Chapter 8

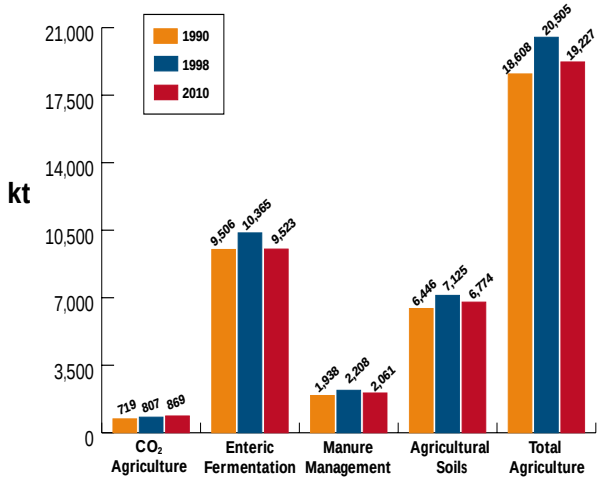
Agriculture

EMISSIONS/PROJECTIONS FOR AGRICULTURE SECTOR

The agricultural sector represents 5.2% of GDP, 8.7% of employment and 7.2% of exports[16]. Three quarters of the land area of Ireland is used for agriculture and forestry, and over 80% of the area under agriculture is devoted to grass, with beef and milk production currently accounting for 68% of gross agricultural output.

Agricultural emissions of greenhouse gases are very significant in the Irish context. Greenhouse gas emissions in 1990 from the agricultural sector were 34.6% of total national emissions, the highest of all sectors. Agriculture was responsible for 84.1% of CH_4 emissions in 1990, expected to rise to 90.1% by 2010 and 78.7% of N_2O emissions in 1990 (expected to be 77.4% in 2010). The high GWP of these gases, at 21 times and 310 times that of CO_2 respectively, means that their weight within the overall basket of gases increases accordingly. For most developed countries, with a higher proportion of economic wealth arising from heavy industry and less from agriculture, CO_2 represents approximately 80% of the basket of gases. For Ireland, with a comparatively greater proportion of economic production from agriculture, CO_2 represented 58.7% of the national basket in 1990, with CH_4 and N_2O representing 40.8%.

GRAPH 6 BREAKDOWN OF GREENHOUSE GAS EMISSIONS FROM AGRICULTURE (fossil fuel combustion (CO_2 Agriculture) ruminants (Enteric Fermentation), manures, and soils (Agricultural Soils) FOR 1990, 1998 AND 2010 PROJECTIONS



Business as usual projections predict that agricultural emissions will increase during the period 1990 to 2010 by 3.3% in aggregate. Ruminant emissions (enteric fermentation), manure management and emissions from soils will increase by 0.2%, 6.3% and 5.1% respectively. Given the projections of significant increases in CO_2 and industrial gases in this period, the overall agriculture contribution is expected to fall to 25.6% of the basket of emissions by 2010.

The main sources of agricultural emissions are enteric fermentation (ruminant digestion), responsible for 51.1% of total emissions from agriculture, and agricultural soils and manures which are responsible for 34.6% and 10.4% respectively of emissions from the sector (1990 data). Cattle are the dominant source of CH_4 from ruminant digestion, and while emissions are directly linked to the size of the national herd, opportunities also exist to reduce the levels of emissions per animal. The quantity of nitrogenous fertiliser spread, and the breakdown of this in the soil, are the main determinants of the amount of N_2O emitted from agriculture.

MEASURES TO CONTROL GREENHOUSE GAS EMISSIONS

A critical challenge for this Strategy is to balance the environmental objective of greenhouse gas emissions reductions with the economic and social objective of protecting farm income and maintaining the highest possible number of farm households.

Policy Reform at EU level

Policy formulation at EU level, in the context of the post-Agenda 2000 arrangements in particular, will afford an opportunity to consider matters of financial support for agreed common and coordinated policies and measures to address greenhouse gas emissions. Ireland will support appropriate proposals at EU level seeking necessary adjustments to CAP mechanisms to pursue climate change abatement action through further integration of environmental considerations into agriculture policy. In this regard, it will be emphasised that reductions in greenhouse gas emissions from the agriculture sector are more important for Ireland than for other Member States in meeting national targets.

[16] 12.7% of GDP, 11.8% of employment and 12% of exports if agri-food sector is included - this covers agriculture, food, drinks and tobacco.

Reduction of Methane (CH_4) from National Herd

Reflecting the central position of cattle production enterprises in Irish agriculture, CH_4 emissions from ruminant animals constitute roughly one fifth of Ireland's total emissions of greenhouse gases, greater than greenhouse gas emissions from power generation. Reductions in this area could have a significant impact on Ireland's total emissions.

The main contributors of CH_4 from ruminant animals (1990) are cattle (86.8%) and sheep (12.6%), with 80.0% of emissions from cattle coming from non-dairy herds. Total cattle numbers have risen significantly between 1990 and 1999 (15.2%), within which the suckler herd increased by 66.4%. Business as usual projections are for numbers to decline from the 1999 level by 2010 (5% drop for total cattle numbers) but total numbers will be still above 1990 levels (+9.6%).

The **objective** will be to secure CH_4 reductions of 1.2 Mt CO_2 equivalent in emissions from livestock. These will be achieved by reducing stock numbers below business as usual expectations for 2010, on the basis that the required CH_4 reduction is equivalent to a reduction of 10% in livestock numbers over the period. An appropriate balance will be maintained between direct reductions in stock numbers to be achieved based on current EU policies and coupled with extensification and other management measures in REPS, and intensification of the range of the measures identified for the agriculture sector as well as any further appropriate measures applied following dedicated research, and demonstrating equivalent greenhouse gas emissions reductions. Such measures will be applied on a least cost basis to contribute towards meeting the overall 1.2 Mt CO_2 equivalent target. Progress will be subject to a two yearly review.

In the development of the programme of reductions of CH_4 from livestock, a number of criteria will be met, including: -

- maintenance of the maximum number of family farms and meeting the requirements of small and low-income farm families;
- identification of viable alternative enterprises to supplement farm income and alternative employment opportunities within the rural environment; and
- measures to improve the sustainability of agricultural systems, including the promotion of organic farming (including the necessary supports for training, marketing, processing and distribution).

Government policy for the development of agriculture, food and rural development is set out in a range of policy statements and programmes which include the *National Development Plan 2000 – 2006; Ensuring the Future – A Strategy for Rural Development in Ireland – a white paper on Rural Development;* the *Programme for Prosperity and Fairness;* and the *Agri-Food 2010 Plan of Action.* The action taken to deliver the targets proposed in the Strategy will build on existing policy requirements and the need for consultation as appropriate including with the farming social partners. The arrangements flowing from the Agenda 2000 Agreement provide the basis for the principal supports for agriculture over the coming years. Negotiations for the post-Agenda 2000 period are expected to commence by 2006, and should provide an opportunity to consider further responses to climate change.

The measures and programmes outlined above will be developed by the Department of Agriculture, Food and Rural Development in partnership with the agriculture sector in the context of the overall need to coordinate measures through the Inter-Departmental Climate Change Team.

For each one percentage point change in overall 2010 stock numbers in the cattle herd, emissions increase or decrease by 0.12 Mt CO_2 equivalent. The direct costs of reductions at farm level are estimated at £90 – £95 per tonne CO_2 equivalent (1999 prices), and direct costs including upstream and downstream industries are estimated to be of the order of £150 per tonne CO_2 equivalent. These costs do not, however, include synergies with other policy priorities (e.g. the capacity to convert additional land to forestry production), nor the economic return at farm level from other alternative land uses for the land freed from cattle production. Furthermore, as reductions will be achieved through the adaptation of existing agriculture schemes (e.g. REPS), further CAP reform and a reduction of land available for agriculture through the expansion of the forestry programme, net costs of measures to reduce CH_4 emissions specifically will be considerably below this.

Reduction in Emissions per Animal

A research programme will be undertaken by Teagasc to identify feeding regimes, appropriate to Irish conditions, that reduce CH_4 emissions from individual animals. The objective will be to reduce the level of emissions per animal, while maintaining productivity levels. While in some respects the technologies to achieve significant reductions are at an early stage of development, there are good grounds for targeting up to 0.5 Mt CO_2 equivalent of the overall greenhouse gas reduction from the national herd on the basis of appropriate research projects on technologies to reduce emission factors being funded and facilitated as a priority. It is recognised that the full achievement of this element of the CH_4

reduction will not be available in respect of the full commitment period, and the full target is to be achieved by 2012. The following list of measures with potential to reduce emissions per animal will be prioritised in research: -

- use of feed additives;
- probiotics and engineering;
- changes in level of concentrate feeding;
- changes in the system of cattle production with a focus on finishing at a younger age; and
- improved feeding and management at farm level.

CH_4 emissions reductions per animal would also be significantly facilitated by adjustments to CAP support measures to encourage lower stocking intensity levels by reaching slaughter age earlier; Ireland will seek these adjustments in the medium term.

The ongoing review of this Strategy will incorporate appropriate measures identified by the research where the reductions potential is quantified and the measures involved are subsequently applied.

Fertiliser Use

Total nitrogen applied to soils has increased by 7.2% between 1990 and 1999, and on a business as usual basis, is expected to further increase by 2010 to 10.7% above 1990 levels. Current livestock grazing systems are very inefficient in the use of both chemical and organic nitrogen. Significant quantities are lost to the atmosphere as nitrous oxide (N_2O) (and also ammonia (NH_3), a contributor to local and transboundary air pollution). There are losses also to surface waters and groundwaters, contributing to water pollution. These, and the consequential environmental damage, are unsustainable.

N_2O emissions arising from nitrogenous fertiliser spreading will be reduced by 10% below the business as usual levels expected for 2010, with a consequential emissions reduction of 0.9 Mt of CO_2 equivalent. This reduction in N_2O emissions, based on reduced fertiliser use, will be supplemented by a number of measures, including:-

- adjustments to the requirements of support schemes. Under the CAP Rural Development Plan 2000 – 2006, farmers participating in the agriculture measures covered by the Plan other than REPS (Compensatory Allowances and Early Retirement), and in a number of other Schemes including On-Farm Investment and Farm Waste Management, will be required to follow Good Farming Practice which is defined in the Plan. This will include a requirement to conform with Teagasc recommendations on nutrient management (including proper use of nitrogen and chemical and organic fertilisers), and to comply with the 1996 Code of Good Agricultural Practice to Protect Waters from Pollution by Nitrates. Farmers participating in REPS itself will be required to follow a farm nutrient management plan to REPS specifications (which are higher than those in the Code) for the total area of the farm;
- use of slow release inhibitors;
- efficient recycling of slurry and dirty water;
- the use of slurries and manures in weather and ground conditions which maximise the uptake of nitrogen by the soil and plant growth (including restrictions in the application of chemical nitrogen and animal waste applications in the September to January period);
- growing of more forage maize and incorporation of slurry into the soil (ploughing in farmyard manure and slurry); and
- bandspreading of animal waste.

The full impact of these measures remains to be quantified by appropriate research and application. Combining the reduction of 10% fertiliser use with the additional measures identified, N_2O emissions could be reduced by up to 0.9 Mt CO_2 equivalent below the business as usual projections by 2010.

The option of utilising taxation on artificial fertilisers will be kept under review in light of the success of the management measures set out above.

Strengthen Relationship with Forestry Policy

A change in land use arising from the conversion of agricultural land from animal production to forestry ensures a double dividend: - a reduction of CH_4 and N_2O emissions and additional sequestration of carbon from the atmosphere. To the extent that this evolution of agriculture policy is driven by climate change considerations, enhanced sequestration of carbon will be a valuable part of the response of the agriculture sector.

The administration of **REPS** now places greater emphasis on forestry as an option. The Rural Development Plan 2000 – 2006, covering both REPS and Forestry, includes a proposal for the integration of the two measures to ensure coherence and to maximise environmental benefits including carbon sequestration. For all applications, it is proposed that the assessment at farm level by REPS planners will include identification of land suitable for productive afforestation. Any such areas will be notified to the Forest Service. The necessary training and guidance will be given to REPS planners on the criteria to be applied on prioritisation of land use between forestry and agriculture. Such criteria will include landscape, biodiversity, pollution control, carbon sequestration, wildlife and productivity/suitability of land for forestry and agriculture.

The Departments of Agriculture, Food and Rural Development and Marine and Natural Resources will continue to review and adjust, as necessary, the conditions for payment of REPS premia, and restructure premia in respect of afforestation, to underpin the attractiveness of suitable forestry development and avoid negative competition between agriculture and forestry. In the context of a mid-term review of REPS in three years' time, the Departments will review the possibility of encouraging more afforestation on the projected 70,000 farms participating in the Scheme.

The current estimate is that on average these 70,000 farmers will afforest about one hectare of land each by 2010 as part of a planned afforestation programme. The carbon sequestration to be achieved specifically within the agriculture sector, in addition to the sequestration to be achieved within the national forestry programme (see Chapter 9), is predicted to be 0.25 Mt CO_2 equivalent. Due to the necessity to adopt a conservative approach to the calculation of afforestation as a Kyoto sink pending finalisation of the international negotiations at COP6, the calculation of this target will be reviewed by the Inter-Departmental Climate Change Team in 2001.

Extensification and Set-Aside

The potential for developing short-rotation biomass for energy generation as an alternative land use where animal numbers are reduced, and for set-aside land, will be developed in conjunction with the renewable energy programme. Biomass is carbon-neutral in the energy cycle, and it will be developed in a manner that reduces greenhouse gas emissions overall. Life-cycle analysis will be undertaken in each case to ensure that any emissions arising from the farming practices employed (soil disturbance, fertiliser use, harvesting and transport) are less than would have occurred from conventional land uses and energy sources.

Animal Waste

Animal wastes have been identified by the European Commission as technologically the most promising area for reducing CH_4 emissions in the agriculture sector, although the proportion of agricultural emissions from this source is relatively small. The use of anaerobic digesters with energy recovery will be integrated with measures to promote renewable energy, on an individual enterprise basis where appropriate through IPC licensing, or where greater quantities are required, on a community or other combined basis (e.g. in association with the treatment of municipal waste). There is significant potential for synergies with other policy priorities, (e.g. improved nutrient management, reduced odour problems, support for rural development and displacement of fossil fuels from electricity production). However, there are a number of technical and financial barriers to the extensive use of anaerobic digesters, and in the implementation of the Strategy, these will be explored by the relevant Government Departments with interests in promoting bioenergy production in order to remove any unnecessary obstacles to the deployment of the technology at farm and community level.

Best Practice Guidelines

The 1996 *Code of Good Agricultural Practice for the Protection of Waters from Pollution from Nitrates*, while introduced with the aim of reducing water pollution, includes recommendations on best practice in the use of chemical nitrogenous fertilisers which would if followed have the effect of reducing N_2O emissions. Participants in the agriculture measures under the CAP Rural Development Plan 2000 – 2006 (except REPS which has specific standards) will be required to meet specified standards of *Good Farming Practice* reflecting legislative and other requirements in a number of areas including nutrient management. These standards will be kept under review during the period of the Plan and will be amended as necessary to reflect legislative changes and other relevant developments, including climate change requirements.

IPC Licensing

Intensive agriculture is subject to IPC licensing; the requirement to use Best Available Techniques (BAT) under the EU IPPC Directive will ensure that all appropriate preventive measures, including CH_4 and energy recovery from manures, are fully taken in enterprises subject to these controls.

International Emissions Trading

The potential modalities for trading of emissions from the agriculture sector will be kept under review and pursued by Ireland in the context of the finalisation of the arrangements for international emissions trading. The Government recognises that this instrument may provide an additional mechanism to deliver on the reduction targets set for the agriculture sector.

TARGETS FOR THE AGRICULTURE SECTOR

Reduction of CH_4 from national herd	
Objective	1.2 Mt CO_2 equivalent
of which Feeding Regimes	0.5 Mt CO_2 equivalent, in a longer term perspective (by 2012 and beyond) depending on outcome of research programme, and at some cost savings, as many lower emission feeding regimes are profitable in their own right
Fertiliser Use	0.9 Mt CO_2 equivalent
On-Farm Forestry Sequestration	0.25 Mt CO_2 equivalent
Manure Management	0.06 Mt CO_2 equivalent
TOTAL	**2.41 Mt CO_2 equivalent per annum**

While **costs** could be of the order of **£100m p.a.**, the total cost to the sector will depend on the balance of measures implemented to reflect the overall limitation commitment for the sector and may be offset by increased income from alternative land uses. The actions for the sector meet other policy objectives and costs will be assigned proportionately.

Chapter 9

Sinks

EMISSIONS/PROJECTIONS FOR SINKS

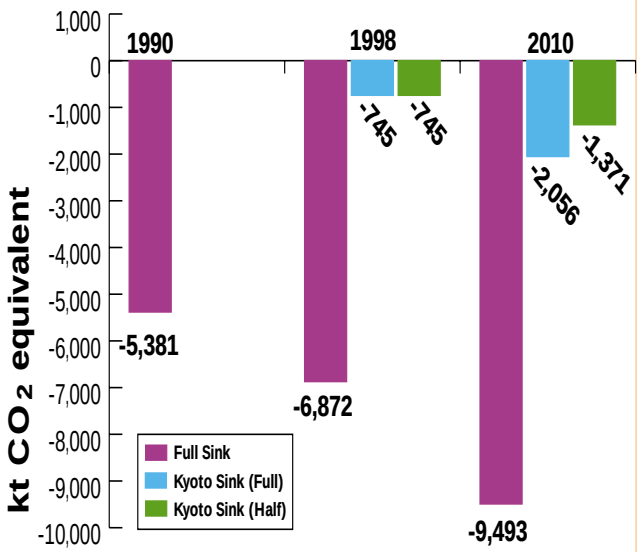
Approximately 9% of Ireland's land area, the smallest proportion in the EU, is covered by forest. The afforestation programme outlined in *Growing for the Future, A Strategic Plan for the Development of the Forestry Sector in Ireland* sets national planting targets of 20,000ha per annum from 2001 to 2030, doubling forest land cover to 17%. Due to various constraints only around half the planting programme (planned at 25,000ha per annum to 2000) has been achieved in the past number of years.

Irish climatic and soil conditions are very suitable for rapid tree growth, notably for certain species of conifer, and the rate of timber production is significantly higher than elsewhere in Europe and on a par with the most favourable conditions in the world. Sitka spruce has one of the highest growth rates of any tree species in Europe and is a highly efficient storer of carbon. It is recognised that from the biodiversity perspective, forest policy should favour broadleaves to the greatest extent possible, and that the current 20% target for planting of broadleaves is inadequate. The reduction of Sitka spruce planting to 60%, as outlined in the *Strategic Plan*, represents the sector's commitment to achieving increased biodiversity, albeit at some cost to forest production. Just over half the national forest stock is owned by Coillte Teoranta, the State forestry company. Significant support is now being given to planting by the private sector, and planting by the private sector now exceeds that by Coillte.

Under the Kyoto Protocol, carbon sequestration by the forestry stock arising from afforestation, deforestation and reforestation activities since 1990, i.e. the planting/deforestation programme since this date may be counted towards meeting Ireland's net greenhouse gas growth limitation target.

Methodologies for accounting for forestry sequestration under the Kyoto Protocol have not yet been agreed. As a number of significant questions regarding the methodologies for incorporating sinks into the Kyoto Protocol process have been raised in the *Special Report on Land Use, Land Use Change and Forestry* by the IPCC[17], published in June 2000, a conservative approach has been taken to calculating total sequestration rates for the purpose of the sector's overall contribution to the Kyoto commitment. However, by 2010, it is estimated that for the likely methodologies, the sequestration rate of forestry (above-ground woody mass only) planted under the *Growing for the Future* Strategy will be 2.1 Mt CO_2 equivalent per annum by 2010, assuming full achievement of the target. If only half the programme is implemented, the sequestration rate will be 2/3rds this, at 1.4 Mt CO_2 equivalent[18].

GRAPH 7 FORESTRY SEQUESTRATION (TOTAL SEQUESTRATION, AND UNDER KYOTO PROTOCOL) FOR 1990, 1998 AND 2010 PROJECTIONS



[17] Summary for Policymakers is available at http://www.ipcc.ch/pub/reports.htm
[18] For the purpose of counting the national forestry sink, a further reduction of 50% to is conservatively assumed take account *inter alia* of the low rate of sequestration while forestry stocks are under 20 years of age.

ENHANCING GREENHOUSE GAS SEQUESTRATION

Review Forest Strategy

The overall aim of *Growing for the Future is* "to develop forestry to a scale and in a manner which maximises its contribution to national economic and social well-being on a sustainable basis and which is compatible with the protection of the environment". However, *Growing for the Future* was prepared prior to the Kyoto Protocol, and it will now be reassessed to ensure that the issues associated with carbon sequestration, and in particular timing, are fully taken into account in its implementation. The forestry planting rate must be maximised as early as possible prior to the commencement of the commitment period, as growth rates, and hence sequestration, are fastest in the middle years of the forestry cycle.The implications for rural development and the sustainability of rural communities will also be taken into account in the review and implementation of *Growing for the Future*.

In assessing the relative economic benefits of the forestry programme and REPS and other agriculture support schemes which impinge on the programme, the economic benefits of enhanced carbon sequestration will be taken into account. Account will also be taken of the relative benefits of forestry planting on different soil types: - e.g. planting on poor quality mineral soils is preferable, from an overall carbon uptake perspective, to planting on peat soils, and these soils are also least suitable for modern agricultural practices.

The recently commissioned state-of-the-art Geographic Information System (GIS) will help to identify areas suitable for forestry while highlighting potentially contentious afforestation sites, in areas such as riparian zones, National Heritage Areas (NHAs), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). This will ensure that all future forestry developments will be analysed for compatibility with the requirements of sustainable forestry practice.

The *Irish National Forestry Standard* and the *Code of Best Forest Practice* issued by the Forest Service of the Department of the Marine and Natural Resources establish the framework for adherence to the principles of Sustainable Forest Management (SFM). They provide a mechanism for the complementary assessment of the implications of climate change and other environmental constraints on forestry. The Forest Service has also issued a suite of *Environmental Guidelines* describing, for forest owners, managers and their staff, the range of measures necessary to conform to best practice in forestry management and implementation of SFM.

Virtually 100% of afforestation in Ireland is grant-aided and all grant recipients must conform to the *Environmental Guidelines*. Adherence to these Guidelines by forestry developers is mandatory, with the Forest Service Inspectorate ensuring compliance. All grant-aided plantations are inspected to ensure that they achieve full stocking and the production levels (and thus carbon sequestration levels) assumed in growth and yield models. Furthermore the Forest Inventory and Planning System (FIPS) ensures that the current annual volume increment and standing wood volume are continuously updated.

The scope for **intensification of the afforestation programme** for the Kyoto and successive commitment periods will also be assessed, in view of the ongoing importance of enhancing sinks capacity towards reducing overall greenhouse gas concentrations in the atmosphere and assisting in meeting longer term greenhouse gas reduction requirements.

The above reassessment will also examine the options for planting a higher proportion of faster growing and/or shorter rotation forestry crops e.g. poplars, willows and some other species which have a greater uptake rate over a shorter period. Short rotation forestry is being examined on a pilot basis, and it is recognised that additional levels of integration are required for success, involving cooperation between different interests. Care will also be required to ensure that the equilibrium storage of carbon over several rotations is as great as that arising from the current planting mixture in the forestry programme.

Research and Development

Extensive forest R&D is carried out with an overall objective to increase quality and productivity from all species – and to ensure cost effective and sustainable practices. An important feature of current research programmes is the identification of appropriate native sources of broadleaf planting stock, as the bulk of the expanded broadleaf planting programme is based on imported stock which may not be best suited to Irish conditions. The inclusion of additional criteria, such as meeting biodiversity obligations, reduces somewhat the potential that would be available to sequester carbon if high-yield conifers only were planted. However, conservation of biological diversity may be one of the most effective, practical responses to climate change; conservation of this biological diversity at all levels (e.g. from genes

within species to the array of habitat types across the landscape) will permit natural species to adapt as their environment changes.

The research programme will be expanded to contain an element seeking to identify those stocks (and species) which are best suited to maximising the sequestration potential of Irish forests. Further research will also be carried out into the appropriate management techniques, and their dissemination through the forestry sector, to ensure that the additional complexities of the broadleaf sector are provided for and sequestration rates enhanced.

The *National Biodiversity Plan*, in preparation, will also address the requirements of integrating environmental concerns into forestry policy planning.

Additional Categories of Sinks

The Protocol makes provision for the inclusion of additional sinks related to human activities in the agricultural soils and land use change and forestry categories, once the rules, modalities and guidelines for these are agreed at a future Conference of the Parties to the Protocol. These categories must be included in meeting commitments in future commitment periods, and there is an option to include them for the period 2008 – 2012. Analysis of the options and implications for the achievement of the Kyoto Protocol emissions reduction objective in respect of these additional categories have been addressed in the *Special Report on Land Use, Land Use Change and Forestry* by the IPCC.

The relevance of agricultural practices to carbon flows in soils may increase when the methodologies to account for the additional categories are finalised. The Departments of the Marine and Natural Resources, and Agriculture, Food and Rural Development will participate in UN negotiations on this issue, with assistance, as appropriate, from Teagasc, COFORD (the National Council for Forest Research and Development) and 3rd level research institutes. In light of the outcome of the negotiations on additional categories of sinks for the second commitment period, the options for including them in respect of the first commitment period will be addressed at the earliest appropriate time in the context of the ongoing implementation and review of the Strategy.

Inventory Research and Development

Current inventories and projections are only developed for the above-ground portion of the forest stock. Significant amounts of carbon can also be sequestered by root systems and forest litter (possibly 50% more than in woody biomass) but there can be carbon losses from forest soils, especially for forestry planted on peat soils. The recent development of FIPS, which incorporates information on forest soils, is an important resource in determining the full extent of carbon sequestration by the national forest stock. The Department of the Marine and Natural Resources and COFORD, in conjunction with the EPA, will undertake the necessary research to address the shortcomings in the methodologies for inventories and projections, having regard to the developing negotiations on Land Use, Land Use Change and Forestry under the Kyoto Protocol.

TARGET FOR FORESTRY SINKS

This will be very dependent on the outcome of the negotiations on accounting for Kyoto forestry. Assuming the same methodologies as used in determining the EU burden sharing, the **target** (based on full achievement of the forestry programme instead of the c. 50% planting rate over the last few years) would be an additional **0.76 Mt CO_2 equivalent sequestered** in excess of business as usual. Because a conservative approach to the calculations has been adopted pending further progress in the international negotiations at COP6, the calculation of this target will be reviewed by the Inter-Departmental Climate Change Team in 2001.

The **marginal costs** attributable to climate change policy are assumed to be **nil**, as provision is made in the forestry programme for the full programme.

While the forestry sector is an economic actor in its own right, participation in forestry is also an option for other economic sectors, including agriculture and in respect of appropriate land use for cutaway bog at the end of peat removal for electricity or other purposes. In the conversion of land from agriculture (livestock rearing) to forestry there is a double benefit of reduced CH_4 emissions due to the reduction in the national animal herd, a reduction in N_2O emissions due to lower use of nitrogenous fertilisers, and CO_2 uptake through the carbon sequestered in the forestry. In addressing **sectoral equity,** as provided for in Chapter 2, the contribution of these sectors to the forestry programme and the sequestration of carbon in national forest stocks will be taken into account, together with the contribution of the forestry sector itself.

Chapter 10

Role of Local Authorities

NEW FOCUS FOR LOCAL AUTHORITIES

Local Government Reform

Local government is undergoing renewal and reform to meet the needs of the communities it serves more effectively and comprehensively. Strengthened local government will expand its sphere of influence into wider public services and community development. A major Local Government Bill has recently been published and when enacted will modernise and consolidate local government law and provide a sound footing for local authorities to function more effectively. This Bill also provides for greater inclusion of the community in local government and enhances the role of the elected member.

Within the existing framework of local government, decision making structures at political and management levels will be improved through the new Strategic Policy Committee structures. These will enable elected representatives and representatives of sectoral interests to formulate local authority policy in a range of areas including infrastructure and transportation, environmental management and services, housing, social and economic development, energy efficiency and renewable energy. In this regard, new County/City Development Boards led by local government and representative of local decision makers will agree County/City Strategies on Economic, Social and Cultural Development by January 2002.

Local authorities can make an important contribution towards raising awareness and initiating climate change action in local communities. The new structures, within and beyond the traditional framework of local government, will provide an influential, representative local base from which to incorporate climate change abatement considerations into relevant local policies and programmes.

In the development of **performance indicators** to measure the efficiency levels achieved by local authorities, one of the criteria will be the contribution the local authority has made to control and reduce greenhouse gas emissions within their areas of direct responsibility, and towards controls and reductions in their local communities. In addition, energy efficiency targets are set for all public sector organisations, including local authorities, and progress on achievement of these targets will be reported on annually.

Local Energy Agencies (LEAs)

These agencies provide information and advice on energy efficiency and alternative energy at a local level, both for internal local authority functions and also for the wider local community. LEAs make a significant "bottom up" contribution to local authorities' and communities' efforts to reduce emissions from their own activities. Measures have been taken to extend the number of agencies with financial assistance for the first three years from the European Union's SAVE programme. When the EU-funded contracts expire after the first 3 years (for both existing and future agencies), financing will revert to normal block funding arrangements through the Local Government Fund. Agencies have also been asked to pursue local business funding opportunities.

The IEC will support the work of the Agencies with necessary material and technical assistance. LEAs will provide direct assistance to the local authorities including in relation to improving energy efficiency in water, lighting and effluent services, social and private housing, administration buildings, integration of energy planning into the local planning process and the development of renewable energy solutions to problems such as waste management. These measures will, of course, lead to financial savings to local authorities arising from reduced energy consumption. The agencies will also provide independent information, training and technical advice to the wider public on energy efficiency and renewable energy.

One of the conditions for EU assistance to LEAs is the establishment of partnerships with similar agencies and local authorities in other EU and applicant states. The EU SAVE programme also provides ongoing financial support for the exchange of experience in energy efficiency and renewable energy, both through the establishment of networks and through an annual call for proposals for financing of specific projects. These programmes provide local authorities with access to best practice in an EU context.

International Good Practice

Local authorities play a particularly important role in relation to greenhouse gas reductions in a number of sectors, including opportunities in the planning and transport sectors, housing and waste disposal, and in relation to emissions from their own activities. The International Council for Local Environmental Initiatives (ICLEI) has established a global campaign – Cities for Climate Protection (CCP) – to "build a worldwide movement of local governments who adopt policies and implement measures that achieve measurable reductions in local greenhouse gas

emissions; improve air quality; and enhance urban liveability and sustainability". The campaign includes more than 175 local authorities around the world, representing 5% of global greenhouse gas emissions: - the target is to recruit local authorities representing 10% of emissions. Local authorities are mobilised to reduce emissions through the identification of sources and quantification of emissions at local level, the setting of reduction targets, and the development and implementation of Local Action Plans, with regular reports on progress.

The CCP campaign also operates a variety of technical assistance projects that focus on innovative financing strategies for energy efficiency measures in local authority buildings, reducing emissions through effective waste management programmes and land use planning, and tackling emissions from the transport sector. Emissions from all these sectors are dealt with in detail elsewhere in this Strategy; the ICLEI initiative provides an important focus for direct action by local authorities complementing the actions of others.

Dublin Corporation has joined the CCP campaign; other local authorities are encouraged to participate actively in the process to learn from international best practice and adapt local government experience elsewhere to Irish circumstances.

Local Agenda 21

This defines and articulates sustainable development considerations at a local/regional level and identifies how they can best be approached and achieved. Consultation and consensus-building are essential elements of Local Agenda 21. Local authorities have important responsibilities to raise awareness and intensify action in support of sustainable development at local level and are developing and implementing Local Agenda 21 initiatives for their areas, which must of necessity have local ownership. The Local Agenda 21 Officers (networked at regional and national levels) provide a forum for exchanging experience and good practice as well as assisting a coherent implementation of Local Agenda 21 across the various local authorities.

LOCAL AUTHORITIES AND SECTORAL RESPONSIBILITIES

The contribution of local authorities to sectoral responses towards the achievement of the national target is dealt with in previous Chapters e.g. in relation to land use planning, development control, transport, the services sector, housing, energy planning and awareness raising.

Local authorities have particular responsibilities in relation to waste management, the source of 17% of CH_4 emissions in 1990. Accordingly, the potential for greenhouse gas emissions reductions from this source is addressed here.

EMISSIONS/PROJECTIONS FOR WASTE

Emissions from waste contributed 15.6% of CH_4 in 1990, equivalent to 3.9% of the 1990 basket of gases. Achievement of national waste management targets, in particular very substantial diversion of waste away from landfill, should lead to an estimated 80% reduction in CH_4 emissions from landfill by 2015, equivalent to 1.7 Mt CO_2 equivalent.

Emissions of CH_4 from the waste sector arise from the anaerobic decomposition, in landfill, of wastes containing carbon. Up to 50% of this can be recovered from modern landfill in practice, and flared off (converting the CH_4 to CO_2), or used for the production of electricity.

MEASURES TO CONTROL GREENHOUSE GAS EMISSIONS

While the target set for CH_4 reduction is ambitious, it is very necessary to the achievement of Ireland's Kyoto commitment, and desirable for a range of other reasons also.

The marginal cost of achieving a climate change dividend through modernised waste management practice, as set out in *Changing our Ways*, in addition to meeting its primary environmental and other objectives, is minimal. Conversely, lost opportunities for achieving reductions in emissions from the waste sector would require compensatory savings to be identified and obtained elsewhere in the economy, adding to the overall burden for other sectors.

In implementing waste management plans, local authorities will be asked to identify and emphasise the climate change gains, and ensure that these are incorporated into the detailed analysis of

management and treatment options. It will be important that sectors, and the public, currently utilising landfill participate to the fullest extent possible in the diversion of waste from landfill. The business community, for example, is contributing to the achievement of Ireland's targets through the diversion of biodegradable waste from landfill by means of individual efforts to facilitate recovery of paper and similar wastes, as well as support for Repak Ltd., which operates a packaging waste recovery scheme aimed at meeting Ireland's targets under relevant EU legislation.

TARGETS FOR WASTE

These are established in *Changing our Ways*, and are to be achieved over a fifteen year timescale. In this regard, the targets for the Kyoto timescale to 2008 – 2012 are established on the basis of maximising early action and early capacity to capture the "no regret" and least cost options.

A reduction of 60% below 1990 levels in CH_4 emissions deriving from the pursuit of policies and provision of new treatment infrastructure in accordance with *Changing our Ways* should be achievable by 2010. Accordingly, the overall emissions from the waste sector in the commitment period are expected to be **0.85 Mt CO_2 equivalent**, or 1.2% of the basket of gases at that time.

The installation of landfill gas recovery in the period to 2010 will double existing landfill gas generating capacity (from 12 MW to 25 MW installed capacity), giving 200,000 MWh additional electricity per annum. Thermal treatment facilities are expected to provide 500,000 MWh electricity and 360,000 MWh utilisable heat per annum. This energy recovery from landfill and thermal treatment will displace **0.8 Mt CO_2 equivalent** from fossil fuel electricity generation.

Chapter 11

Implementation

IMPLEMENTATION

The Minister for the Environment and Local Government will ensure that the necessary implementation and monitoring mechanisms are put in place to deliver this Strategy. This will involve a high degree of policy integration across major sectoral areas, and detailed coordination of action at a cross-sectoral level.

From Framework to Action

The Government's commitment to move from Strategy to action is set out in Chapter 1. All relevant Government Departments and Agencies will undertake the necessary analytical and other work to develop and implement the many necessary measures indicated in the Strategy to meet our climate change obligation. Staffing and other resources will be required to realise this step, and will be provided by the relevant Ministers and the Government as necessary.

Climate Change Team

The Government has agreed that a cross-Departmental Climate Change Team will be established at a senior policy level to secure early implementation of measures in this Strategy. This team will be assisted by a cross-Departmental/Agency Support Unit comprising environmental, relevant sectoral and economics expertise to underpin the necessary analysis for implementation of specific measures. The Climate Change Team will establish necessary consultative arrangements with Social Partners, and will report to the Environmental Network of Government Departments on a regular basis. The biennial review of the Strategy will also be undertaken by the Team in consultation with Comhar.

Emissions Trading

In the light of the continuing evolution of negotiations on international emissions trading, the Emissions Trading Advisory Group will be invited to continue providing advice and recommendations to the Minister for the Environment and Local Government on how Ireland should be most appropriately positioned to take part.

Analysis and Assessment of Taxation Measures

This will be overseen by the Tax Strategy Group (TSG) (chaired by the Department of Finance). Preparatory work will be undertaken by the Green Tax Group, a sub-group of the TSG also chaired by the Department of Finance. Necessary supporting analysis will be commissioned prior to preparation of proposals for the Tax Strategy Group. The assessment and analysis work of the Groups will be completed in time for introduction of appropriate initial measures in Budget 2002.

Costs and Benefits of Measures

For each sector, the ***costs*** of undertaking action are identified in the Strategy in broad terms, together with the reductions in greenhouse gas emissions. This process does not in all cases quantify the economic ***benefits*** of taking action, either at a national economic level or at a sectoral level (e.g. efficiency improvements that improve the profitability of enterprises, competitiveness and employment opportunities). Gains also arise in synergies with other major policy objectives (e.g. improved security of energy supply through greater use of renewable energy, reduced environmental damage through better controls on the use of nitrogenous fertilisers). Neither do anticipated implementation costs at a sectoral level include the costs of inaction (e.g. the costs of adaptation to climate change, or future costs of non-compliance with the Kyoto Protocol). In the implementation of specific measures, a full quantification of the costs and benefits at a sectoral level will be undertaken.

Indicators

To assist in monitoring implementation, a robust and comprehensive set of indicators will be developed within the next year, at a sectoral and national level, under the aegis of the Climate Change Team. The primary consideration will be to measure progress towards meeting the Kyoto commitment and preparation for adopting more ambitious targets in the post-Kyoto period. Progress will be measured against the specific greenhouse gas emissions reductions targets at a sectoral level throughout this Strategy.

A range of recognised indicators is already utilised in the energy sector, and these will be expanded as necessary to provide measurements for all sectors and gases. Emphasis will also be placed on synergy with indicator series being utilised for other policy purposes. The range of indicators to be measured will include: -

- sectoral and total annual emissions of greenhouse gases;
- annual emissions reductions attributable to sectoral and to cross-sectoral policies and measures;
- energy efficiency at economy and at sectoral levels, including the degree of decoupling of economic growth from growth in energy consumption and other sources of greenhouse gas emissions;
- impacts on international competitiveness;
- cost-effectiveness and economic efficiency of measures; and
- progress towards sustainable development.

The indicators will be compared to the best international benchmark indicators for efficiency and greenhouse gas emissions performance.

Poverty Proofing

In assessing measures, full regard will be had to their contribution towards **achieving social justice and overcoming social exclusion.** Where measures are assessed as having the potential to operate against the National Anti Poverty Strategy (NAPS), compensatory approaches will be sought to offset or overcome these effects, and where appropriate, to support the overall objectives of the NAPS.

Implementing Revenue Recycling

Some of the policies identified will generate an additional stream of income, which will be recycled, through reductions in other forms of taxation, such as taxes on labour, and compensatory arrangements for sectors of society least able to bear additional costs, including through the Social Welfare Code. The full mix of policies will seek to ensure that no sector is significantly disadvantaged overall, but that all will have a greater discretion to make choices that minimise greenhouse gas emissions.

COMMUNICATING THE STRATEGY

Public awareness of climate change and public identification of the necessary action must be heightened. The Minister for the Environment and Local Government will undertake a specific campaign to address awareness, and underline the need for support for the Strategy across the economy and society. The necessary initiatives will include awareness campaigns, measures on education and information provision. These actions will be supported by the EPA, ENFO, the IEC, and Comhar. Specifically, the environmental awareness campaign, *The Environment – It's Easy to Make a Difference*, will place an emphasis on the importance of taking action now to meet the challenge of climate change, and identify a broad range of actions at the level of the individual that will contribute to reducing emissions. Further avenues to achieve behavioural change at the individual level will include further incorporation of education for sustainable development in relevant curricula; relevant utilities and sectors will also be encouraged to emphasise the underlying message on the need for climate change action in their own advertising. Comhar will develop more detailed proposals for a communications strategy as part of the Strategy implementation.

REVIEW

The Strategy will be subject to regular, biennial review, to monitor performance and assess whether additional action is necessary to meet Ireland's target. The first such review will be undertaken in 2002 by the cross-Departmental Climate Change Team in consultation with Comhar.

Particular attention will continue to be paid to the identification and implementation of further "no-regret" policies, to give maximum protection to the economy overall and to contribute towards reducing greenhouse gas concentrations in the atmosphere.

The Strategy will also be subject to review and analysis at international level, under international reporting requirements and the system of in-depth reviews carried out on country reports of activities under the Convention and Protocol, and ultimately under the Protocol compliance regime.

It will, in addition, require substantial review once commitments for the period after 2012 are negotiated.

Requirements regarding data gathering and analytical work to support this ongoing review process are set out below.

SUPPORTING MEASURES

Inventories

Inventories are prepared by the EPA, in conformity with the IPCC Guidelines, on the basis of activity data supplied by relevant Government Departments (energy balances, agriculture statistics, etc.), the census of industrial production, communications from individual emitters (e.g. industrial gases), etc. Not all activities are reported, and while the quality of the inventory is good, it is subject to ongoing improvement. For example, the national conversion factors for some activities, especially in the agriculture sector, have been developed from inadequate research. The reporting requirements under the Kyoto Protocol will be significantly more rigorous than those currently applicable under the UNFCCC, including more transparency and completeness in the inventories for the base years (1990 for all gases except the industrial gases, 1995 for these gases) and subsequent years.

Projections

Projections of greenhouse gas emissions are prepared by the EPA on the basis of projections of future activities supplied by the sources providing data for the inventories. The activity data are based on sectoral assumptions of future policy development (prepared separately in relation to energy, industrial (process), agriculture, forestry activities); it is not always clear that these assumptions are compatible with each other or compatible with macroeconomic forecasts adopted by the Department of Finance, nor are the projections always clearly developed to include expected policy developments at EU level.

An improvement in the quality of projections and their regular availability will be essential in assessing progress towards the achievement of this Strategy and identifying the need for any intensification of policies and measures or adoption of additional policies and measures.

Actions

- EPA capacity to meet the reporting requirements of the Kyoto Protocol will be developed, and the EPA will identify areas of priority research to be undertaken by other agencies (e.g. Teagasc). The Agencies involved will give priority to greenhouse gas emissions research. Under the RTDI and the Environment Measure of the Productive Sector Operational Programme 2000 – 2006, it is anticipated the EPA will shortly place contracts for research on emission factors; impacts of land use and land use change on carbon emission/fixation; inventory development and improvement; and impacts and indicators of climate change.

- The sectoral disaggregation of emissions has been identified as inadequate to meet the ongoing analytical requirements associated with sectoral contributions to limitations and reductions. Work necessary to achieve the breakdown of the underlying activity data to the level required will be undertaken as a priority, to be completed within 12 months.

- In order to meet the requirements of the Kyoto Protocol to make demonstrable progress by 2005, additional inventory capacity will be developed to show the "with measures"[19] and the "without measures"[20] emissions trajectories.

- In tandem with, and in the same timescale as the improvements in inventory provision already identified, improved projections of greenhouse gas emissions will be developed, including the quantification of "with measures" and "without measures" options, clearly indicating the quantification of the impact of the measures being undertaken and any need for additional measures. The assumptions underlying all projections will be made explicit.

- The Minister for the Environment and Local Government will establish a users' group of those preparing the inventory data and those who require the output for the purposes of ongoing analysis, to assist in the development of improved inventories and projections.

[19] "With Measures" inventories will be those reported under the Convention and Protocol.
[20] "Without Measures" will indicate reductions below business as usual of the measures undertaken in this Strategy. Under EU proposals for the development of concrete ceilings to the amount of emissions reductions that may be achieved using the flexible mechanisms, the extent that they may be used could be related to the extent of domestic action undertaken.

Appendix 1

Science and Impacts

SCIENCE OF CLIMATE CHANGE, AND IMPACTS OF EXPECTED CHANGES

Expected Extent of Climate Change

For the IPCC mid-range emissions projection in the Second Assessment Report (1995), **global temperature** is expected to increase by 2°C by 2100 above 1990 levels, within a range of approximately 1°C to 3.5°C. The average rate of warming will probably be greater than any seen in the last 10,000 years.

Average **sea level** is expected to rise as a result of thermal expansion of the oceans and melting of glaciers and ice-sheets. The mid-range projection is about 50cm from the present to 2100, within a range 15cm to 95cm.

In the case of both temperature and sea level, these are expected to continue to increase beyond 2100 even if equilibrium is achieved in the interim in greenhouse gas concentrations.

Warmer temperatures are expected to lead to a more vigorous hydrological cycle; this translates into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places. There is a possibility of an increase in precipitation intensity, suggesting a possibility for more extreme rainfall events.

There is still uncertainty related to climate change projections: - future unexpected, large and rapid changes in complex systems such as the global climate system (as have occurred in the past) are, by their nature, difficult to predict, and this implies that future climate changes may also involve "surprises". The *possible* rapid changes of particular significance to Ireland include a substantial reduction in the strength of ocean circulation (including the Gulf Stream) in the North Atlantic.

Global Implications

The IPCC has examined the impact of global climate change at a regional level. In general, it is clear that those countries that will be least in a position to meet the necessary adaptation costs are most vulnerable to the impacts of climate change and that global efforts to alleviate poverty and starvation will be greatly hampered. Vulnerability to climate change depends both on the sensitivity to climate change and the ability to adapt to these changes. A highly vulnerable system is one that is highly sensitive to modest changes in climate, where there is the potential for substantial harmful effects, and where the ability to adapt is severely constrained.

At a global level, and assuming a continuation of business as usual, without achievement of the stabilisation of greenhouse gas concentrations at levels equivalent to 550ppm to 750ppm CO_2,[21] the following broad results may be expected by the end of the 21st century.

- Substantial dieback of tropical forests and grasslands (including to desert) can be expected; the release into the atmosphere of the carbon stored in these ecosystems will add to overall concentrations, accelerating climate change. Temperate forests are expected to be more resilient, with an increase in vegetation biomass expected.
- Substantial decreases in water resources are expected in Australia, India, southern Africa, most of South America and Europe, and the Middle East, but increases in North America, central Asia, and eastern Africa.
- Cereal yields can be expected to increase slightly in mid and high latitudes (Canada, China, much of Europe), but the decreases in yields in Africa, India, and the Middle East are likely to more than offset these slight increases. It will be noted that the analysis that shows potential for yield increases does not fully take account of the effects of climate change in particularly vulnerable areas and the effects of extreme climate events (increases in the incidences of floods and droughts).
- The annual numbers of people flooded is expected to increase from approximately 15 million per annum to 90 million, mainly in southern and south eastern Asia (including India, Bangladesh, Burma, Thailand, Vietnam, Indonesia and the Philippines), but including also eastern Africa, Middle Eastern and North African coasts and western Africa. Some low-lying oceanic islands can be expected to become almost uninhabitable. Coastal wetlands are very sensitive to sea level rise, in particular rapid rise, as their location is intimately linked to present day coastlines.
- Global human health can be expected to be reduced through the greater spread of vector-born diseases, including up to 300 million more people at risk from malaria.

Even if stabilisation of greenhouse gas concentrations at appropriate levels can be achieved in timescales sufficient to prevent dangerous anthropogenic interference with the climate system, ongoing human-induced climate change can be expected to continue, possibly for some centuries, as certain changes lag behind changes in the atmosphere for some considerable time. Accordingly, even if emissions were rapidly to be stabilised at near-current levels, certain changes in climate may be inevitable because of the lag period: - many changes to the climate system are expected to take place as a result of the historical increase in greenhouse gas emissions over the last 2 centuries.

[21] Stabilisation of greenhouse gas emissions at twice the pre-industrial levels of CO_2 (i.e. at c. 550ppm) is envisaged in scenarios to be necessary to prevent dangerous anthropogenic intervention in the global climate system.

Appendix 2

Gases, Inventories and Projections

GASES, INVENTORIES AND PROJECTIONS

Some greenhouse gases are relatively more potent at retaining solar energy in the atmosphere than others and consequently can have different effects on the climate system. Greenhouse gases also have different lifetimes in the atmosphere. To compare the different greenhouse gases, emissions are calculated on the basis of their Global Warming Potential (GWP) over a 100 year horizon, a measure of their relative heating effect in the atmosphere: -

- CO_2 is used as the basic unit (GWP of 1);
- CH_4 has a global warming effect equivalent to 21 times that of CO_2, i.e. a GWP of 21;
- N_2O has a GWP of 310; and
- the compounds included in the HFC and PFC families, and SF_6, have GWPs ranging up to 23,900.

GREENHOUSE GASES

Carbon Dioxide (CO_2)

CO_2 emissions derive largely (93.7% in 1990) from energy use, i.e. fuel combustion as an energy source for electricity generation, transport, industry, commercial and residential sectors. Emissions also arise from some industrial processes, primarily cement production, fertiliser manufacture (ammonia) and lime manufacture.

In the base year, CO_2 represented 58.7% of the basket of 6 gases. This had increased to 63.3% of net emissions by 1998, and is projected to rise to 69.6% by 2010[22]. The relative growth of CO_2 in the basket is due to the projected increase in energy use in the period 1990 to 2010 (78.8% increase in TPER), against a business as usual expectation of an 3.3% increase in emissions from agriculture (96.5% of emissions in 1990 from the sector were non-CO_2).

The sectoral sources of CO_2 in 1990, 1998 and 2010 are set out in Table A2.1 below.

There are significant increases in emissions in a number of sectors. The very large increase in transport emissions is due to a number of factors including rising vehicle numbers (almost 75% increase in private vehicles 1996 to 2010) and the increase in travel kilometres undertaken (over 100% increase expected between 1996 and 2010).[23] This is despite the 25% increase in fuel efficiency of the new vehicle fleet expected from the agreement between the EU Commission and vehicle manufacturers between 1996 and 2008.

The expected decreases in the proportion of total emissions from industry (excluding process emissions) in the period to 2010 is due to the greater use of more efficient fuels such as gas and a decrease in the energy intensity of industrial production.

Table A2.1 ('000 tonnes)

Sectoral Breakdown CO_2	1990		1998		2010	
Energy Industries	11,057	35.0%	15,047	37.6%	18,250	35.5%
Residential	6,752	21.4%	6,447	16.1%	6,470	12.6%
Transport	4,961	15.7%	8,768	21.9%	13,645	26.6%
Industry & Const	3,833	12.1%	3,917	9.8%	4,030	7.8%
Commercial/Instit	2,314	7.3%	2,775	6.9%	3,975	7.7%
Ammonia Production	989	3.1%	1,058	2.6%	1,058	2.1%
Cement	750	2.4%	1,000	2.5%	3,000	5.8%
Agri/Forestry/Fishing	660	2.1%	752	1.9%	835	1.6%
Lime Production	191	0.6%	192	0.5%	75	0.1%
Solvents	67	0.2%	71	0.2%	36	0.1%
Totals	31,575	100.0%	40,028	100.0%	51,373	100.0%

Sources: EPA (Inventories 1 March 2000; Projections 9 June 2000).

[22] All projections for 2010 in this Appendix are in accordance with Table A2.4.
[23] External Evaluator Report 26 *Update of Forecasts of Vehicle Numbers and Traffic Volumes* (DKM Economic Consultants March 1998), and compatible with *Study of Environmental Impacts of Irish Transport Growth and of Related Sustainable Policies and Measures* (Oscar Faber December 1999).

Methane (CH_4)

In 1990, 84.1% of all CH_4 emissions derived from the agriculture sector (principally enteric fermentation in ruminant animals and manure management), with 13.9% from waste (landfill gas); the remaining 2% came from energy-related emissions (energy, transport, residential and industry). Substantial reductions in CH_4 emissions from landfill are expected through the implementation of the waste management policies in *Changing Our Ways*.

CH_4 represented 23.9% of all emissions in the base year; this had decreased to 21.3% by 1998 and it is expected to decrease further to 16.2% by 2010.

The sources of CH_4 in 1990, 1998 and 2010 are set out in Table A2.2.

Under IPCC Guidelines, the extraction of peat and its burning for energy purposes is shown as an emission: - no provision is made in the Inventory Guidelines to offset the interruption of the CH_4 emissions from natural peatlands, as these emissions are non-anthropogenic. Should the IPCC Guidelines change, to allow the offsetting of CH_4 *not* emitted to the atmosphere from boglands that are cut for peat production, this could have a significant impact on the assessment of greenhouse gas flows from peatlands and the peat industry. However, if the Guidelines were to be changed, it is possible Ireland may have to include CH_4 emissions from peatlands that are managed in their natural state (e.g. Special Areas of Conservation) in the inventories and projections. Any changes in the Guidelines would be taken into account in the development of policy in relation to peat.

Nitrous Oxide (N_2O)

In 1990, 78.1% of all emissions of this gas derived from the agriculture sector (mostly from breakdown of nitrogenous fertilisers in the soil), with small proportions from industrial processes (production of nitric acid in the manufacture of fertiliser) and the combustion of fuels (11.4% and 10.5% respectively). Marginal decreases in emissions from 1998 levels by 2010 are expected from the amounts of nitrogenous fertilisers applied to lands; further increases from fuel combustion in energy and transport are also expected, as N_2O is a by-product of NOx breakdown by catalytic converters. Reductions in emissions from nitric acid production are expected.

N_2O represented 16.9% of all emissions in the base year; this had decreased marginally to 15.7% by 1998 and it is expected to decrease further to 12.9% by 2010.

Table A2.2 ('000 tonnes CO_2 equivalent)

Sectoral Breakdown CH_4	1990		1998		2010	
Enteric Fermentation	9,506	74.1%	10,365	76.0%	9,523	78.2%
Waste	1,780	13.9%	1,594	11.7%	1,131	9.3%
Manure Management	1,294	10.1%	1,478	10.8%	1,385	11.4%
Fugitive Emissions	127	1.0%	85	0.6%	39	0.3%
Residential	85	0.7%	55	0.4%	25	0.2%
Transport	37	0.3%	48	0.3%	76	0.6%
Commercial/Instit	4	0.0%	4	0.0%	4	0.0%
Industry & Const	3	0.0%	3	0.0%	2	0.0%
Agri/Forestry/Fishing	1	0.0%	1	0.0%	1	0.0%
Energy Industries	0	0.0%	0	0.0%	0	0.0%
Totals	12,836	100.0%	13,631	100.0%	12,185	100.0%

Sources: EPA (Inventories 1 March 2000; Projections 20 March 2000).

The sources of N_2O in 1990, 1998 and 2010, are: -

Table A2.3 ('000 tonnes CO_2 equivalent)

Sectoral Breakdown N_20	1990		1998		2010	
Ag Soils	6,446	71.0%	7,125	70.8%	6,774	69.7%
Nitric Acid	1,036	11.4%	812	8.1%	812	8.4%
Manure Management	644	7.1%	731	7.3%	676	7.0%
Energy Industries	431	4.7%	620	6.2%	527	5.4%
Residential	182	2.0%	186	1.8%	294	3.0%
Industry & Const	117	1.3%	124	1.2%	60	0.6%
Commercial/Instit	86	1.0%	99	1.0%	73	0.8%
Transport	85	0.9%	318	3.2%	469	4.8%
Agri/Forestry/Fishing	58	0.6%	54	0.5%	34	0.3%
Totals	9,084	100.0%	10,068	100.0%	9,719	100.0%

Sources: EPA (Inventories 1 March 2000; Projections 20 March 2000).

Other Gases[24]

HFCs, PFCs and SF_6 do not occur naturally and are extremely long-lived in the atmosphere. All are manufactured for specific industrial purposes or are by-products of industrial manufacturing processes. These gases are imported to Ireland; none are manufactured here, and no industrial processes emit them as by-products. They are either incorporated into manufactured products or are fugitive emissions during manufacturing processes.

Hydrofluorocarbons (HFCs) were not in common use in 1990; they have been developed to replace CFCs, the use of which is banned under the Montreal Protocol. In Ireland, they are used for the manufacture of insulation boards, and increasingly in metered dose inhalers for sufferers from asthma and other respiratory disorders.

Perfluorocarbons (PFCs) are used in the manufacture of integrated circuits in the computer sector. Use was very low in 1990.

SF_6 is used as an insulating gas in high-tension switchgear in electricity transmission, and for some specialist functions in the manufacture of integrated circuits. This is the most potent greenhouse gas (its GWP is 23,900) but emissions are low.

It is intended to use 1995 as the base year for these gases, as provided for in the Kyoto Protocol, in line with the intention of most Parties, as data for emissions in 1990 are inadequate and emissions were insignificant until 1995.

The initial estimations are that in 1995 total emissions of all these gases together represented 0.5% of total emissions, at 256 kt CO_2 equivalent. This is expected to rise very rapidly in the period to 2010; much of the rise due to the replacement of CFCs with HFCs.

Actual and potential emissions of these gases must be identified for reporting under the Convention. Actual emissions include those gases where annual release to the atmosphere can be measured or estimated; potential emissions include gases in manufacturing or included in equipment or products, where release to the atmosphere may not occur until after a significant number of years. It has not yet been decided on what basis compliance with the Kyoto target will be determined.

Actual emissions of these gases in 2010 are expected to increase to some 672 kt CO_2 equivalent, an increase of 262%, and will represent 0.9% of the overall six gas basket.

Potential emissions, including HFCs incorporated into manufactured products, including products for export, are estimated at 1,885 kt CO_2 equivalent, or 2.6% of the basket in 2010.

[24] The inventory for these gases is a first approximation only, prepared by the Department of the Environment and Local Government; the EPA is developing full inventories and projections from 1995 as a matter of urgency.

Forest Sinks

The provisions of the Kyoto Protocol require the inclusion of certain afforestation, reforestation and deforestation activities undertaken since 1990 to be counted towards meeting the Kyoto target. The methodologies for calculating the net emissions or sink capacity are the subject of ongoing negotiations. For Ireland, however, the current afforestation programme will mean a sequestration of carbon from atmospheric CO_2, which will make a significant contribution to meeting our overall Kyoto target. In 1998, net removals of CO_2, calculated conservatively and on the basis of above-ground biomass only, pending finalisation of reporting methodologies, were 745 kt (1.2% of gross greenhouse gas emissions); by 2010, the achievement of the full national forestry programme would increase removals to an estimated 2,056 kt (2.8% of gross emissions). Even if only 50% of the projected planting is achieved, the net reduction is calculated at 1,369 kt (1.9% of gross emissions)[25].

Negotiations are also ongoing on the identification of additional categories of human activities related to agriculture soils, land use change and forestry that *may* be counted towards meeting the Kyoto target. It will be obligatory to account for these categories for the commitment periods post-2012.

Ireland is participating actively in the negotiations on the methodologies for calculating and reporting the existing Kyoto sinks and the possible additional categories of sinks, in order to ensure that Irish circumstances are taken into account to the extent possible. The Departments of Marine and Natural Resources, and Agriculture, and Food, and Rural Development are assisting the Department of the Environment and Local Government in this regard.

PROJECTIONS FOR 2010

These are based on projections of activity data supplied to the EPA from official sources and the application of internationally agreed methodologies to this data to arrive at greenhouse gas emissions.

The commitment period covers the 5 years, 2008 – 2012; projections for 2010 are taken as the mid-point of the commitment period and regarded as the average for the period.

Table A2.4 ('000 tonnes CO_2 equivalent)

	CO_2	CH_4	N_2O	HFC PFC SF_6	Total Emissions	*Emissions Index*	Sinks (Kyoto basis)	Net Total	*Net Index*
Base Year	31,575	12,836	9,085	256	53,752	*100.0*	0	**53,752**	***100.0***
1998	40,028	13,631	10,069	256	63,984	*119.0*	-745	**63,239**	***117.6***
2000	42,675	13,139	9,630	799	66,243	*123.2*	-991	**65,252**	***121.4***
2005	47,210	12,940	9,692	1,342	71,184	*132.4*	-1,523	**69,660**	***129.6***
2010 Low	51,373	12,185	9,720	672	73,950	*137.6*	-2,056	**71,894**	***133.8***
2010 High	51,373	12,185	9,720	1,885	75,163	*139.8*	-1,369	**73,794**	***137.3***

[25] Data on the carbon flows in forestry soils is incomplete; for many soils, the effect is likely to be positive, but in the case of forestry on peat soils, the overall carbon flow above and below ground may be neutral or negative.

Sources of Data

CO_2 Projections

For Projections to 2005: EPA, 24 August 2000, in accordance with revised 1996 IPCC Guidelines and associated software (the official basis for reporting emissions under the UNFCCC), based on ESRI energy projections (June 2000) and including non-energy sources of CO_2; economic growth assumptions are those in the ESRI *Medium-Term Review 1999 – 2005* (October 1999).

For 2010: EPA, 9 June 2000 from ESRI 8 June 2000.

CH_4 and N_2O Projections

EPA, March 2000, in accordance with revised 1996 IPCC Guidelines, based on data for animal numbers and agricultural activity supplied by Department of Agriculture, Food and Rural Development 3 March 1999 (average of June and December censuses for livestock numbers). 2000 projections for non-energy CH_4 and N_2O are same as for 2010.

Industrial Gases Projections

EPA, March 2000, based on incomplete 1998 survey data from Department of the Environment and Local Government. 1995 data repeated for 1998, and 2000 interpolated on straight-line basis between 1995 and 2010. Low projection for 2010 includes a proportion of HFC used by industry on the basis of the balance of production being exported (in accordance with methodologies for accounting for actual emissions). High projection for 2010 includes 100% of HFC use by industry (in accordance with methodologies for accounting for potential emissions). A 1995 base year is taken for these gases.

Sinks Projections

Department of the Environment and Local Government, in accordance with methodology used in developing EU burden sharing for counting sequestration by afforestation since 1990. This in turn based on revised dataset for forest biomass supplied by the Department of the Marine and Natural Resources to the EPA for EPA inventories and projections 18 August 1999.

High sequestration rate assumes achievement of full planting programme (25,000ha pa 1998 to 2000, 20,000ha pa post 2000, 80% conifers and 20% broadleaves). Low sequestration rate assumes 50% of programme to 2010 is achieved, in accordance with sensitivity analysis by Department of Marine and Natural Resources 6 May 1998. Carbon in forest soils, below-ground biomass, litter and forest products not counted. EPA inventory figures for sequestration reduced by 50% to allow for sigmoidal growth (i.e. lower uptake of carbon in earlier years of tree growth); maximum uptake in post-1990 forestry will be post 2012.

Range of Projections

A range is provided to reflect two possible scenarios in relation to sinks and PFC/HFC/SF_6 emissions. The "Low" projection assumes that: -

- PFC/HFC/SF_6 projections for 2010 are shown using the "actual" emissions approach where only amounts of substances released in Ireland are included in the net total emissions and removals;
- 100% of the planned forestry programme is achieved between now and 2010.

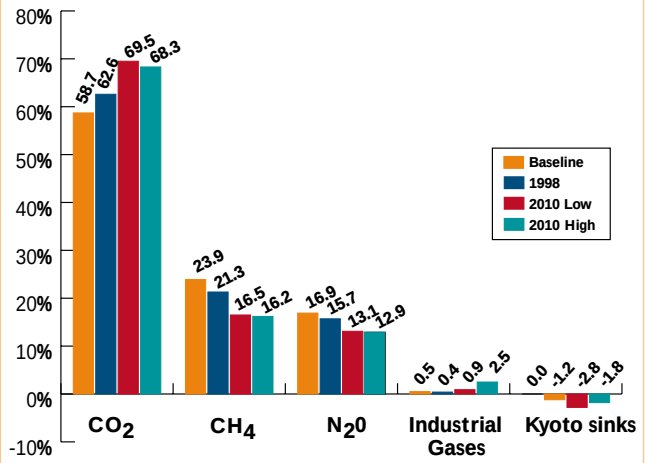
The "High" projection assumes that: -

- PFC/HFC/SF_6 emissions are allocated against the national limitation target using the "potential" emissions approach where all amounts of substances used in Ireland are included in the net total emissions and removals; most of the HFCs used are projected to be exported, and depending on the methodologies to be agreed for assigning these gases, may appear in our inventories. For the purposes of this Strategy, it is assumed that these emissions must appear in Ireland's inventory, analogous to the convention that the "embedded carbon" in the manufacture of goods requiring the use of energy or the emission of CO_2 from processes are shown in the inventory of the country of manufacture.
- 50% of the planned forestry programme is achieved between now and 2010.

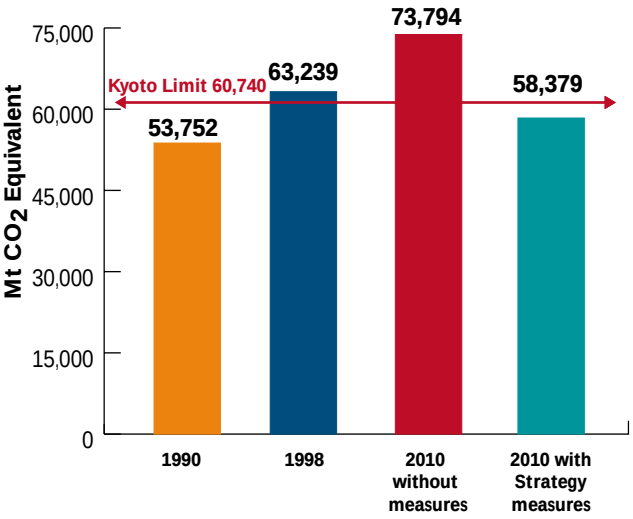
These projections indicate that by the year 2010, Ireland's net greenhouse gas emissions and removals, calculated in accordance with the Kyoto Protocol, will be in the range of 71.9 – 73.8 Mt CO_2 equivalent, which is in the range 33.8% – 37.3% above emissions in 1990. Ireland's limitation target of 13% corresponds to a quantitative limitation target of 60.74 Mt CO_2 equivalent per annum for the period 2008 – 2012. Therefore, Ireland will need to achieve annual emissions savings of the order of 11.154 to 13.054 Mt CO_2 equivalent per annum in the commitment period.

There is a range of uncertainty in any projections, and there have been previous increases in the projections range. Accordingly, for the development of this Strategy and to prepare for post-2012 targets, it is assumed that the reduction below "business as usual" to be achieved will require to be up to 15.5 Mt CO_2 equivalent.

GRAPH 8 BREAKDOWN OF EMISSIONS BY GAS ON GWP BASIS, 1990, 1998 AND 2010 PROJECTIONS



GRAPH 9 IMPACT OF STRATEGY ON ACHIEVEMENT OF KYOTO TARGET



It is clear that with the expected increase in CO_2 emissions, compared to the smaller increases in CH_4 and N_2O emissions on the business as usual outlook, that CO_2 will become a larger proportion of total emissions by 2010. The secondary gases (non-CO_2), mainly from the agriculture sector, will decrease from 40.8% of the overall basket to 29.1%/29.6%. The industrial gases will account for 0.9% to 2.5% of the basket, depending on actual or potential emissions, up from a very small base (0.5% of the base year basket). **See graph 8.**

SCALE OF REDUCTIONS REQUIRED

The ERM June 1998 consultancy report has identified a quantified list of **domestic** policies and measures totalling 10 to 11 Mt CO_2 equivalent potential reductions below business as usual. Their contribution is not adequate on their own to meet the Kyoto target (assuming 10.5 Mt CO_2 equivalent reduction); accordingly the Strategy identifies adequate additional measures to meet the Kyoto target, as illustrated in **graph 9.**

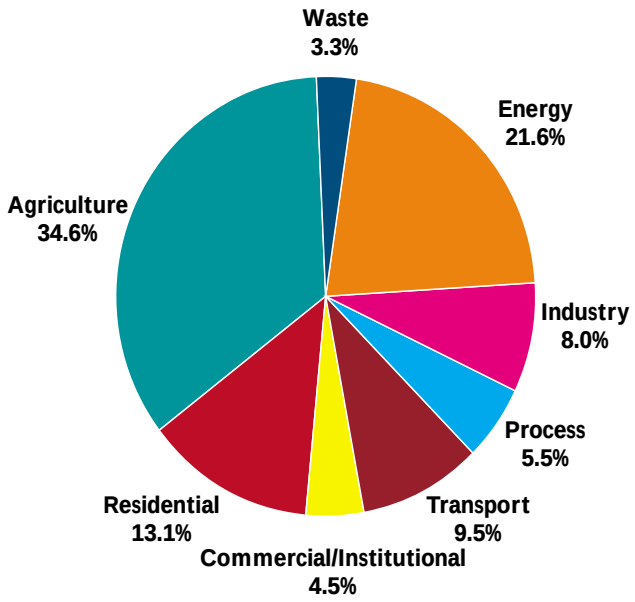
The ERM report has also identified a number of additional, unquantified, policies and measures at a sectoral level which might also be adopted, in addition to cross-sectoral economic instruments (where quantification of the reduction potential was not undertaken) that may also be adopted.

The consultancy report ***does not*** quantify the additional reductions that will be available from common and coordinated policies and measures at EU level, nor does it quantify the reductions that may be obtained using the flexible mechanisms under the Kyoto Protocol.

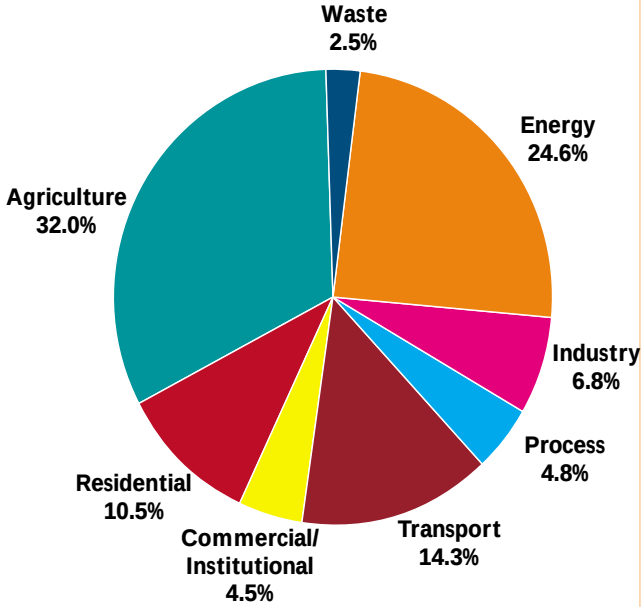
SECTORAL PROJECTIONS

In developing the Strategy, it is essential to have an understanding of the sectoral sources of emissions on a business as usual basis. It is also necessary to understand the expected changes in emissions projections for each sector on foot of the Strategy.
See graphs 10-15 following.

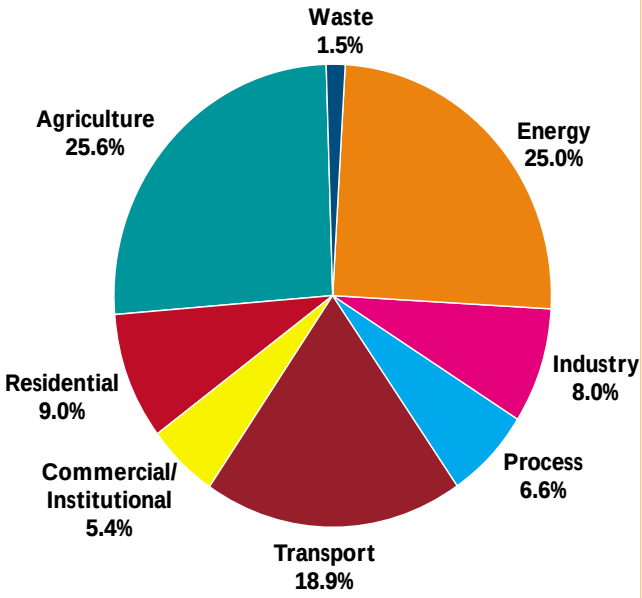
GRAPH 10 SECTORAL BREAKDOWNS OF EMISSIONS FOR 1990



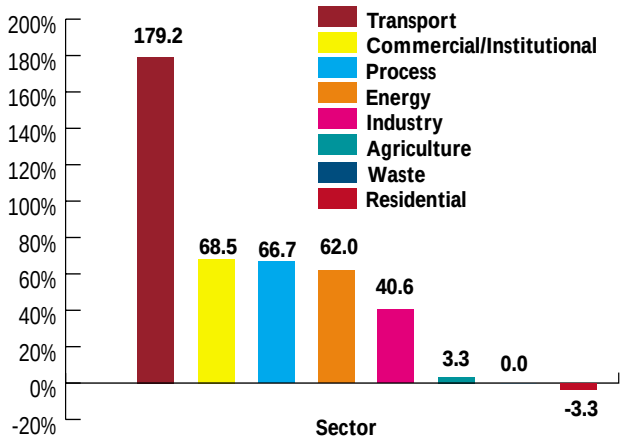
GRAPH 11 SECTORAL BREAKDOWNS OF EMISSIONS FOR 1998



GRAPH 12 SECTORAL BREAKDOWNS OF EMISSIONS FOR 2010 PROJECTIONS (WITHOUT MEASURES)

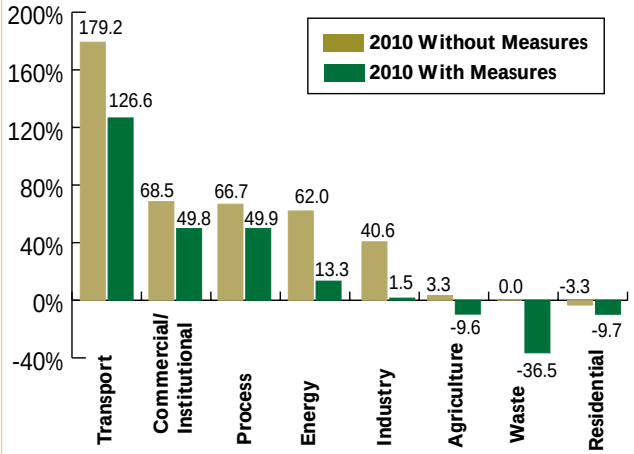


GRAPH 13 PERCENTAGE INCREASE IN EMISSIONS BY SECTOR 1990 – 2010 (WITHOUT MEASURES)



GRAPH 14

PERCENTAGE CHANGE IN EMISSIONS WITH AND WITHOUT MEASURES 1990 – 2010 FOR EACH SECTOR



GRAPH 15

SECTORAL BREAKDOWN OF EMISSIONS WITH THE STRATEGY MEASURES FOR 2010.