across all sectors of the economy. SEI programmes include the Large Industry Energy Network (LIEN), a voluntary networking initiative of 85 of the largest commercial energy users in Ireland; the Energy Agreements Programme, which assists companies achieve certification to the Irish Standard on Energy Management; and the Public Sector Investment Programme. Further detail on SEI programmes to promote more efficient energy consumption is set out in chapter 7.

ESB Customer Supply Energy Efficiency Programmes

ESB Customer Supply has been directly engaged in promoting the benefits of greater energy efficiency to its customers since 1991. It is estimated that between 1991 and 2005, the cumulative saving in direct costs to business, industry and residential customers (lifetime savings) has been in the region of 6,300 GWh. The Winter Peak Demand Reduction Scheme (WPDRS) was introduced from Winter 2003/04 as an incentive to business customers to reduce electricity consumption during the power system's peak hours (5pm - 7pm) in winter months (November - February). The Scheme provides incentives for customers to reduce their electricity consumption and to establish stable patterns of energy consumption. The level of incentive increases with the amount of energy saved.

Regulation Targets

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

Intelligent Energy Europe programme

The EU Intelligent Energy Europe (IEE) Programme is aimed at tackling mainly non-technological barriers to the market uptake of energy efficiency, renewable energy and more sustainable transport measures. It covers 3 thematic areas: energy efficiency (SAVE); renewable energy sources (ALTENER); and energy aspects of transport (STEER). Irish projects have received part funding for projects in all three fields, in partnership with organisations in other eligible Member States. Among the organisations which have recently received support is the Tipperary Energy Agency,[7] for its projects to develop a standardised energy check for use by SMEs for quick identification of potential savings in energy use, and to develop a framework for encouraging the growth of markets for bio-fuels as a low carbon fuel for local authorities and other public sector transport fleets across the EU.

[7] http://www.tea.ie

4.3 Options for the future

Co-firing in power generation

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

CHP and distributed generation and heating

By generating electricity closer to where it is consumed, using more efficient technologies such as CHP, distributed power generation has the potential to contribute more efficient and less CO_2-intensive electricity generation and also take pressure off existing electricity generation capacity. Under its Renewable Energy Research, Development and Demonstration Programme, SEI provides support for CHP and district heating feasibility studies, including the development of project financing and other market penetration measures. The potential for widespread deployment of distributed heating systems may, in practice, be limited by the inflexibility of such systems in the context of building practices in Ireland.

Micro CHP

As well as the conventional large (less than 1Mw) and small-scale CHP applications, technological advances have made the deployment of micro-scale CHP (greater than 100Kw) commercially feasible. Suitable for domestic and small business applications, these small-scale plants have the potential to contribute to reduced consumption of both electricity and energy used for space and water heating by domestic and other small-scale consumers.

Wave and ocean energy

The Government has recently launched an Ocean Energy Development Strategy, to be led by Sustainable Energy Ireland and the Marine Institute, to promote the development of an ocean energy strategy in Ireland, including support for initial research and development through to full commercial application. The first phase of the strategy has already seen the deployment of a scale model testing device at a test site at Spiddal, County Galway. The ocean energy resource available to Ireland indicates a potential to supply 100% and 6% of the forecasted all-Ireland electricity

demand from wave and tidal energy sources respectively. While it is not yet known how much of this could be exploited economically, it is estimated that some 84 Mw of installed capacity could exist by 2020, displacing some 90,000 tonnes of CO_2[8].

Carbon capture and storage

In the longer term, the capture of CO_2 either before or after fossil fuel combustion in power generation may offer potential to remove much of the CO_2 generated at the source of the emissions.[9] While a coal-fired power plant with carbon-capture technologies has the potential to offer significant CO_2 savings over conventionally generated electricity, it will however reduce a plant's generation efficiency by 8%-12%. It would also be necessary to identify suitable means of shipping the captured CO_2 and sites for long-term storage.

Carbon capture is most efficient in those plants with the highest CO_2 emissions content, namely peat and coal. Given the importance of these fuels for security of supply in power generation, the application of carbon capture technologies to plants which burn these fuels could potentially offer a medium-term solution to the large quantity of CO_2 emissions generated by these plants. The attractiveness of such technologies as a solution to large emissions sources such as power stations is, however, somewhat undermined by the potentially large retrofitting costs involved. While retrofitting the ESB's coal-fired station at Moneypoint with carbon capture technology could reduce Ireland's total greenhouse gas emissions by 7%, it has been estimated that such retrofitting could cost over €500 million[10].

Promotion of efficient energy use by energy suppliers

The recently-adopted EU Directive[11] on energy efficiency in end-use and energy services requires energy suppliers to offer electricity and other energy supplies to end-use consumers as part of a comprehensive package of energy services. The Directive includes targets to improve energy efficiency by 1% per annum from 2008. Measures covered by the directive include management of customer demand for electricity for inter alia, appliances and space and water heating, and promotion of lower consumption at peak times. With appropriate pricing, the Directive proposes that electricity consumers would be encouraged to reduce their energy consumption over time and the energy suppliers would also be incentivised to promote reduced energy consumption among their customers through competition between energy suppliers. Such a framework may also be extended through a system of tradable 'white certificates' issued for a given quantity of energy saved. This is described further in chapter 7.

8 *Ocean Energy in Ireland*, Department of Communications, Marine and Natural Resources, 2005.
9 *Emerging Energy Technologies in Ireland: A Focus on Carbon Capture and Hydrogen*, SEI, 2005.
10 *Emerging Energy Technologies in Ireland*, SEI, page 87.
11 Directive 2006/32/EC

5. Transport

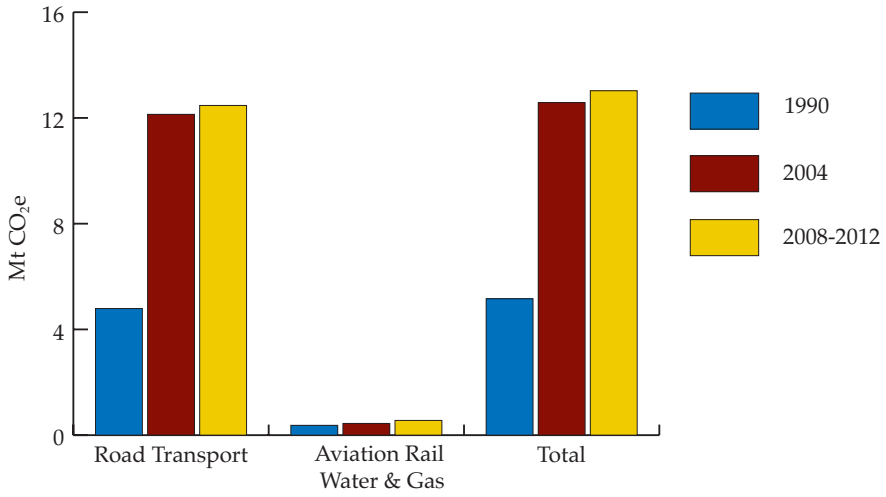

Figure 5.1: Transport emissions by source Mt CO_2e

5.1 Trends and Projections

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

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

Transport's contribution to national greenhouse gas emissions must be considered in the context of its pivotal role in supporting Ireland's economic prosperity, regional development and social inclusion. The growth in transport emissions has primarily been caused by increased fuel consumption in the road transport sector. This can be attributed to a number of inter-linking factors associated with Ireland's significant economic growth in recent years, including growing population, increased demand for housing leading to urban sprawl, increased commuting, larger air passenger numbers through our airports and increased freight movements. More people are travelling more often, and there are more vehicles on our roads. People are buying larger private vehicles as disposable income increases, which is offsetting technological fuel efficiency improvements.

Emissions in 2004 increased by 6.1% on the previous year, reflecting continuing growth in road traffic. The number of vehicles on our roads grew by 21% between 2000 and 2004 alone. The number of private cars increased by almost 20% in that period, with the number of goods vehicles increasing by over 30%. This upward trend in the national vehicle fleet, which is related to the link between transport demand and economic growth, is expected to continue: Irish car ownership levels, at 397 per 1000 population in 2004, are well below the EU-15 average of 488 cars per 1000 (in 2001). Without any further measures to tackle emissions from transport, emissions are projected to continue to increase to an annual average of 13.03 Mt in the period 2008 – 2012.[1]

The growth in emissions from the transport sector has been inflated by international fuel bunkering, i.e. where fuel is bought within the State by private motorists and hauliers but consumed elsewhere. International reporting guidelines require that emissions be reported on the basis of domestic sales rather than domestic consumption. The Department of the Environment, Heritage and Local Government estimates that, in 2004, 10% of petrol and 25% of diesel sold in Ireland was consumed outside the State, equating to 2.2 Mt CO_2e of emissions. When fuel bunkering is not included it is estimated that emissions from domestic consumption in road transport increased from 5.2 Mt CO_2e to 10.0 Mt CO_2e between 1990 and 2004, an increase of 92%.

5.2 Policies and Measures

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

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

5.2.1 Fuel Efficiency Measures

Technological Improvements

Improving the fuel efficiency of the passenger vehicle fleet is a key part of reducing emissions from the transport sector since private cars will remain an important

[1] Current projections do not include expected reduction in greenhouse gas emissions arising from the implementation of *Transport 21* during the period covered by the Kyoto Protocol and in future years.

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

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

Between 1995 and 2003, CO_2 emissions from new passenger vehicles are reported to have been reduced by an average of 12%[2]. However, the contribution of technological improvements to reducing emissions from transport in Ireland has been lost due to a purchasing trend toward vehicles with larger engine sizes.

Fuel Economy Labelling

Since 2001, fuel economy and CO_2 information for new cars must be displayed in car salesrooms. This requirement enables consumers to make purchasing decisions informed by these particular environmental indicators. The Society of the Irish Motor Industry now publishes a *Guide to Passenger Vehicles' Fuel Economy and CO_2 emissions*[3], which contains fuel economy and CO_2 emissions information for all vehicles on sale in Ireland.

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2 *Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Fifth annual Communication on the effectiveness of the strategy.* 2005. See http://ec.europa.eu/environment/CO2/CO2_home.htm

3 See http://www.simi.ie.

Alternative fuels

Alternative fuels such as biofuels offer the potential to reduce the environmental impact and energy intensity of the transport sector. In April 2005, the Government announced a scheme for the provision of excise relief on biofuels. This was extended following an announcement in the 2006 Budget to a five year (2006 – 2010) biofuels excise relief package worth in excess of €200m. It is expected that the extended programme will result in Ireland achieving 2% market penetration of biofuels by 2008 and will bring about a the reduction of over 0.25 Mt of CO_2 annually. To complement this scheme, *Transport 21* provides funding for pilot projects to make cleaner, more environmentally friendly vehicles available, embracing public transport, the haulage industry and taxis. These initiatives include pilot projects for biofuels and hybrid-electric technologies, which will be used to guide which future policy development, particularly in relation to public transport investment.

VRT and Annual Motor Tax

Both Vehicle Registration Tax (VRT) and annual motor taxation for private vehicles are based on engine size, which is related to fuel consumption and CO_2 emissions. The National Climate Change Strategy proposed rebalancing VRT and motor tax so that they are more closely aligned to actual tailpipe CO_2 emissions. A 50% relief in VRT for hybrid-electric cars was introduced in 2001. This was augmented in Budget 2006 with an extension of this relief to flexible fuel vehicles for a two-year period from January 2006. Motor tax does not currently distinguish between technologies that provide a greater CO_2 efficiency for a given engine size. The Government is currently assessing the feasibility of rebalancing VRT even further and also motor tax in line with CO_2 emissions as a means of addressing emissions from the transport sector.

National Car Test (NCT)

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

Fuel efficiency measures in public transport

Incorporating sustainability considerations into the day-to-day operations of the CIÉ companies is important in terms of improving performance and efficiency. The need to report on sustainability issues and, in particular, on progress in testing the feasibility of alternative fuels such as biofuels, has been agreed between CIÉ and the Department of Transport.

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

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

5.2.2 Modal Shift

Investment in and use of public transport

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

Modelling of the impacts of *Transport 21* in the Greater Dublin Area shows a reduction of almost 20% in fuel consumption and CO_2 emissions during rush-hour in 2016, compared to a situation in 2016 without *Transport 21* in place.[4] This will be as a result

[4] A modelling study of the potential impacts of *Transport 21* in the Greater Dublin Area during rush hour in 2016 was carried out by the Dublin Transportation Office in 2005. The modelled scenario considers the full investment plan in place in the Greater Dublin Area without any additional tolls or road charging.

of modal shift from private cars to public transport and includes the contribution of associated demand management measures. The saving equates to CO_2 savings of around 0.016 Mt per year from 2016.

Rail Services

The two Luas light rail lines began operation in 2004. Luas carried over 22 million passengers in its full first year of operation. A survey of Luas users, carried out by the Rail Procurement Agency (RPA) in 2005 indicates that 24% of those surveyed have switched from private modes of transport (e.g cars, motorcycles and taxis).

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

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

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

Bus Services

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

Transport 21 will see a doubling of bus priority measures in the Greater Dublin Area (GDA) with a 60% increase in bus capacity. Significant capital funding for the

purchase of a large number of new buses in the GDA will be provided. The cites of Cork, Galway, Limerick and Waterford will also benefit from funding for city bus services, a range of traffic management, bus priority and car restraint measures, including Green Routes/Quality Bus Corridors (QBCs), Park and Ride facilities, cycle paths and improved pedestrian facilities.

Cycling facilities

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

Tax exemption for public transport commuting

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

5.2.3 Maximising Efficiency

Roads Investment

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

Exchequer investment in national roads was €7.8 billion over the period 1997 – 2005, with over €1.4 billion invested in 2005. Since 2000, a total of 57 projects (354kms) have been completed. Work is currently in progress on 27 projects (300kms) with in excess of 50 projects (over 700kms) at various stages of planning.

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

Freight

Road freight accounts for the bulk of Irish freight transport. Analysis of goods vehicles shows that 41% of vehicles are less than four years old.[5] This is positive from an emissions viewpoint, as newer vehicles are more fuel-efficient and have reduced emission levels. The road haulage sector is pre-disposed to maintaining fuel-efficient operations, since fuel represents a significant cost for the sector. In addition, the new EU Driver Training Directive includes logistics and route planning modules for road hauliers, which will help to improve the efficiency of road freight operations and thereby reduce emissions.

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

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

5.2.4 Demand Management

Relationship between transport and spatial policies

Demand-side measures, correctly targeted, seek to maximise the efficiency of the transport network by managing the demand for travel and influencing patterns of

[5] Bulletin of Vehicle and Driver Statistics, 2004

commuting behaviour. Demand management comprises a range of measures, including:

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

The Dublin Transportation Office (DTO) has been engaged in formulating policy recommendations in relation to demand management for the Greater Dublin Area (GDA)[6]. The recommendations on demand management are being designed to focus on policies that will help the Government and the local authorities in the GDA to respond to growing travel demand, in general, and to specific problems such as long distance commuting. In this regard, road pricing and congestion charging are options to be considered as elements in the possible range of policies for managing traffic demand.

National Spatial Strategy

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

The Guiding Principles recognise that the National Spatial Strategy to 2020 is a key backdrop to all transport plans and policies.[7] The integration of spatial development and transport investment should support more sustainable travel patterns for individuals and business, including facilitating a modal shift to more sustainable forms of transport (e.g. public transport, cycling and walking) and delivering net benefits in terms of reduced environmental and health costs. The National Spatial Strategy notes that transport's role in supporting balanced regional development is to:

6 *Greater Dublin Area Travel Demand Management Study.* Dublin Transportation Office. 2004.

7 *The National Spatial Strategy. 2002 – 2020. People, Places and Potential.* Department of the Environment, Heritage and Local Government.

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

The National Spatial Strategy will be given regional effect through the Regional Planning Guidelines and Local Authority Development Plans. It is estimated that a 2.5% reduction in passenger kilometres travelled on implementation of the National Spatial Strategy will contribute to an annual saving of around 0.075 Mt of CO_2 emissions over the period 2008 – 2012.[8] This reduction in emissions will arise because of shorter commuting distances and a shift to public transport, cycling and walking. Passenger journeys undertaken by public transport will also have associated CO_2 emissions. However, the distances travelled are anticipated to be shorter and emissions much less compared to private car travel.

Regional Planning Guidelines

The Regional Planning Guidelines, which will be implemented by local authorities, will be of benefit in aligning land-use planning and transport investment. The transport planning perspectives will continue to provide an input to reviews of the Guidelines and local authority development plans.

Cork Area Strategic Plan: The Cork Area Strategic Plan (CASP) provides an excellent example of successful land-use planning, with appropriate use of rail, bus and cycle solutions. The Department of Transport is committed in *Transport 21* to the implementation of the CASP including investment in rail infrastructure and in bus

[8] Based on a study commissioned by the UK Department of Transport, *Visioning and Backcasting for UK Transport Policy (VIBAT)* 2006 which estimates a 2 – 10% reduction in passenger kilometres travelled as a result of a range of measures to make urban areas more attractive by using strategic and local urban design to reduce dependence on car travel.

priority Green Routes as envisaged in the CASP. The areas east and north of Cork city in the Cork Area Strategic Plan (CASP) provide good examples of successful land use and transport planning. Development adjoins to existing urban areas and to existing transport infrastructure - for example to rail lines where the particular strengths of rail can be exploited by operating from and to substantial catchment areas and on routes where rail has a competitive advantage over road transport.

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

Road Pricing

In relation to road pricing, the National Climate Change Strategy (2000) stated that climate change considerations should be integrated into considerations of road pricing to maximise climate change gains and achieve additional improvements in urban air quality. While the current National Development Plan and *Transport 21* provide for the procurement and construction of a number of major national road projects as toll public private partnership projects, the primary objective of such projects is to ensure the provision of vital public infrastructure and to ensure operation and maintenance to a high standard over the long term for the benefit of the user.

5.3 Options for the Future

Making transport users fully aware of the external costs (such as environmental pollution) of their chosen mode of transport will be a key component in bringing about more sustainable travel patterns towards shorter, less frequent trips and modal shift to more sustainable forms of transport. At present the marginal costs of using the car are low and the fixed costs are higher. These high costs are often ignored or even used as a justification for using private vehicles as much as possible after purchase. Changing the car taxation regime towards a pricing strategy where payment is made for each individual trip would embrace the 'polluter pays' principle and place a strong emphasis on moving the costs away from vehicle ownership to vehicle use.

Influencing and changing personal behaviour will comprise a key component in controlling the growth of emissions from the transport sector. It will be a key element

of a sustainable transport strategy that will reinforce other measures such as investment in public transport, demand management and fiscal measures. Making consumers aware of the impact of transport on the environment and, most importantly, ensuring that this knowledge is translated into a change in personal behaviour holds significant potential to deliver major savings in CO_2 emissions from transport. This is evident in relation to the potential CO_2 savings from the promotion of eco-driving, as discussed below.

Public Awareness

Raising public awareness through, for example, awareness campaigns holds significant potential to change consumer preferences and personal behaviour. In relation to purchasing preferences, a redesign of the existing fuel economy labelling scheme for private cars will be examined to more clearly display the CO_2 impact of the vehicle in question and so play a greater role in consumer decision-making.

Driver behaviour can contribute to increased CO_2 emissions through inefficient driving style and therefore reduced fuel efficiency. Promoting 'eco-driving', or smooth and safe driving at lower engine revolutions, will encourage people to drive in a way that delivers benefits in term of savings in fuel consumption and therefore reductions in greenhouse gas emissions. Eco-driving has the potential to deliver significant CO_2 savings - often quoted as up to a 20% improvement in fuel efficiency[9].

As an integral part of *Transport 21*, the Government is planning a public awareness campaign that will focus on the benefits of eco-driving and its potential to deliver major results in terms of CO_2 emissions while also benefiting the consumer in terms of fuel savings. In addition, *Transport 21* provides funding for a range of sustainable transport initiatives which includes pilot projects to test the feasibility of eco-driving as a means of increasing fuel efficiency and decreasing CO_2 emissions in the public transport, road haulage and taxi sectors. The results of these pilot projects will then be assessed as an input to policy development in this area. It is estimated that a major public awareness campaign, sustained over a period of time, could deliver CO_2 reductions of approximately 0.13 Mt of CO_2 per annum over the period 2008 – 2012.

Demand management is a fundamental method of achieving greater energy efficiency from the transport sector as a whole. The provision of additional transport infrastructure and services cannot meet all of the inexorable growth in demand for

[9] The European Climate Change Programme calculated the reduction potential of eco-driving of at least 50 million tonnes of CO_2 in Europe by 2010.

travel. Neither is it possible to justify the huge investment in public transport without taking measures to encourage commuters, in particular, to move from the private car to these more sustainable modes of travel. Indeed, it is clear that the benefits of the investment will be seriously undermined if it is not accompanied by an effective demand management strategy. A detailed demand management strategy, initially for the Greater Dublin Area, will be developed for Government consideration as the investment programme outlined under *Transport 21* proceeds. Its objective will be to at least reduce growth in transport demand by providing real and attractive alternatives to the private car.

Measures could include some form of congestion charge in Dublin city centre and possibly a wider Metropolitan Area destination charge, towards the end of the ten-year *Transport 21* period, once a major enhancement of public transport capacity has been delivered. A detailed implementation strategy will be developed taking account of background work already undertaken by the Dublin Transportation Office.

The impacts of these proposed investments in infrastructure and demand management will be to improve the integration of transport services in the Greater Dublin Area, to greatly increase the capacity of the public transport network and to reduce congestion. The upgrading of the M50 (increasing its capacity by 50%) will be complemented by the construction of an orbital Metro (Metro West) to provide a realistic and attractive public transport alternative to the car. In short, the new integrated network will open up huge possibilities for all transport users and allow easier and speedier movement across the entire network.

Modelling studies carried out by the DTO looked at, inter alia, the impacts of *Transport 21* in terms of CO_2 emissions in the rush hour in the Greater Dublin Area. The model compares two scenarios in 2016 (i) CO_2 emissions in rush hour with *Transport 21* in place and (ii) CO_2 emissions in rush hour without *Transport 21* in place. The model shows a 6% reduction in fuel consumption and CO_2 emissions with *Transport 21* in place in 2016 (modelled without associated demand management measures) compared to scenario (ii). Including demand management measures in the *Transport 21* scenario shows a 20% reduction in fuel consumption and CO_2 emissions compared to scenario (ii). This additional improvement in CO_2 emissions as a result of the introduction of demand management measures equates to additional savings of around 0.01 Mt of CO_2 per year in 2016.

Intelligent transport systems

There has been a progressive increase in the use of intelligent transport systems (ITS). An ITS Strategy is currently being developed by the Department of Transport to consider the role ITS can play in facilitating more economic, efficient and effective management of roads and public transport services. ITS is generally regarded as the integrated application of computer, sensor, electronics and communications technologies along with transport management strategies to provide an integrated, safer, more efficient and more sustainable surface transport system. The strategy being developed foresees ITS making an important contribution to delivering the best value for money from the Government's significant investment in physical transport infrastructure.

The deployment of ITS technologies in road vehicles and infrastructure can have a positive impact on congestion and therefore CO_2 emissions. Soft ITS measures such as electronic integrated public transport ticketing and real time information will improve the accessibility and efficiency of public transport. Technologies such as adaptive traffic signal control at linked road junctions, coupled with variable speed limits, can facilitate greater throughput and regulate traffic flow. In addition, management techniques can mitigate traffic congestion that arises following road incidents. The use of ITS in road vehicles and infrastructure can also find applications in demand management strategies.

Fuel efficiency measures in public body vehicle fleets

Clean and energy efficient vehicles could be promoted and their uptake encouraged by setting targets for public procurement of clean and energy efficient vehicles. Such a measure holds the potential to increase the fuel efficiency of all public body vehicle fleets and also reduce vehicle emissions. However, these technologies are more expensive than conventional vehicle manufacturing technologies, and any such policy would have financial and practical implications for the bodies concerned.

Fuel Tax Measures

The National Climate Change Strategy (2000) proposed a restructuring of fuel excise duty on a progressive basis in order both to reduce the incentive for international fuel bunkering in Ireland and encourage a shift to cleaner more CO_2-efficient vehicles. However, it was recognised that the costs to the economy of doing this would have to be carefully balanced against the recognised short-run elasticities of demand for fuel consumption. The Strategy proposed that restructuring of fuel excise duty would take place concurrently with any realignment of VRT and motor tax to ensure the maximum greenhouse gas emissions reduction, while minimising the economic impact. There is a large volume of Irish and international literature on

the price elasticities of transport fuel demand, which indicates that, over the longer run, people are likely to change their fuel consumption in response to changes in fuel prices, either through buying a more fuel-efficient vehicle or altering commuting behaviour.[10] Based on vehicle stock on the road in 2000, SEI has estimated that a reduction of 2,000km travelled per vehicle per annum would reduce CO_2 emissions by 0.44 Mt of CO_2 per annum.

Rebalancing VRT and Annual Motor Tax

Tax incentives to encourage the purchase of cleaner and more energy efficient vehicles have the potential to increase the fuel efficiency of the vehicle fleet. At the EU level, the European Commission presented a proposal for a Directive in July 2005 that would see the introduction of a CO_2 element into the car taxation system of both motor taxes and vehicle registration taxes in Member States. A Commission studyestimates that such a restructuring of the taxation system would reduce the average emissions of new passenger cars in the EU by 5%.[11]

Applying a 5% reduction in emissions to the new passenger car fleet in Ireland in 2004 would deliver savings of 0.02 Mt of CO_2. The savings would be cumulative on an annual basis until full turnover of the vehicle stock had occurred. The above calculation is carried out for only those new vehicles bought in 2004. It is possible to calculate the CO_2 savings if the entire 2004 vehicle fleet were replaced by vehicles that release 5% less CO_2. This analysis shows that savings of 0.26 Mt of CO_2 are possible.

Company Car Tax

A reform of the way in which the benefit of private use of a company car is taxed could deliver savings in CO_2 emissions. Such a reform would change the company car tax system to an emission basis rather than a mileage basis. Business miles would no longer be taken into account in calculating the company car tax charge, and the percentage charge would then be related to CO_2 emissions[12]. The reform would also

10 See *Strategies to Reduce Greenhouse Gases from Irish Transportation*, SEI, 2002, for a more detailed discussion.

11 *Fiscal Measures to Reduce CO2 Emissions from New Passenger Cars.* A study contract undertaken by COWI A/S for the European Commission's Directorate General for Environment, 2002.

12 In the UK, for example, company car tax is based on a car's list price and CO_2 emission values. A minimum charge of 15% of the car's price applies to cars if the CO_2 emissions figure is 140g/km or less. This charge rises in 1% increments for every 5g/km over the minimum level (there is an upper ceiling of 35%). The 2006 budget included the announcement that the threshold for the minimum percentage charge rate will be reduced from 140g/km of CO_2 to 135g/km for 2008 – 2009. A new lower, 10% band for company cars with CO_2 emissions of 120g/km or lower was also announced which will come into effect in 2008 – 2009. Company cars running on alternative fuels such as LPG and electricity receive additional discounts. In the UK in 2003, the reform saved 0.15 to 0.2 million tones of CO_2 which is equivalent to around 0.5% of CO_2 emissions from all UK's road transport.

reduce the incentive for company car drivers to drive unnecessary extra business miles thereby reducing business travel and helping to reduce congestion. In addition, there is a relatively high turnover of company cars into the second-hand car market. Encouraging the purchase of more fuel efficient company cars will have knock-on positive benefits for the wider car fleet.

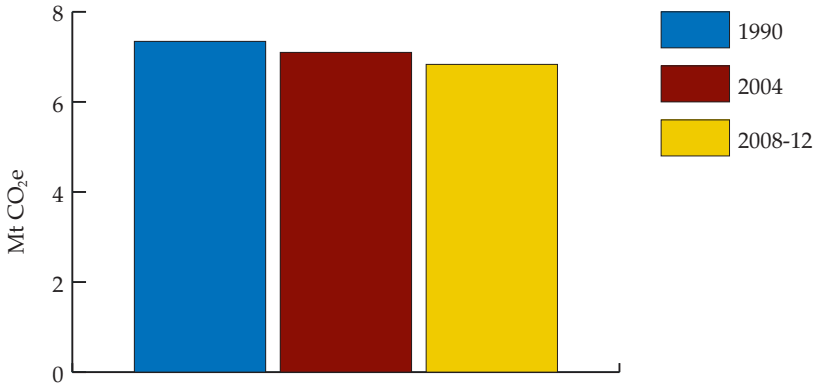

Figure 6.1: Residential Emissions Mt CO_2e

6.1 Trends and Projections

This sector comprises both residential housing stock and all non-residential buildings in the commercial and services sectors, including in the public sector.[1] Recognising that a proportion of all energy consumed by the non-residential built environment relates to the provision of space and water heating and the use of appliances, policies and measures directed at the non-residential element of the built environment are considered in this section.

For the purposes of reporting greenhouse gas emissions, this sector only includes emissions arising from direct energy consumption in private dwellings for space and water heating. Greenhouse gas emissions arising from non-residential buildings, such as those in the commercial and public sector, are included in the Industry, Commercial and Services sector. Greenhouse gas emissions in the residential element of this sector comprised approximately 10% of total greenhouse gas emissions in 2004. Emissions arising from the production of electricity for use in the residential and other sectors, including electricity use for space and water heating, are attributed to the energy sector, while emissions from petrol and diesel use in private cars are attributed to the transport sector.

While energy consumption, excluding electricity use, rose by 23% between 1990 and 2004, mainly due to an increase of 44% in housing stock in the State from approximately 1.01 million units to approximately 1.44 million in 2004, direct

[1] The National Climate Change Strategy included total emissions from the commercial / services sub-sector with industry emissions

emissions associated with non-electricity energy use fell by almost 4% from 7.355 Mt to 7.099 Mt during this period. Emissions from the average dwelling fell by 30% between 1990 and 2004.[2] This fall is a result of a significant shift away from solid fuel use towards less carbon-intensive fuels such as natural gas as well as the adoption of strengthened energy efficient standards for new buildings under the national building code.

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

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

6.2 Policies and Measures

6.2.1 Improved Spatial and Energy Use Planning

National Spatial Strategy

The National Spatial Strategy, published in 2002, aims to achieve a better balance of social, economic and physical development across Ireland. The Strategy provides a 20-year framework for planning at national, regional and local level. Balanced regional development requires that the full potential of each region to contribute to the overall performance of the State be developed on a sustainable economic, social and environmental basis. Good spatial planning has the potential to deliver beneficial environmental impacts in areas such as transport and a general holistic approach to continued spatial development.

At national level substantial progress is being made in implementing the NSS, which is having an increasing influence on policies and programmes across a range of Government Departments and agencies. At regional level, a key policy bridge between national development priorities and local planning has been put in place with the adoption of Regional Planning Guidelines. These provide a strategic framework for local planning. At county and city level, strategic land use and

[2] Source: SEI, *Energy In Ireland 1990 –2004.*

planning frameworks for a number of Gateways are in place, with work well advanced on others.

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

Development Plan Guidelines

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

The Planning and Development Act 2000 sets out, in accordance with Section 10 and the First Schedule to the Act, that a development plan may include objectives for promoting design in structures for the purposes of flexible and sustainable use, including conservation of energy and resources.

Residential Density Guidelines

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

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

The Guidelines stress that firm emphasis must be placed by planning authorities on the importance of qualitative standards in relation to design and layout in order to

ensure that the highest quality of residential environment is achieved. Planning authorities have generally reviewed and varied their Development Plans as necessary to give full effect to the recommendations and policies contained in the Guidelines.

The 1999 Residential Density Guidelines will be reviewed and updated on the basis of experience to date with the existing guidelines, changed demographics and settlement patterns and forecasted changes. The updated guidelines will also reflect the need for building sustainable communities and the outcome of a research study on apartment sizes and space standards.

6.2.2 More Energy Efficient New Buildings

Building Regulations

Amending Part L (Conservation and Fuel Energy) Building Regulations were made in 2002, providing for higher thermal performance and insulation standards for dwellings. Higher standards for new dwellings, envisaged in the NCCS to be implemented in two phases (2001 and 2005), were implemented in a single step with effect from 1 January 2003. The amending Part L Regulations of 2002 also set higher thermal performance for replacement doors, windows and roof lights (roof windows) in existing houses with effect from 1 July 2003. This was estimated to reduce CO_2 emissions by 0.25 Mt tonnes by the end of 2012.

Further amending Part L Regulations, made at the end of 2005 to incorporate higher thermal performance/insulation standards for new non-domestic buildings (such as offices, shops, factories and leisure centres), will commence on or after 1 July 2006. This will lead to an additional 0.45 Mt reduction in CO_2 emissions per annum by the end of 2012.

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

Higher thermal performance/insulation standards under Part L have significant economic and social benefits, in addition to the environmental benefits set out above. For example, the higher standards for new dwellings operative from 1 January 2003 are estimated to reduce the energy requirements for domestic space and water heating by 23%-33%, depending on the size and type of dwelling. Such energy

savings would be particularly beneficial for low-income families affected by fuel poverty. In the case of commercial buildings, the lifetime cost of operating and maintaining a building is a multiple of the initial capital cost. Accordingly, additional investment in energy saving technology at the construction stage could represent good value for money.

EU Energy Performance of Buildings Directive (EPBD)

Amending Part L Building Regulations were made in December 2005 to partly transpose Articles 3, 4, and 5 of the Energy Performance of Buildings Directive.[3] The Regulations also provide the legal basis for the introduction of revised energy performance assessment methodology (Domestic Energy Assessment Procedure or DEAP) for new dwellings. This expresses the energy performance of the building as a single parameter- CO_2/m^2 per annum and provides explicit recognition of the possible contribution of high-efficiency boilers, e.g. condensing boilers, and renewable energy technologies.

Building Energy Ratings

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

- BER of new dwellings, with effect from 1 January 2007
- BER of new non-domestic buildings, with effect from 1 January 2008,
- BER of existing buildings, when sold or let, with effect from 1 January 2009.

A BER certificate or "label" will allow prospective tenants or buyers to objectively compare the energy performance of a building. An Advisory Report attached to the BER certificate will set out cost effective ways of improving building energy performance for the information of building owners and landlords in planning future upgrade works.[4]

Sustainable and Energy Efficient Buildings and Low Energy Housing

House of Tomorrow: This SEI programme stimulates the uptake of energy-efficient practices in building design and construction. The programme funds designers and architects who work on "clusters" of buildings (normally 10–100 buildings) with

3 Building Regulations (Amendment) Regulations 2005 (S.I. No. 873 of 2005)

4 See http://www.epbd.ie

considerably improved energy use parameters, typically 20–40% better than the requirements of the current Building Regulations.

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

- Tralee Town Council recently completed construction on a 64 house social housing scheme and community facility/crèche at Rathass, as part of the SEI House of Tomorrow' programme. The Scheme includes a variety of innovative energy solutions in a number of houses to reduce running costs for tenants, including under floor heating supplied by geothermal heat pump, solar panels and efficient gas condensing boilers run on Liquid Petroleum Gas. The combination of increased levels of insulation and the use of innovative energy practices produces energy savings of over 40% for the scheme.

- York Street Apartment Development - this brownfield Dublin city centre development for Dublin City Council, supported by Sustainable Energy Ireland under the House of Tomorrow Programme, will include 66 new apartments arranged in five blocks with communal spaces on the ground floor. Each block will have a district heating system with a central condensing gas boiler. Domestic hot water will be provided by 5 solar thermal panels with back-up from highly efficient gas boilers at peak loads. The well-insulated fabric and highly efficient heating system with solar panels will result in a reduction of 51% of CO2 emissions, energy savings of 51% and fuel cost saving of 70% compared to apartments constructed to normal standards. Other environmental design features will include; shallow plan blocks for good daylighting and natural ventilation, dual aspect apartments and dual aspect living spaces, adaptable glazed balconies on south and west facades, green roofs to control water seepage and attract wildlife, renewable energy, energy conservation, life cycle usage, rain water harvesting and waste management.

- Killarney Court, Dublin - The provision of 105 residential units by Cluid Housing Association through renovation and refurbishment illustrates

various best practice strategies to lessen the impact on the environment. The renovation of an existing building saves considerably on the energy consumption and use of new materials, which would have otherwise been expended in demolition and new build. Location within centre city with a wide range of amenities within walking distance reduces car dependence and energy consumption. Reduced energy consumption is achieved by upgrading previously uninsulated external walls and roof with thermal insulation to comply with current standards. Planted landscaped areas and playground provide improved residential amenity and use natural run off and soakage to deal with rainwater. Replacing single-function use with a multi-functional renovated building with onside employment (3 workshops, offices and shop) and community hall, increases local access to employment and facilities, lessening car dependence.

Design of Large Buildings: The Energy Performance of Buildings Directive requires that the economic and technical feasibility of alternative/renewable energy systems be assessed during the design of large buildings over 1,000 m^2. This will be operative from 1 January 2007. Sustainable Energy Ireland will, by end-July 2006, publish a national feasibility study covering a wide range of large buildings. SEI will also publish free software to enable designers undertake the relevant feasibility assessments.

Design Guidelines for Social Housing: A key to tackling fuel poverty is to ensure that housing is provided with a method of heating which will be efficient in operation and will ensure that all rooms can be adequately heated so that they can be used by the occupants. Guidelines for Social Housing provide that all social housing incorporate whole-house heating properly designed and using efficient systems while having due regard to the preferences of the likely occupants. The standards of insulation required have been progressively improved in line with improvements with the Building Regulations. The improved thermal performance and insulation standards will deliver reduced heating costs for the occupants of local authority dwellings and reduce greenhouse gas emissions due to lower energy requirements. A review of the design guidelines is currently underway and it is expected that revised guidelines will be published during 2006.

Greener Homes Scheme: The Greener Homes Scheme, launched in 2006, provides assistance to homeowners who intend to purchase a new renewable energy heating system for either new or existing homes. The scheme is administered by Sustainable Energy Ireland and aims to increase the use of sustainable energy technologies within Irish homes over the next five years. It is estimated that the full uptake of the funding

available under the scheme will reduce emissions by 20,500 tonnes annually. Householders can receive grant assistance to install renewable heating systems (solar, biomass or heat pump based) that meets their particular needs in terms of heat demand, budget and environmental considerations. There has been significant public interest in this grant scheme and around 3,500 grant applications were received since its announcement in March 2006.

6.2.3 Improved Efficiency of Existing Buildings

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

Reducing Energy Consumption in Existing Houses

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

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

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

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

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

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

6.2.4 Improved Efficiency of Appliances

Energy Labelling

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

Demand Side Management

Controlling the demand for energy consumption in the residential sector will benefit not only the consumers of energy in terms of reduced costs, but will also help to reduce Ireland's overall energy requirement and, for electricity generation, reduce the pressure on existing generating capacity. As well as programmes directed towards

the industrial and commercial sectors, Sustainable Energy Ireland provides advice to residential customers on reducing their energy consumption, including a home energy survey to identify areas in which the greatest energy savings can be made.

6.2.5 Changing Fuel Mix

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

6.2.6 Public Sector Buildings

Public Sector Investment Programme

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

The Energy Performance of Buildings Directive requires that a BER certificate be displayed in all public service building, including existing older public buildings. This will become fully operative from 1 January 2009.

6.3 Options for the future

Providing a framework for housing policy in Ireland

The Government is currently preparing a housing policy statement to elaborate principles for the development of housing policy in Ireland in the years ahead. The

general principles that will underpin this policy are set out in *Housing Policy Framework: Building Sustainable Communities*.[5] The policy framework places an emphasis on the building of high quality, integrated sustainable communities and reflects a commitment to making continuing improvements in the quality of housing and neighbourhoods. This approach is endorsed in the draft social partnership agreement *Towards 2016*[6], which notes the linkages required to achieve sustainable communities, in relation to balanced regional and rural development, planning, physical and social infrastructure, environmental sustainability and the development of social capital.

Improving the quality of social housing

A key element of the Government's approach to housing policy is its commitment to improving the social housing stock. As well as ensuring that new social housing is built on best quality design and planning principles, the Government will continue its programme to rejuvenate existing social housing. Building on the €1 billion spend on remedial works on local authority housing estates since 1997, a programme of regeneration and remedial works for all run-down estates nationwide will be rolled out. In addition, the installation of central heating systems in all local authority housing will be completed by 2008, providing for much improved standards of energy efficiency.

Tighter energy efficiency standards in the Building Regulations

The Energy Performance in Buildings Directive requires that national Part L Building Regulations standards be reviewed at least every 5 years. Thermal performance standards for dwellings will be reviewed by 2008; and for non-domestic buildings by 2010. This is to ensure the continuous upgrading of energy performance standards for new buildings and material alterations of existing buildings. It will also present opportunities to take on board ongoing technological developments.

Additional Building Regulations will be made in 2007 to underpin the introduction of a new building energy performance assessment methodology for newly constructed non-domestic buildings, expressing building energy performance assessment in a similar way to new dwellings (kg Co_2/m^2 per annum), when this more complex methodology has been developed.

Support for innovative design and construction technologies

The Government already provides support to encourage the uptake of energy-efficient practices in building design and construction through, for example, the

5 Published by the Department of Environment, Heritage and Local Government. Available on http://www.environ.ie

6 Available on http://www.taoiseach.gov.ie

House of Tomorrow Programme. In deciding whether such practices and technologies should be generally adopted, the Government will have regard to the need to ensure adequate certification and the practicality of more widespread application. Experience gained through demonstration programmes such as House of Tomorrow and voluntary uptake of technologies through, for example, the Greener Homes Scheme, will help to inform future amendments to national Building Standards.

Continued switching to less-CO_2-intensive fuels

Government-funded programmes, such as the Greener Homes Scheme, which encourage greater use of sustainable energy in homes will be evaluated to assess their impact. In parallel, the potential for awareness-raising at both the national and local levels, to contribute to more efficient energy consumption in homes, will be considered.

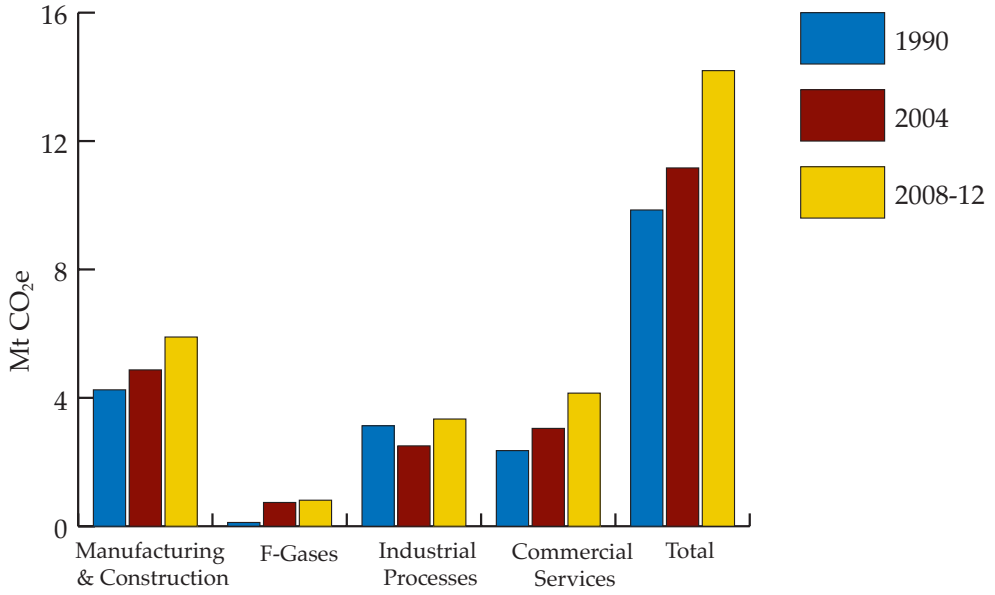

Figure 7.1: Industry, Commercial and Services emissions by source Mt CO_2e

7.1 Trends and Projections

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

Emissions from the sector as a whole grew by 13% between 1990 and 2004. Within this overall increase, however, emissions from the commercial/services sector grew by 29% and emissions from industry grew by 8%. While not exactly analogous, the CSO Census of Industrial Production records that industrial production has increased by some 330% over the same period. Within industry, process emissions fell by 20% due to the cessation of fertiliser manufacturing in Ireland. However, this masks a 126% increase in process emissions from cement, lime and periclase production driven mainly by large increases in cement production to support strong demand for construction materials.

Emissions are projected to increase by 33% between 2004 and 2012 with strong growth in all sectors, particularly in cement production and the commercial and services sub-sector.

7.2 Policies and Measures

Emissions Trading Scheme

The EU Emissions Trading Scheme, introduced in 2005 for energy and large industrial emitters, covers 100% of industrial process emissions and approximately 80% of combustion-related emissions from manufacturing industry. The small number of commercial installations included in the Scheme account for less than 2.5% of emissions from the commercial/services sub-sector. The operation of the trading scheme is described in more detail in chapter 1.

Investment Analysis

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

7.2.1 Energy Efficiency Measures

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

Negotiated Agreements

In 2002 and 2003, Sustainable Energy Ireland engaged in a pilot Negotiated Agreements programme involving 26 companies. The pilot programme estimated energy efficiency gains over business as usual of 5.4% (individual agreement), 16.4% (collective agreement) and 17.1% (technology agreement). A key incentive for the introduction of negotiated agreements was a proposed exemption from any carbon tax that might be introduced. Following the 2004 Government decision not to introduce a carbon tax, SEI has re-focused its work in this area on the development of Energy Management Action Plans and, with the National Standards Authority of Ireland, on a new Energy Management Standard.

Large Industry Energy Network

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

Energy Agreements Programme

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

Fuel Switching

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

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

Process Substitution

Recognising that process emissions from the cement and associated sectors are a significant contribution to emissions, amounting to 2.5 Mt in 2004, the National Climate Change Strategy proposed the development of a negotiated agreement between the industry and Government to stimulate the introduction of lower clinker content cement in Ireland. However, companies within the cement sector are now included in the EU Emissions Trading Scheme, the price signals from which act as sufficient incentive for the introduction of appropriate emissions abatement.

The recent study for Government on greenhouse gas emissions projections[1] also examined cost-effective abatement options available to sectors covered by the EU Scheme and concluded that cost-effective process substitution in cement manufacturing could result in significant reductions in greenhouse gas emissions, if all identified options were fully implemented. It is recognised, however, that it is for individual installations in the Emissions Trading Scheme to achieve emission reductions in the most cost-effective manner available to them.

IPPC Licensing

The 2003 Protection of the Environment Act introduced provisions enabling the EPA to consider greenhouse gas emissions as part of the Integrated Pollution Prevention and Control (IPPC) licensing regime. In addition, the European Commission is preparing general BREF documents[2] on energy efficiency in the context of the IPPC Directive to provide information on the development of best practice for energy systems that are used in a variety of industrial processes.

7.2.2 Fluorinated Greenhouse Gases

The most potent of all greenhouse gases comprise SF6 and the families of gases known as HFCs and PFCs. Collectively known as F-gases, their use has grown more

1 *Determining the Share of National Greenhouse Gas Emissions for Emissions Trading in Ireland 2008-2012,* March 2006, ICF Consulting and Byrne O Cléirigh.

2 Best Available Techniques (BAT) Reference Documents.

then three-fold between 1995 (the base year for these gases) and 2004. Although comprising less than 1% of total emissions in Ireland in 2004, there is an upward trend emissions of F-gases, attributable to increased semiconductor production, refrigeration and air-conditioning. The phasing out of CFCs, for the purpose of complying with the Montreal Protocol on substances that deplete the ozone layer, has also been a factor in increased use of HFCs and PFCs as alternatives.

In some cases, the use of F-gases is unavoidable, given the lack of alternatives to replace ozone-depleting substances being phased out under the Montreal Protocol. A range of options were outlined in the Strategy for the control of F-gases usage. These have been largely overtaken by developments in the industry, such as the introduction of voluntary agreements and regulatory measures at European level, and the strengthening of the IPPC licensing regime.

EU Measures to control F-Gases

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

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

F-Gases Regulation[3]***:*** the regulation provides for a number of measures to control emissions of F-gases. Operators will be required to prevent, detect and repair leakages from a list of specified stationary applications and to maintain adequate records on the quantity of F-gases installed in an application and records related to maintenance, servicing and final disposal. Appropriate arrangements, underpinned by training and certification for relevant personnel, must also be put in place for the recovery and recycling or destruction of gases. Appliances containing F-gases can only be placed on the market if they bear a label indicating the chemical names of these gases and the quantity contained, and stating that they are covered by the Kyoto Protocol. In addition, the regulation introduces prohibitions and other restrictions for certain products containing F-gases. The regulation will apply with effect from 4 July 2007.

3 Regulation 842/2006/EC on certain fluorinated greenhouse gases.

Mobile Air-Conditioning Directive[4] : vehicles with air-conditioning units use a refrigerant known as HFC-134a, which has a global warming potential of 1300 times that of CO_2. Because air-conditioning units in cars have the potential to leak, this directive places restrictions on the types of units fitted to vehicles before they can be approved for sale. Gases with a global warming potential of greater than 150 will be prohibited from use in air-conditioning units from 2011 onwards. The directive also provides for harmonised leak detection tests and limits on the retrofitting and refilling of mobile air conditioning units. The directive amends the European Whole Vehicle Type Approval Directive, which sets out Member States' obligations to achieve compliance with technical requirements before vehicles are placed on the market.

7.3 Options for the future

White certificate schemes

As a market-based mechanism to help improve efficiency of final energy utilisation at least cost, a system of white certificates is a tradable instrument (similar to a credit under the Kyoto Protocol) that represents a quantity of energy saved. Operating under a 'cap and trade' system, companies could be set a target level of energy efficiency to meet, either directly or by suppliers and / or distributors, and may achieve this through implementing energy efficiency improvements or through buying surplus certificates from other companies. The European Commission is currently considering the implementation of such a scheme on an EU-wide basis, linking it to a measurement system under the new Energy End-Use Efficiency and Energy Services Directive. While a white certificate scheme would be likely to enjoy sufficient economies of scope if introduced at the EU level, it may not be feasible to introduce a scheme for Ireland alone given transaction costs and other constraints.

Extension of demand-side energy efficiency programmes

Sustainable Energy Ireland will promote and expand its Energy Agreements Programme to target energy and emissions savings in those companies with large energy consumption that are strongly motivated to address the strategic dimension of their energy dependence. By this means and through the efforts of the existing Large Industry Energy Network, SEI programmes address over 60% of energy use in Irish Industry, much of which falls within the scope of the Emissions Trading Scheme. SEI has developed a web-based Energy MAP demand-side programme that has the scope and potentially the scale to enable small and medium sized companies to structure their efforts effectively. The Government is planning to launch an extensive

[4] Directive 2006/40/EC relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC.

energy efficiency campaign this Autumn, which will be targeted, inter alia, at the SME sector and also put Ireland on a path towards meeting the target set out in the Energy End-Use Efficiency and Energy Services Directive, to achieve one percent savings in energy use annually from 2008. In this context, consideration will be given to what additional incentives and supports might be needed to stimulate the adoption of more efficient energy management practices and technologies in the SME sector.

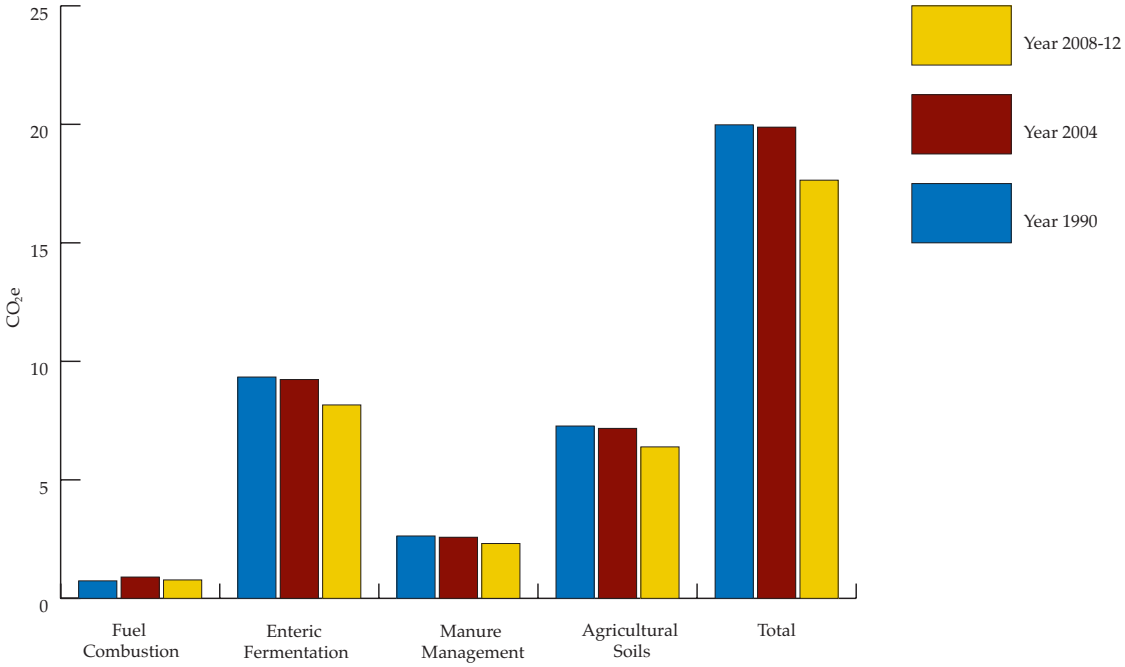

Figure 8.1: Agriculture emissions by source Mt CO_2e

8.1 Trends and projections

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

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

Total emissions from the sector have remained virtually unchanged over the period 1990 (19.979 Mt CO_2e) to 2004 (19.881 Mt CO_2e) although there was as sustained increase in emissions from 1990 to a peak of 22.014 Mt CO_2e in 1998. Substantial reductions have taken place in the period from 1999 to 2004. Emissions are closely linked to livestock numbers and sales of nitrogenous fertilisers and have tended to track these over the period.

Research by the FAPRI-Ireland Partnership[1] in 2003 in light of the reform of the EU Common Agriculture Policy (CAP) concluded that given full decoupling of aid from

[1] Food and Agricultural Policy Research Institute, 'The Luxembourg CAP reform Agreement: Analysis of the Impact on EU and Irish Agriculture,' 2003, www.tnet.teagasc.ie/fapri.

production - the option chosen by Ireland - across the EU 15, emissions from agriculture would decrease to a level 16% below that recorded in 1990. This research was based on full decoupling by all 15 Member States.

In 2006, following a review of these projections and using a more advanced tier two level IPPCC methodology to calculate emissions of methane, overall emissions from the sector are now forecast to fall to an average 17.644 Mt CO_2e per annum, some 12% below 1990 levels, throughout the Kyoto commitment period 2008-2012. The projections assume that full decoupling of agricultural support from production, which began in Ireland on 1 January 2005, should lead to a reduction in livestock numbers, and a consequent reduction in emissions. The analysis takes account of the precise level of decoupling that will operate in all EU Member States but excludes reform of the EU sugar regime. The analysis does not include the effect of a World Trade Organisation agreement as part of the Doha round, as the shape of any such agreement remains unknown.

8.2 Policies and Measures

8.2.1 Overview

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

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

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

8.2.2 Common Agricultural Policy

The National Climate Change Strategy proposed a reduction in methane equivalent to a 10% reduction in livestock numbers below business as usual 2010 projections, with an appropriate balance to be maintained between direct reductions in livestock numbers and reductions in methane emissions per animal.

The decision by Government to adopt full decoupling of direct payments from production will result in significant reductions in emissions from the sector. A new direct payment scheme, the Single Farm Payment Scheme, was introduced on 1 January 2005 to replace the Livestock Premia and Arable Aid Schemes. The introduction of this scheme provides greater freedom to farmers to make production decisions that more closely correspond with market signals. This will incentivise farmers to improve efficiencies of inputs. Recipients of the single payment must be in compliance with five statutory environmental management requirements (SMRs) as well as other SMRs, and maintain land in 'Good Agricultural and Environment Condition' (GAEC).

8.2.3 Policies to reduce emissions per animal

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

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

Suckler Cow Premium

Additional eligibility criteria facilitated a reduction in the average age of the suckler herd and the number of calves born by allowing an increasing number of heifers to be eligible for payment. Increasing the number of heifers (younger animals) eligible for payment should have had the effect of reducing methane emissions per animal.

Animal Husbandry

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

Animal diet

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

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

8.2.4 Manure management and agricultural soils

Environmental Legislation

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

Rural Environmental Protection Scheme (REPS)

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

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

REPS Planners are now required to identify areas suitable for forestry during preparatory work for REPS plans, identifying farm areas appropriate for afforestation on environmental, agricultural, forestry and socio-economic grounds. This will continue to be the case for the programming period 2007 to 2013 and REPS participants wishing to avail of forestry initiatives will be fully accommodated. The new Rural Development Regulation, coming into effect on 1st January 2007, also provides for additional payments to beneficiaries who undertake forest-environment commitments beyond the existing requirements. The Department of Agriculture and Food is examining ways to utilise this new provision so that afforestation on REPS farms can be made more attractive

Good Farming Practice

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

EU Nitrates Directive

The introduction of Regulations (SI no. 788 of 2005) to implement the EU Nitrates Directive, places limits on the amount of livestock manure which may be applied to land. It also stipulates the timing and method of application and sets requirements on the storage and management of manures. The Regulations, which came in force on 1 February 2006,[2] set down legal maximum limits for fertiliser applications (organic and chemical) based on stocking rate, crop requirements and soil type. This will lead to more efficient use of nitrogenous fertiliser and to a reduction in N_2O emissions.

8.3 Options for the future

With the full decoupling of agricultural support from production, the overall size of herd numbers, as the main determinant of emission levels, will be largely determined by market forces, subject to the constraint of ensuring environmental sustainability.

Improved slurry spreading techniques

An evaluation of strategies to control ammonia emissions from the land spreading of cattle slurry is being undertaken under the Department of Agriculture and Food's Research Stimulus fund. The use of the "trailing shoe" method of slurry spreading could provide reductions of emissions as it encourages greater uptake of nitrogen by the soil, consequently reducing the amount of supplementary chemical nitrogen that might be required. Currently, higher grant aid of 40% is available to encourage and promote the use of "trailing shoes," compared to the grant assistance of 20% which applies to all other slurry spreading equipment. This method is, however, expensive and therefore the Department continues to grant-aid low trajectory splash plate slurry spreaders so as to maximise slurry spreading capacity. This is necessary if more slurry spreading is to be carried out during the spring, which is the optimum time for nitrogen up-take. Further reductions of emissions from slurry spreading would require soil injection of slurry. This method is expensive and is not always a practical proposition when soil type, soil conditions and crop type are taken into account.

[2] Certain aspects of the Regulation are under review as of May 2006. Any amendments would be subject to European Commission approval.

Support for bio-energy crops

The bio-energy market is very much demand-led and dependent on reliable markets for products. The Government will shortly publish the report of the Bioenergy Strategy Group which analyses in detail the potential for the development of bio-energy, with particular focus on the potential contribution of the agricultural sector. Greater uptake of bio-energy crop production by the agricultural sector will not lead to reduced greenhouse emissions in the agriculture sector, but will contribute to efforts to reduce fossil fuel consumption, particularly for space and water heating, across all sectors of the economy.

The new schemes to support the installation of renewable heat technologies in the commercial and residential sectors provides a strong underpinning for the development of a wood chip biomass infrastructure. These schemes complement existing supports for bio-energy crops such as the energy crops scheme, which provides a payment rate of €45 per hectare for qualifying energy crops. Crops receiving aid under this scheme will be used for the production of biofuels or the generation of electric and thermal energy. The aim is to replace the use of fossil fuels and reduce CO_2 emissions. The Scheme complements the excise relief on the production or supply of biofuels introduced in the 2006 Finance Act.

As part of the EU Strategy for Biofuels, it is intended to review the operation of the Energy Crops Scheme during 2006. Plans are also in train for a grant scheme for the planting of short rotation coppice willow. It is envisaged that such a scheme would be eligible under the current Rural Development programme but would not qualify for annual premiums because of the short rotation period involved (less than 15 years).

Alternative carbon-neutral fuel sources

The use of meat and bone meal, tallow, forest thinnings from the timber industry and short rotation willow coppice as alternatives to fossil fuels in electricity generation or in industrial and commercial scale combustion has the potential to reduce carbon dioxide emissions. While reduced emissions from the use of such carbon-neutral fuel sources would be attributable to the energy or industry sectors, it is recognised that a cross-sectoral approach is required in developing the supply of such carbon-neutral alternatives to fossil fuels.

Deployment of renewable energy technologies at farm level

Various options already exist to stimulate the use of renewable energy technologies on farms. Further initiatives to promote the installation of such technologies will be investigated in the context of existing programmes in support of renewable energy

technologies. A restructuring of excise relief for marked gas oil / biodiesel could reduce agriculture-related fuel combustion emissions. Such a restructuring would also have a relevance to emissions in other sectors of the economy that use marked gas oil, such as off-road vehicles in the construction industry.

Manure management through the use of new and emerging technologies

The Department of Agriculture and Food has recently launched a Farm Waste Management Technology Demonstration Scheme to support the demonstration of new technologies and to help the agriculture sector meet the requirements of the Nitrates Directive. There are a number of financial and technical obstacles to the extensive use of anaerobic digesters, for example, and therefore the Scheme will seek to examine the potential for new and emerging technologies for the treatment of livestock manures, in particular from the pig and poultry sectors.

The Farm Waste Management Technology Demonstration Scheme will provide funding of up to €4 million to support, at a grant rate of 40%, a maximum of 10 demonstration projects for emerging technologies including fluidised bed combustion (suitable for burning poultry litter) and treatment plants comprising of anaerobic/aerobic digestion/processing systems. One of the aims of the scheme is to examine the potential for such technologies to produce energy for consumption on-site or for sale to the national grid.

One obstacle to the development of anaerobic digestion in Ireland is that the current legislation prohibits the spreading on pasture land of digestate from an anaerobic digestion plant where the feedstock used consists of animal by-product containing protein. This restricts the availability of the optimum feedstock required to make the digestive process feasible. The Department of Agriculture and Food is currently reviewing these restrictions.

Agricultural soils - optimisation of nitrogen use

Chemical fertiliser nitrogen is an important input on grassland farms and an important factor determining the demand/supply of nitrogen on these farms is the livestock-stocking rate. Usually, the higher the stocking rate, the greater the requirement for nitrogen in order to produce more grass. Current livestock grazing systems result in some of the potential nutrient value of fertiliser being lost from the agricultural system. Improved farming practices, resulting in better utilisation of nutrients, have the potential to reduce nitrogen applications without significant impact on output levels. The use of nitrogen in the most efficient and environmentally sustainable manner should therefore be maximised, whether this is achieved through nutrient management plans or codes of good farming practice.

When used in association with grass, clover has the capacity to provide nutritionally balanced forage. Because of its nitrogen fixing capacity, it also has the potential to reduce the need for chemical nitrogen fertilizer on grazed grassland without affecting the sward quality. The potential to reduce nitrogen input by increased use of nitrogen fixing plants in grassland is well known. However, such systems have not proved popular with farmers, for several reasons. Significantly, circa 90% of the grassland in Ireland is permanent with less than 3% of the total area being reseeded annually. Therefore, the potential to introduce modern high yielding varieties of clover is limited. A further difficulty relates to the persistence of the clover in swards, the need to reduce stocking rates in order to maintain animal performance and the difficulties of matching forage supply to animal requirements across the grazing season. For these reasons it is considered that increased usage of white clover does not have the potential to make a significant contribution to reducing nitrogen usage in the short term.

Nevertheless, one consequence of decoupling has been to remove the need for less intensive farmers to maximize production. The Government will explore ways in which such farmers could be encouraged to increase their use of grass clover mixtures.

Minimum tillage systems

In recent years there has been considerable discussion on the merits of minimum tillage systems (sometimes referred to as eco-tillage) compared to traditional plough based systems. These minimum tillage systems involve the incorporation of straw after harvesting by means of shallow cultivation and the sowing of the subsequent crop without ploughing. Thus, fuel usage arising from sowing is reduced. It is also suggested that it improves the soil organic matter content and soil structure and that there may be some reduction in chemical nitrogen requirement. In these ways it could reduce the level of greenhouse gas emissions from agriculture. Some research has been carried out to show that yields can be maintained in eco-tillage systems, but further work will be pursued by the Department of Agriculture and Food to evaluate the impact on fuel usage, fertiliser usage and other tillage crop inputs as well as defining other management parameters for such systems

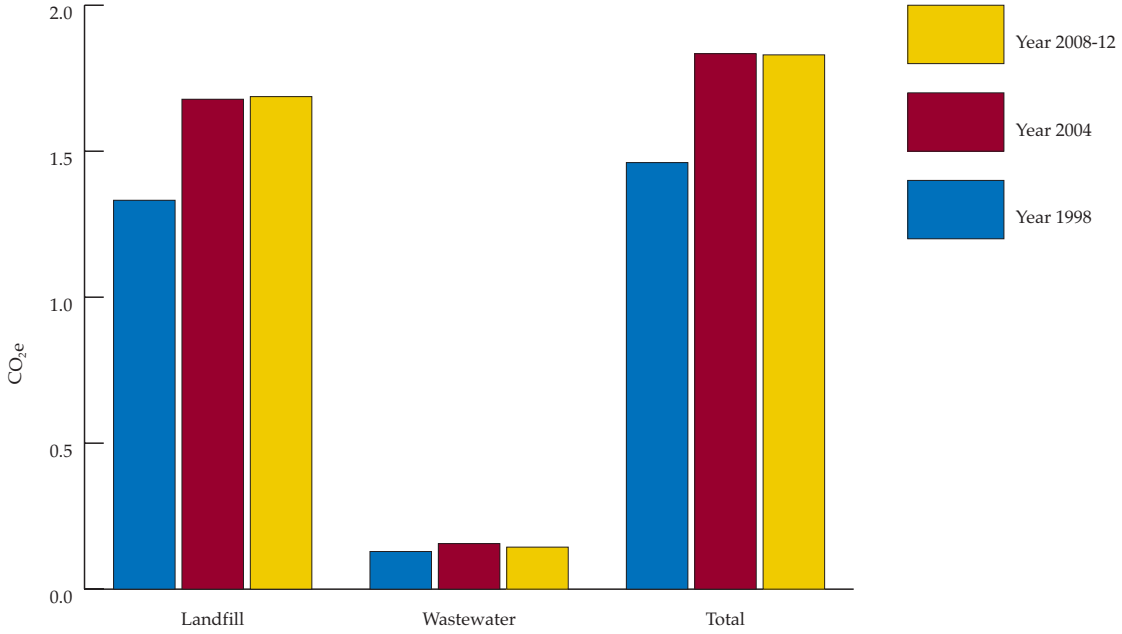

Figure 9.1: Waste emissions Mt CO_2e

9.1 Trends and Projections

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

Emission forecasts compiled by the Department of the Environment, Heritage and Local Government for the waste management sector have been prepared on the basis of both historical records and future estimates of waste arisings, together with past management practices and the future management objectives that are set out in the National Strategy on Biodegradable Waste and which will be given practical effect through the Regional Waste Management Plans. The calculations assume the

implementation of Regional Waste Management Plans and that target levels for diversion of municipal biodegradable waste away from landfill will be achieved. Average emissions from the sector, including landfill and wastewater are projected at 1.83 Mt per annum by 2012, up from 1.46 Mt per annum in 1990.

9.2 Policies and Measures

National policy is to regard waste as a resource. This is reflected in our commitment to developing a recycling society. It is also reflected in the Government giving priority to incineration with energy recovery over landfill for dealing with residual waste.

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

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

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

Diversion of biodegradable waste from landfill

The deposition of biodegradable waste in landfill produces methane, with the potential for generation of gas being determined by the amount of degradable organic carbon in wastes, which in turn depends on the quantity and composition of the waste material present. Gas production in landfill occurs predominantly over a 21-year period and is greater in well-managed landfill sites where the potential for aerobic decomposition is more limited. Ireland is obliged under the EU Landfill Directive[1] to ensure that no more than 35% of 1995 levels of biodegradable municipal waste is landfilled by 2016.

Ireland's approach to achieving this target is set out in the *National Strategy on Biodegradable Waste*. Published in April 2006, the Strategy sets out the Government's approach to reducing the amount of biodegradable municipal waste (BMW) going to landfill and encouraging measures aimed at the prevention, recycling and recovery of biodegradable municipal waste. The Strategy requires that 80% of projected arisings of biodegradable municipal waste be diverted from landfill by 2016 and is based on the integrated waste management approach established as Government policy since publication of the national policy framework document *Changing Our Ways* in 1998. Under this approach, the preferred options for dealing with biodegradable municipal waste, based on the internationally recognised waste hierarchy, are:

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

Renewable Energy from waste - landfill gas capture

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

In addition, landfill gas accounts for the majority of the currently installed 28 Mw of generation from biomass, including 4 Mw of capacity at the Ringsend waste water

[1] Directive 99/31/EC

treatment plant, opened in 2004. The level of landfill gas capture is increased through the implementation of the technical requirements of the Landfill Directive, and utilisation for electricity generation is supported by Government policies and incentives aimed at increasing the penetration of renewable electricity in Ireland. The new Renewable Energy Feed-In Tariff support scheme includes price supports of up to €70 per MwH for landfill gas electricity generation. However, the technical upper limit of 50% on the amount of landfill gas that can be recovered will ultimately limit the greenhouse gas mitigation potential of this measure.

Role of local authorities

Local authorities have particular responsibilities in relation to waste management and play a key role in the implementation of the greenhouse gas emission reduction measures proposed for the waste sector through:

- adoption of best international practice in implementing modernised waste management practices, as set out in the national policy framework document *Changing Our Ways;* including vigorous implementation of Waste Management Plans and the introduction of use-related charges for both commercial and domestic waste.
- Installation of landfill gas recovery systems.

9.3 Options for the future

Climate change considerations have been integrated into the range of recent national policy documents, in particular the *National Strategy on Biodegradable Waste*, published in 2006. Full implementation of these strategies will enable the potential contribution of the waste sector to be maximised.

10. Sinks

10.1 Trends and projections

Kyoto Protocol parties may offset sequestration of CO_2 from afforestation against their emissions targets under the Protocol. There are two Articles under the Kyoto Protocol that enable the use of domestic forest sinks by parties with reduction commitments. Article 3.3 is confined to afforestation (planting of new forest) and deforestation, since 1990. Article 3.4 - comprising a number of activities such as cropland and grazing land management in addition to forest management - is confined to activities in forests that existed before 1990.

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

10.2 Policies and Measures

Afforestation Programme

One of the aims of Ireland's forest policy is to encourage planting by providing an annual premium to farmers and land owners that compensates for income foregone from conventional farming, and the long pay back periods associated with forestry. Ireland has had, on a per capita basis, one of the most intensive afforestation programmes in the developed world since 1990, funded jointly by the Government and the EU, under successive accompanying measures to CAP reform. Since 1990, some 244,000 hectares have been afforested, with deforestation of approximately 1,500 hectares over the same period. Despite this rate of planting, however, Ireland remains one of the least forested countries in the EU. At the end of 2004, the national forest estate stood at 680,000 ha. This represents about 10% of the area of the country, compared to the 35% average throughout the other EU Member States.

Integration of REPS and forestry

As discussed in chapter 8, the administration of REPS requires planners to identify farm areas appropriate for afforestation. As an important contributor to carbon sequestration, new ways of promoting greater synergy between REPS and forestry are being examined with a view to increasing the level of afforestation on REPS farms

10.3 Options for the future

Development of domestic forest energy markets

Policies aimed at promoting renewable energy (in the form of heat and electricity) from biomass will create a market for thinnings and residues (both in-forest and from saw-milling). Research is required to develop effective production methods. Furthermore, policy to encourage the development of production, processing and marketing infrastructure will be required if forest energy is to compete effectively against fossil fuels.

Government support for increased rates of afforestation

Government and EU policy has an important role to play in the rate of afforestation through grant aid to private forestry. While rates of afforestation have slowed to around 10,000 hectares per annum in recent years, this still represents one of the most vigorous afforestation programmes in Europe. A full review of forestry strategy is underway and will be completed in 2006.

Sink potential of Article 3.4 Activities

Article 3.4 of the Kyoto Protocol provides for sequestration from activities involving agricultural soils, land-use change and forestry. Further research will be required to establish whether the potential of grasslands to act as sinks could be verified and used to offset national greenhouse gas emissions. While Ireland will not benefit from any potential emissions reductions arising from grassland sinks in the Kyoto commitment period 2008 – 2012, sequestration from Article 3.4 activities may prove valuable in future commitment periods.

11. Conclusion

11.1 Summary of key points

In response to the overwhelming scientific evidence of human induced global warming and its consequences, the Government supports the international effort being made under the United Nations Framework Convention on Climate Change to reduce greenhouse gas emissions. The Government welcomes the coming into effect of the Kyoto Protocol and, for the purpose of ensuring the wellbeing of present and future generations, is committed to taking the steps necessary to ensure that Ireland meets its emissions limitation target for the purposes of the Protocol.

In support of the ultimate objective of the UNFCCC, the fundamental aim of national policy on climate change is progressively to lower the carbon intensity of the economy, without undermining economic competitiveness or social progress.

As well as the environmental benefits of lowering the carbon intensity of the economy, the Government is conscious of the need, from a security of supply point of view, to broaden the fuel base on which society and economic activity depend.

The international effort to tackle human-induced climate change, as well as an increasing focus on non fossil-based fuels in terms of security of supply, present new opportunities for innovation, development and growth.

In its approach to the short-term objective of meeting Ireland's target for the purposes of the Kyoto Protocol, the Government is seeking to find the best balance between reducing domestic greenhouse gas emissions and using the flexible mechanisms established in the Kyoto Protocol to purchase credits arising from emissions reductions elsewhere in the world. In principle, domestic emissions reductions are preferable, in view of the medium and longer-term benefits of lowering the carbon intensity of the economy.

Use of the flexible mechanisms provided for under the Kyoto Protocol will be supplementary to domestic actions and will be underpinned by the principles set out in Chapter 1.

A three-year pilot phase of the EU Emissions Trading Scheme commenced in January 2005. A review of the scheme has commenced and a broadening of its scope is expected. Anticipating also that the operation of the trading scheme will extend beyond 2012, the Government will be aiming, based on experience gained in the pilot phase, to identify the optimum circumstances in which to realise the potential offered by the Scheme.

The Government aims to achieve an appropriate balance in the relative effort expected of each sector to national emission reductions. Some options to achieve further reductions in greenhouse gas emissions have relatively high costs associated with them but may be justified in pursuit of the national objective of lowering the overall carbon intensity of the economy.

The Government recognises that local and regional authorities have a role in the mitigation of greenhouse gas emissions and in adaptation to the climate change that is already happening; the latter will become increasingly important as the effects of current and historic emissions manifest themselves in the short to medium term.

At this point in time, national climate change policy does not encompass Joint Implementation (JI) or similar domestic offset schemes. However, there may be benefits to providing an option for such schemes in the future.

Ireland supports and will participate constructively in international efforts to find agreement on further greenhouse gas emission reductions, in pursuit of the overall objective of the UNFCCC, in the period post-2012.

11.2 Invitation to participate

All interested parties are invited to comment on any aspect of this review paper, as an input to the preparation of a new National Climate Change Strategy.

RESPONSES

Submissions should be marked "National Climate Change Strategy Review Consultation" and sent, not later than 30 September 2006, to:

Air Quality and Climate Change Section
Department of the Environment, Heritage and Local Government
Custom House
Dublin 1

or (preferably) by e-mail to: climatereview@environ.ie

It is intended that submissions received will be published on the Department's website.

Glossary

Adaptation (to climate change) The taking of measures to cope with the effects of climate change, rather than the action taken to reduce emissions.

Anaerobic decomposition/digestion The breakdown of organic materials in the absence of air (oxygen). CH_4 is a by-product, either vented to the atmosphere or used as an energy source

Anthropogenic Human induced as a result of human actions.

Base year The year against which commitments under the Kyoto Protocol are measured. Emissions levels in 1990 set the basis for determining the national limitation target of 13% (a base year of 1995 will be used for F-gases).

BAT Best Available Techniques under the EU Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC).

BMW Biodegradable Municipal Waste

CAP Common Agricultural Policy (of the EU).

CDM Clean Development Mechanism

CH_4 Methane. The second most significant greenhouse gas. Naturally occurring and also arising from human activity.

CHP Combined Heat and Power. The waste heat from electricity generation is put to another useful purpose.

Climate change The global climate system is subject to natural variation. In the context of the UNFCCC and Kyoto Protocol, what is meant is that change in climate attributable to human activity arising from the release of greenhouse gases into the atmosphere and which is additional to natural climate variability.

CO_2 Carbon Dioxide. The main greenhouse gas arising from human activities, and also naturally occurring. Atmospheric concentrations have risen from about 280ppm prior to the industrial revolution to about 380 ppm now.

CO_2-efficient (generally fuels). Those that release less CO_2 per unit of energy generated than others.

Natural gas is more "CO_2 efficient" than coal, as carbon is a lesser constituent of natural gas and less CO_2 is released than in the combustion of coal to produce the same energy output.

CO_2-equivalent Where gases other than CO_2 are referred to, for comparison purposes these are converted to their equivalence in global warming terms to CO_2. See GWP. Sequestration rates of carbon are quantified in terms of CO_2 removed from the atmosphere.

COFORD National Council for Forest Research and Development.

Combined Cycle Gas Turbine (for electricity generation). Electricity is generated from both the gas turbine (akin to a jet engine) and from the waste heat.

Comhar The National Sustainable Development Partnership. The terms of reference for Comhar are to advance the national agenda for sustainable development, to evaluate progress in this regard, to assist in devising suitable mechanisms and advising on their implementation, and to contribute to the formation of a national consensus in these regards.

Commitment period The Kyoto Protocol provides that Parties' targets are to be achieved over the 5-year period 2008 – 2012 (the "first commitment period"). Targets for future commitment periods (post 2012) are yet to be negotiated.

Common and coordinated (in an EU Context). Common policies are policies and measures requiring common action across all Member States, usually on foot of an initiative by the European Commission. Coordinated policies and measures are those where common action is not required, but where benefits accrue through Member States taking action on a joint basis.

COP Conference Of the Parties to the UNFCCC, which meets annually. The 12th Conference (COP12) is to meet in Nairobi in November 2006.

Cross-sectoral Pertaining to more than one, or many, sectors of the economy.

Demand Side Management In the energy sector, the management and reduction of energy use through incentives and other measures to reduce and/or manage more efficiently customer demand for energy.

DTO Dublin Transportation Office.

Emissions trading In the context of the EU Emissions Trading Scheme or the flexible mechanisms of the Kyoto Protocol, this refers to the buying and selling of allowances to emit a defined quantity of greenhouse gases or credits that represent a quantity of greenhouse gas emissions already reduced.

ENFO The Environmental Information Service. ENFO is a public information service on environmental matters, providing public access to wide-ranging and authoritative information on the environment. ENFO was established in September 1990 and is a service of the Department of the Environment and Local Government. Website: http://www.enfo.ie/

Enteric fermentation That part of the digestive process in ruminant animals (cows, sheep) where bacteria and other gut flora convert parts of the grass to a usable form for the animal; CH_4 is a by product and expelled from the animal.

EPA Environmental Protection Agency. Website: http://www.epa.ie

Flexible mechanisms See Kyoto mechanisms.

Fossil fuel Peat, coal, fuels derived from crude oil (e.g. petrol and diesel) and natural gas are called fossil fuels because they have been formed over long periods of time from ancient organic matter. All contain varying amounts of carbon, and in the recovery of energy from the fuel through combustion in the presence of air, the carbon combines with the oxygen to form CO_2, which is vented to the atmosphere.

Fuel Bunkering Also known as 'fuel tourism' this refers to fuel that is bought within the State by private motorists and hauliers but consumed elsewhere.

GDP Gross Domestic Product.

Global Warming Potential See GWP

Gothenburg Protocol (1999) To the 1979 Convention on the Long-Range Transportation of Air Pollution to Abate Acidification, Eutrophication and Ground-Level Ozone. The Gothenburg Protocol requires reductions in emissions by 2010 in SO_2, NOx, Volatile Organic Compounds and Ammonia.

Greenhouse gas A gas in the atmosphere that freely allows radiation from the sun through to the earth's surface, but traps the heat radiated back from the earth's surface towards space and reradiates it back to the earth's surface. The heating effect

is analogous to the manner in which the glass of a greenhouse traps the sun's radiation to warm the air inside the greenhouse. Most greenhouse gases occur naturally and are a necessary part of the global climate system, but their concentrations can be increased by human action, causing climate change.

GWP Greenhouse gases have different efficiencies in retaining solar energy in the atmosphere and also have different lifetimes in the atmosphere, before natural processes remove them. To compare the different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWP) over a normalised time horizon, giving a measure of their relative heating effect in the atmosphere. The 100 year time horizon (GWP100) is the one generally used and that provided for in relation to the Kyoto Protocol. The IPCC (1995) has developed these GWPs; all are expressed as GWP100:- CO_2 is the basic unit. (GWP of 1). CH_4 has a global warming potential equivalent to 21 units of CO_2, i.e. a GWP of 21. N_2O has a GWP of 310. Compounds in the HFC family have GWPs in the range 140 to 11,700. PFCs have GWPs in the range 6,500 to 9,200. SF_6 has a GWP of 23,900.

HCFCs Hydrochlorofluorocarbons. A family of ozone depleting substances whose use is controlled under the Montreal Protocol on Substances that Deplete the Ozone Layer (1987, as amended). While HCFCs are also greenhouse gases, they are excluded from the UNFCCC and Kyoto Protocol as their use is controlled under the Montreal Protocol.

HFCs Hydrofluorocarbons. See Industrial gases.

HGV Heavy Goods Vehicle.

Industrial gases The three non-natural greenhouse gases and gas families. HFCs Hydrofluorocarbons), PFCs (Perfluorocarbons) and SF_6 (Sulphur Hexafluoride). These are more potent than the naturally occurring greenhouse gases and did not exist in the atmosphere before the industrial age. There are a number of individual HFCs and PFCs within these "families" of gases.

IPPC Integrated Pollution Prevention and Control, in the context of licensing under the Environmental Protection Agency Act, 1992.

IPCC Intergovernmental Panel on Climate Change. This is the authoritative scientific source on human interference with the global climate system. Website: http://www.ipcc.ch

JI Joint Implementation

kt Kilotonne (1,000 tonnes). 1,000 kt = 1 Mt

Kyoto mechanisms The three flexible measures that are provided for in the Kyoto Protocol viz. Emissions Trading, JI (Joint Implementation) and the CDM (Clean Development Mechanism).

Kyoto Protocol The second international agreement (1997) on climate change, setting binding limitation and reduction targets for developed countries. It is a protocol to the UN Framework Convention on Climate Change. Website: http://www.unfccc.int. Text of Protocol at http://www.unfccc.int/resource/convkp.html

LEAs Local Energy Agencies

Modal Shift In the transport sector, move from the use of one mode of transport to another (e.g. greater use of public transport, rather than private cars for commuting).

Montreal Protocol On Substances that Deplete the Ozone Layer (1987, as amended). Imposes bans and controls on emissions that damage stratospheric ozone. See CFCs and HCFCs.

Mt Million tonnes.

MW Megawatt = 1,000 kilowatts.

MWe Megawatts of electricity.

NDP National Development Plan 2000 – 2006.

N_2O Nitrous Oxide. The third most important greenhouse gas. Naturally occurring and also arises from human activity.

"No regret" measures Policies and measures which achieve immediate savings; where savings can be made on the basis of returns in investment at, or better than, commercial rates; or where adaptation to maximize emissions reductions and limitations is made to policies and measures necessary for other reasons.

NOx Nitrogen Oxides, viz NO (Nitrogen Oxide) and NO_2 (Nitrogen Dioxide). These are not greenhouse gases and are to be distinguished from N_2O. NOx is implicated in

acidification and other air pollution effects. Not controlled by the Kyoto Protocol, but significant reductions below 1990 levels are to be achieved under the Gothenburg Protocol. NOx is a by-product of fuel combustion and measures implemented to control greenhouse gases from combustion require integration with measures to reduce NOx.

NRA National Roads Authority.

OECD Organisation for Economic Cooperation and Development.

Party A country that has signed or ratified the UN Framework Convention on Climate Change or Kyoto Protocol, as appropriate. The EU is also a Party.

PFCs Perfluorocarbons. See Industrial gases.

ppm Parts per million.

Probiotics A live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance.

PSO Public Service Obligation. An obligation placed on utility undertakings (generally in the energy sector) which takes account of general social, economic and environmental factors.

REPS Rural Environment Protection Scheme.

Sequestration (of carbon) The removal of CO_2 from the atmosphere and the storage of the carbon, generally by growing plants (e.g. by the fixing of carbon in the organic compounds which make up the body of a tree). It can include storage of carbon in associated soils and litter. Non-organic mechanisms for carbon sequestration are not considered by the Strategy.

SEI Sustainable Energy Ireland. The national agency for energy efficiency and renewable energy information, advice and support.

SF_6 Sulphur Hexafluoride. See Industrial gases.

Sink The reservoir in which sequestered CO_2 is stored, e.g. forestry. There are a number of natural sinks for CO_2 (e.g. the oceans, the natural biosphere) but sequestration by natural mechanisms is not relevant to the Kyoto Protocol.

SMEs Small and Medium-sized Enterprises.

SO_2 Sulphur Dioxide. Implicated in acidification and other air pollution effects. Not controlled by the Kyoto Protocol, but significant reductions below 1990 levels are to be achieved under the Gothenburg Protocol. SO_2 is a by-product of the burning of many fossil fuels and measures implemented to control greenhouse gases require integration with measures to reduce SO_2.

UNFCCC UN Framework Convention on Climate Change, the first international agreement (1992) on action to tackle human-induced climate change. Website of the secretariat: http://www.unfccc.int. Text of Convention athttp://www.unfccc.int/resource/convkp.html

VRT Vehicle Registration Tax.

Appendix 1. Options for Additional Measures

Energy

Co-firing in power generation
CHP / distributed generation and heating
Micro CHP
Wave / ocean energy
Carbon capture and storage
Promotion of efficient energy use by energy suppliers

Transport

Demand Management
Intelligent transport systems
Public awareness
Fuel Tax Measures
Rebalancing VRT and annual motor tax
Company Car Tax

Built Environment and Residential

Providing a framework for housing policy in Ireland
Improving the quality of social housing
Tighter energy efficiency standards in the Building Regulations
Support for innovative design and construction technologies
Continued switching to less-CO_2 intensive fuels

Industry, Commercial and Services

White certificate schemes
Extension of demand-side energy efficiency programmes

Agriculture

Improved slury spreading techniques
Support for bio-energy crops
Alternative carbon neutral fuel sources
Deployment of renewable energy technologies at farm level
Manure management through the use of new and emerging technologies
Agricultural soils – optimisation of nitrogen use
Minimum tillage systems

Sinks

Development of domestic forest energy markets
Government support for increased rates of afforestation
Sinks potential of Article 3.4 Activities

Appendix 2. Emissions reduction strategies by emissions source

Fossil Fuel Combustion

- Demand Side Management
- Increased Fuel Efficiency
- Waste Reduction
- Fuel Switching
  - Less Carbon Intensive Fuels
  - Renewable Energy
- Carbon Capture

Agricultural Production

- Activity Levels
  - Stocking Density
  - Usage of Nitrogenous Fertiliser
- Production Methods
  - Animal Husbandry
  - Manure Management
  - Grassland and Crop Management
  - More Effective Usage of Nitrogenous Fertiliser
- Carbon Sequestration

Industrial Process and 'F' Gases

- Industrial Process
  - Product Substitution
  - Decomposition to Gases with Lower Global Warming Potential
- 'F' Gases
  - Product Substitution
  - Leakage Reduction
  - Decomposition to Gases with Lower Global Warming Potential
- Carbon Capture

Waste Management

- Reduced Landfill
- Application of Waste Hierarchy
- Decomposition to Gases with Lower Global Warming Potential
  - Energy Production
  - Flaring