Carbon Credits in Ireland: Issues and Potentials

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

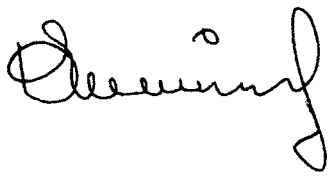
FOREWORD

Forests have many functions in Irish life and the economy. As well as a provider of wood and wood products for a burgeoning forest industry they provide a range of services from recreation to conservation.

They are also one of the largest carbon stores nationally, and on a global scale. This function of forests has received greatly increased attention with the recent reports of the International Panel on Climate Change. These have distilled the findings of leading scientific opinion on world climate patterns. They have clearly concluded that global warming, as a result of emissions of greenhouse gases such as carbon dioxide, is occurring and is a serious threat to mankind. At the same time the international process to address global warming, the Conference to the Parties (COP) to the United Nations Framework Convention on Climate Change has been meeting annually since 1995 in order to hammer out an international agreement on the reduction of greenhouse gas emissions. This process made substantial progress when the Kyoto Protocol to the convention was agreed in 1997. It made further significant headway at the resumed COP6 at Bonn when the principles governing a number of key issues, including forest carbon sinks were agreed at a political level. I was particularly pleased that COFORD, through its Director Dr Eugene Hendrick, was able to play its role at Bonn as part of the forestry team alongside Mr Diarmuid McAree, the Chief Forestry Inspector with the Forest Service.

These developments have brought the prospect of carbon trading closer to reality. There is increasing interest among growers of the prospects of trading the carbon stored in their forests. It was to address this interest that COFORD collaborated with Coillte in the production of this timely report on carbon trading and credits. I would like to thank Coillte for their foresight and financial assistance in supporting the work reported here. While the report was written before the Bonn agreement it still has much to offer in providing insights into the nature of emissions trading and how it might operate on a national and international level.

This work is a part of COFORD's contribution to the development of national carbon accounting and trading. We are working closely with the Department of the Environment and Local Government, the Forest Service and the Environmental Protection Agency on carbon accounting in forestry. In the last month we signed a research contract with University College Dublin to update and refine current estimates of the rate and extent of carbon storage in Irish forests. The results of this work together with this present publication will make a significant contribution to carbon trading in the future.



David Nevins
Chairman

1. BACKGROUND

In June 1992, the UN Conference on Environment and Development (UNCED) was held in Rio de Janeiro. One of the outcomes of this meeting was a Climate Change Convention, whereby parties thereto agreed to arrest global warming. How this was to be achieved was not elaborated. This Framework Convention on Climate Change calls for a stabilisation of greenhouse gasses in the atmosphere, but does not specify the level. The European Union has agreed that the increase in global temperature should not exceed about 2º Celsius. This implies achieving a stabilisation at 450-550 parts per million (ppm) of carbon dioxide. Pre industrial levels were 280 ppm, and present levels are about 360 ppm. Because of the long-lived and cumulative nature of atmospheric emissions, if the EU target is to be achieved, global emissions will have to start declining quite soon. Present emissions are rising at the rate of about 1% per annum.

The Kyoto Protocol to the Convention on Climate Change – referred to in this paper simply as 'Kyoto' or 'Kyoto Protocol' - was agreed in Kyoto in December 1997, wherein assigned amounts or quotas of emissions were agreed by developed countries. There is a provision in Kyoto that allows carbon sequestered since 1990 to be counted as a contribution towards a country's quota. The potential opportunity arises because trees and other growing plants take carbon from the atmosphere as part of the photosynthetic process (details on the Kyoto Protocol, including sinks, are provided in Box 1).

In the context of Kyoto targets and sinks, this paper provides a strategic context for any Irish forest owner wishing to know what are the prospects and potentials for earning money from carbon sequestration in Ireland.

BOX 1

SINKS IN THE KYOTO PROTOCOL

ARTICLE 3.3

The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced, land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex I. The greenhouse gas emissions by sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 and 8.

Article 3.4

Prior to the first session of the Conference of the Parties serving as the meeting of the Parties to this Protocol, each Party included in Annex I shall provide, for consideration by the Subsidiary Body for Scientific and Technological Advice, data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall, at its first session or as soon as practicable thereafter, decide upon modalities, rules and guidelines as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I, taking into account uncertainties, transparency in reporting, verifiability, the methodological work of the Intergovernmental Panel on Climate Change, the advice provided by the Subsidiary Body for Scientific and Technological Advice in accordance with Article 5 and the decisions of the Conference of the Parties. Such a decision shall apply in the second and subsequent commitment periods. A Party may choose to apply such a decision on these additional human-induced activities for its first commitment period, provided that these activities have taken place since 1990.

2. THE KYOTO PROTOCOL

The Kyoto Protocol to the Framework Convention on Climate Change comes into effect when not less than 55 parties to the Convention have deposited instruments of ratification, acceptance, approval or accession, subject to conditions. Parties representing at least 55% of CO_2 emissions in 1990 must also ratify. There are two features that distinguish Kyoto from previous international aspirational commitments to good practice and process.

- For 38 industrialised countries – the Organisation for Economic Co-operation and Development (OECD) group and many of the countries of the former Soviet Union (referred to hereafter as Annex 1) – emission quotas have been agreed under Article 3, to be achieved by 2008-2012, with 'demonstrable progress' to be made by 2005. The OECD group agreed to achieve a 5% reduction below 1990 levels, while the former Soviet countries agreed to stabilise at 1990 levels over the same period.

- Secondly, flexible mechanisms are provided for, which allow some of a national target to be met by reduction of activity in another state.

- Under Article 6, joint implementation is provided for, whereby any Party in Annex 1 may acquire from, or transfer to, any other Party emission reduction units resulting from projects aimed at reducing human-induced emissions.

- Under Article 12, provision is made for utilising a clean development mechanism, whereby Parties not included in Annex 1 can benefit from projects which achieve certified emission reductions, and Annex 1 parties may use these reductions as a contribution to the meeting of their limitation and reduction commitments.

- Under Article 17 the parties included in Annex B (industrialised countries) may participate in emissions trading for purposes of fulfilling their commitments, whereby a market in carbon equivalent emissions is created and those above their quota can buy from those who are achieving reductions in excess of their allowance, and therefore have a surplus.

But 'any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments.' The developing countries – the 'Group of 77' and China – are not party to any ceiling on emissions.

3. EMISSIONS AND SINKS

Under the Kyoto Protocol, quotas have been allocated to the industrial countries, using 1990 as a base. The EU agreed to a quota comprising a reduction of 8% below 1990 levels for the six greenhouse gasses – CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6). In June 1998, a system of burden sharing or target sharing was agreed for the EU Member States, to meet this aggregate target, allocated to Member States as indicated in Table 1.

3.1 Sinks

In meeting national reduction commitments, Parties can use net changes in greenhouse gas emissions from sources and removals by sinks to meet their commitments, but only those resulting from direct human-induced, land use change and forestry activities and limited to afforestation, reforestation, and deforestation (Article 3.3) and forest management (Article 3.4) since 1990. There is considerable difference in estimates resulting from the methodologies used to determine sink effects, and a standard approach will need to be agreed. The variation among countries is considerable, with carbon sinks in 1996 amounting to 51% of emissions in Sweden, to only 1.1% in the Netherlands, and 7.4% for the Union as a whole (Table 2).

Note, however, that only a small proportion of such sinks can be claimed as contributing to the Kyoto target, because the attributable sinks are confined to changes since 1990.

TABLE 1: GREENHOUSE GAS QUOTAS, BY MEMBER STATE OF THE EUROPEAN UNION.

Member state	**Change from 1990** **%**	**Emissions 1990** **million tonnes of CO_2 equiv.**	**Annual target or quota, 2008-2012 million tonnes of CO_2 equiv.**	**Difference** **million tonnes of CO_2 equiv.**	**Per capita emissions, 1990 tonnes of CO_2 equiv.**
Austria	-13.0	78	68	-10	9.2
Belgium	-7.0	139	129	-10	13.7
Denmark	-21.0	72	57	-15	13.7
Finland	0	65	65	0	14.2
France	0	546	546	0	11.0
Germany	-21.0	1208	955	-253	14.7
Greece	25.0	99	124	+25	9.9
Ireland	**13.0**	**57**	**64**	**+7**	**16.0**
Italy	-6.5	543	507	-36	9.5
Luxembourg	-28.0	14	10	-4	34.7
Netherlands	-6.0	217	204	-13	13.5
Portugal	27.0	69	87	+18	7.0
Spain	15.0	302	348	+46	7.6
Sweden	4.0	66	68	+2	7.9
UK	-12.5	790	691	-99	13.3
EU	-8.0	4264	3922	-342	13.1

Source: CEC (1999) Annex 1. ([1])
European Environment Agency (1999).

[1] The Irish data have recently been revised, yielding emissions of 54 million tonnes of CO_2 equivalent in 1990, and an assigned amount of 61 million tonnes.

TABLE 2: EMISSIONS AND REMOVALS OF CO_2, 1996 IN THE EUROPEAN UNION.

Member state	**Emissions of CO_2 million tonnes**	**Removals/sinks million tonnes**	**Removals/emissions %**
Austria	62	14	23.0
Belgium	129	2	1.6
Denmark	60	1	1.7
Finland	66	14	21.0
France	399	60	15.0
Germany	910	30	3.3
Greece	92	-	na
Ireland	**35**	**6**	**17.0**
Italy	448	36	8.0
Luxembourg	7	0	0.0
Netherlands	185	2	1.1
Portugal	51	1	2.0
Spain	248	29	12.0
Sweden	63	32	51.0
UK	593	19	3.2
EU	3347	247	7.4

Source: European Environment Agency (1999).

4. THE HAGUE

The rules that are to apply in the implementation of the flexible mechanisms and the sinks were to be agreed in a rolling series of conferences of the parties (COP) culminating in the sixth such meeting – COP6 – in The Hague in late 2000.

The EU set out its position, in a briefing paper, (EU 2000) on a number of areas prior to the commencement of COP 6. The main priorities for the EU, as set out in this paper, were to:

- enable parties to launch the process of ratifying the Protocol; and
- safeguard the Protocol's environmental integrity and credibility.

With these objectives set, the EU highlighted what it thought were the important issues for discussion at COP 6, which included:

- ensuring a primary role for domestic policies and measures;
- limiting the use of sinks as offsets;
- clarifying the rules for the Kyoto mechanisms;
- ensuring a tough compliance regime;
- aid for developing countries to adapt to climate change.

Agreement was not reached, mainly because of disagreement between the 'umbrella group' – the US, Japan, Canada and Australia – and the European Union on what would qualify as sinks, with the umbrella group arguing for a much more generous definition, that would - in the European view – diminish the 5 per cent overall effective reduction (below 1990 levels) in greenhouse gas emissions agreed at Kyoto by up to one third.

The fact that (a) there is no agreement, and (b) that the initial disagreement focused almost exclusively on the rules that would apply to sinks, increases the uncertainty which forest owners in Ireland are faced with in assessing the prospects for some income for carbon sequestration. There was some limited discussion on other issues. It seems clear that the EU has in effect dropped its requirement for a 'concrete ceiling' on the amounts of emissions that could be traded, but the issue of the extent and nature of domestic action to be required of each party needs to be clarified. The Japanese raised concerns about enforcement of trading rules across frontiers, on the basis that such trans-frontier activity might be counter to the Japanese constitution.

A further round of negotiation – called COP6 bis– was proposed for May 2001 – but the US have asked for deferral to July on the basis that the personnel of the new Bush administration are too new in the job to be sufficiently informed to negotiate. Whenever negotiations re-commence, it is hoped that the lessons of The Hague can be internalised by the two main 'developed country' parties – and progress made. However, the change in administration in the US may impact on the outcome.

The main outcomes of The Hague conference are the following:

- increased uncertainty as to whether there will be an agreement at all;
- increased uncertainty as to the extent to which the contribution of sinks will be allowed as a contribution to national assigned amounts; and
- the negotiations also led to a crystallisation of the EU's position in a number of areas, for example the EU showed a willingness to move on the issue of a 'concrete ceiling' but remained firm on excluding nuclear technologies from the Clean Development Mechanism.

Perhaps the most salient point to arise from the negotiations was the EU's commitment to the environmental integrity of the Protocol. This is best summed up by the response of Commissioner Wallstrum to the proposals, "any agreement must safeguard the environmental integrity and credibility of the Protocol and unfortunately some of the ideas under discussion in the final hours in The Hague did not guarantee this." This commitment to environmental integrity also seems to have been matched by a greater willingness to accept a flexible implementation of the Protocol.

5. TREES AS CARBON SINKS [2]

5.1 Rules and Guidelines

Articles 3.3 and 3.4, as detailed in Box 1, set out the Kyoto Protocol's rules on the use of forests and land use management as offsets against emissions. Article 3.3 limits the carbon credit to the net effect of direct human-induced activities undertaken since 1990. This results in the following equation to determine the net 3.3 sink

Afforestation + Reforestation - Deforestation = Net Change.

No other forestry or land use management activities are allowable under Article 3.3, nor are any activities, which occurred before 1990.

This aggregate could be either a positive or negative effect on the atmospheric carbon stock and will result in a carbon credit or debit to be included in a country's final declaration of net emissions. Figure 1 demonstrates this graphically, for a country with net forestation over the period, resulting in a carbon credit equal to the broken line to be offset against any growth in emissions.

Article 3.4 has been the major sticking point in the COP negotiations to date as the rules and modalities for its implementation have not been agreed. A broad definition of this article would allow for the inclusion of forest management, cropland management and grassland management, resulting in some developed nations having extremely large sinks thus negating the environmental integrity of the Protocol. A narrower definition would allow only for revegetation to be counted.

5.2 Calculating Carbon

The sequestration potential of forests can be calculated according to the following formula:

GI x BD x CC x BEF = Sequestration Rate

Where: GI = Growth Increment
BD = Bulk Density
CC = Carbon Content
BEF = Biomass Expansion Factor

5.3 Irish Figures

Byrne (2001) presents preliminary estimates for the sequestration potential of Irish forests using the above formula. In doing so, he makes a number of assumptions regarding the composition of the Irish forest stock:

- first, that it is comprised of 80% coniferous and 20% broadleaved species;
- Sitka spruce of yield class 16 is used as a proxy for the coniferous stock. While, beech of yield class 4 is used for broadleaves;
- wood is assumed to have a bulk density of 35 Mg m^{-3} and a carbon content of 40%;
- two age classes are assumed, less than or greater than 17 years; and
- the growth increments are assumed as follows:

	<17yrs	**>17yrs**
	m^3 $ha^{-1}yr^{-1}$	
Sitka spruce	4.4	16.2
Beech	0.9	0.9

These assumptions result in the following Sequestration Rates:

	<17yrs	**>17yrs**
	$tCha^{-1}yr^{-1}$	
Sitka spruce	0.80	2.95
Beech	0.23	0.23

Applying these figures to Forest Service data and predictions on forest growth results in a total carbon sequestration of 1.76 $MtCO_2$ under Article 3.3 over the first commitment period 2008-2012, giving an offset of 6.46 $MtCO_2$. The average CO_2 reduction over 2008-2012 would be 1.29 Mt CO_2yr^{-1}, allowing the 3.3 sink to account for 9.9% of Ireland's reduction target.

[2] This section is based on Byrne (2001)

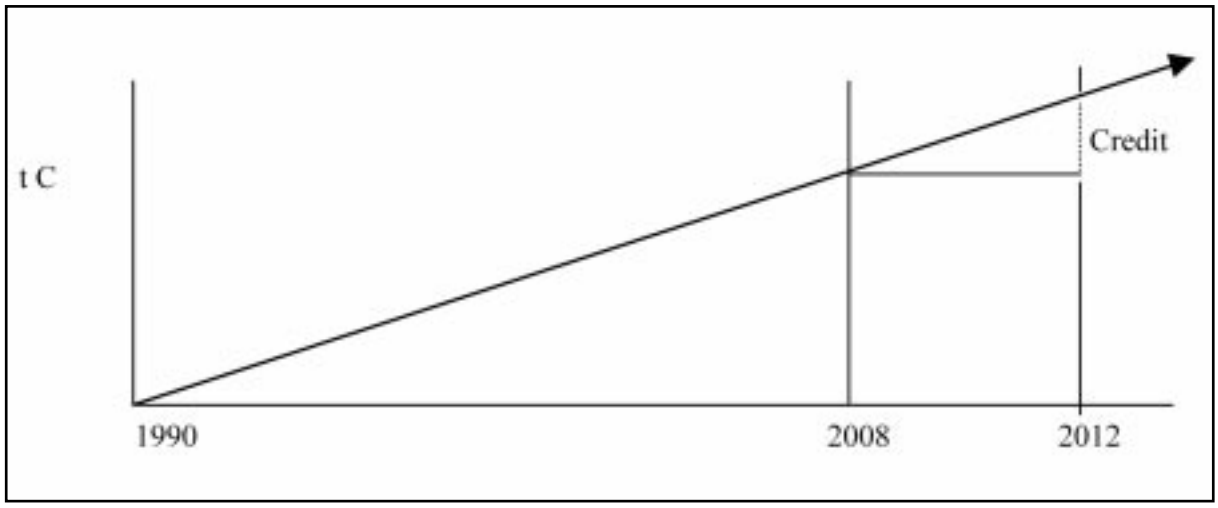


FIGURE 1: CALCULATING CARBON CREDITS UNDER ARTICLE 3.3.

6. TRADING

6.1 Background

The basic approach in emissions trading is to fix the quantity of emissions, and then to allow those who have quantities allocated to them to trade, but the total allocation does not exceed the cap. From such trading, a price emerges which expresses the scarcity value of the environment. This is in contrast to using taxes to achieve abatement, whereby polluters are in effect charged for polluting, and adjust their behaviour accordingly, by reducing emissions.

The economic power of the emissions trading stems from the following sources:

- different emitters have widely differing costs – it is much cheaper for some to reduce than for others. Those who can reduce very cheaply can exceed the average performance, and sell the pollution rights thus created to those who find it expensive to cut emissions;
- the permit price signals continuously that there is money to be made if emissions can be reduced;
- there is a continuous incentive to innovate and to reduce emissions.

This experience has been documented in a number of sources (Box 2) (OECD 1999, Sorrell and Skea 1999) from which what follows is drawn. In the European Union, both milk and fish production are limited by law, and the overall national envelopes are allocated to individual producers as quotas. These quotas can be traded, but only within national boundaries. To this extent, there is experience in the EU with quota trading enforceable by law. However, it is in the US that most of the relevant experience in the use of trading to secure environmental objectives has occurred, although European producers participated in the ozone depleting substances trades discussed below.

6.2 Some Initiatives to Date

6.2.1 International Transfer of Ozone Depleting Substances

The only significant experience with trading in the EU is the International Transfers of Ozone Depleting Substances. In the phase down period, the transfer of production quotas was allowed, so long as the total production did not exceed the overall limit. The quotas were allocated to producers on the basis of production levels - 1986 and 1989 depending on the substance.

This enabled parties to:

- agree a rapid phase out;
- achieve economies of scale by concentrating the (diminishing) production in a smaller number of facilities; and
- shift rapidly to more profitable substitutes.

BOX 2

CORPORATE EMISSIONS TRADING

On January 27, 2000, the Royal Dutch Shell Group announced that it has adopted a voluntary internal trading system for reducing greenhouse gas emissions. Its overall objective is to reduce emissions to 10 per cent below 1990 levels by 2002. It will employ a 'cap and trade' approach, whereby participants are issued a limited quota – each permit confers the right to emit 100 metric tonnes of carbon dioxide equivalent per year. The number of permits is limited so that the aggregate amount is 2% lower than participating business units' emissions in 1998. So far, six units, representing approximately one-third of the transnational company total greenhouse emissions, have signed up.

Source: www.shell.com/steps

6.2.2 Reduced Lead in Petrol

The first significant victory for trading as a policy mechanism was the lead-trading programme introduced in the US in 1982, when more stringent limits on the average amount of lead in petrol per gallon were required.

Each refinery was not required to meet the new standard; instead:

- those above the limit could purchase rights from those below the limit;
- and from 1985, they were allowed to bank savings so that reductions made in one year could be utilised in a later year;
- the target was achieved, at substantially lower cost than if uniform reductions had been imposed.

6.2.3 The Acid Rain Trading Programme

A second US tradable permit programme, which has had success, is The Acid Rain Trading Programme.

In 1990, the Clean Air Act Amendments provided for an acid rain trading programme. The legislation imposed a 50% reduction of acid rain precursor emissions by electricity utility sources with 1980 as the base.

In phase 1, each of the 263 large generating units are annually issued permits or allowances, approximately equal to the product of average 1985 - '87 heat input times a target emission rate of 2.5 pounds of SO_2 per million Btu (the phase 2 plants get an allocation at a rate of 1.2 pounds of SO_2 per million Btu).

No specific technology or emission rates are mandated for any particular plant. But each plant had to comply with the source specific limits established previously under the State Implementation Plans which implement the National Ambient Air Quality Standards for SO_2.

Performance: In 1995, 8.7 million allowances were issued to 58 utilities for 445 generating plants (Table 3).

TABLE 3: PERFORMANCE INDICATORS, ACID RAIN EMISSIONS TRADING, US.

Year	Emissions of SO_2 million tonnes	Average SO_2 rate pounds /million Btu
1985	10.68	3.48
1995	5.30	1.74

Source: Ellerman, *et al (1999).*

The reduction achieved is well below the cap of 8.7 million tonnes, which is well below what would have been achieved without trade, achieved almost equally by fuel switching and scrubbers.

The flexibility provided by the trading programme has reduced compliance costs by between a third to a half. However, this may exaggerate the contribution of trading *per se;* in parallel with the introduction of trading, low sulphur coal prices fell as a result of de-regulation of rail transport, and this reduced the costs of achieving any given reduction target.

6.3 Current Developments – Member State Level

6.3.1 Denmark

The Danish Parliament has passed a proposal to establish a domestic emissions trading market amongst electricity producers. It has been notified to the Commission, and approval is likely to be forthcoming (Box 3).

BOX 3

DANISH EMISSIONS TRADING SCHEME

The Danish emissions trading scheme is enacted by Act No. 376 of 2 June 1999 on quotas for electricity production. The start date has yet to be fixed, but it runs until 31 December 2003. It covers emissions of carbon dioxide from approximately 15 of the largest electricity producers. The total allowances granted under the scheme are for 23 million tonnes (Mt) of carbon dioxide (CO_2) in the year 2000, 22 $MtCO_2$ in 2001, 21 $MtCO_2$ in 2002 and 20 $MtCO_2$ in 2003. This compares with average annual emissions from these sources of approximately 30 $MtCO_2$ during the reference period of 1994-1998. There has been a free allocation of allowances according to historical criteria (actual emissions during the reference period), and technical criteria that favour more energy efficient production such as Combined Heat and Power plants.

In the case of producers emitting more than their annual allowance, a fine of DKK 40 (about €5.38) is levied for every excess tonne of CO_2 emitted. This fine limits the maximum price of permits that will be traded under the scheme, because if the price of permits were to exceed the cost of the fine, then firms are assumed to choose to pay the fine rather than buy the more expensive permits. The environmental consequence of this fine 'over-riding' the need for more expensive permits is that the environmental outcome cannot be guaranteed if electricity producers choose to emit more than their allowance and pay the fine. The scheme is intended to be a trial scheme that can be improved upon subsequently.

6.3.2 The United Kingdom (UK)

Proposal of the Emissions Trading Group

In the UK, a number of companies and associations, working with the government, have developed proposals for a UK Emissions Trading Scheme, open to all companies operating in the UK. It is in response to the proposed industry energy tax – to be introduced in 2001. It would be open to any UK company, but is especially aimed at those companies not covered by the various negotiated agreements that offer partial exemption from the tax. The draft proposal was released in October 1999. The government has expressed support for the scheme in principle, and follow up discussions are now in train. These discussions are focusing on the integration of trading and the voluntary agreements, the participation of the electricity sector (to avoid double counting with users of electricity), the status and scope of the Emissions Trading Authority, the tax treatment of trades, competition issues in the context of EU rules, and how to allocate quotas.

The main features of the proposal are the following:

- **Organisational Structure of Initiating Group:** the initiative is proposed by the Emissions Trading Group (ETG). There is a Steering Committee representative of major industrial 'actors' in the UK, including Blue Circle Industries (cement production), BP Amoco (oil), British Steel, Vauxhall Motors, Du Pont, Scottish Power (electricity), the Confederation of British Industry (CBI), and of government, including Her Majesty's Treasury and the Department of Trade and Industry. A much wider group of companies and government representatives are involved in Technical Committees.

- **Eligibility:** open to all companies in the UK who commit themselves to binding greenhouse gas (GHG) limits. There would be two categories of participant: firms that agreed an annual emission limit with the government and firms that agreed an output related emissions target under a climate change levy (CCL) agreement.

- **Rule Making and Enforcement:** by an Emissions Trading Authority.

- **Units:** the units traded would be tonnes of CO_2 equivalent, using internationally agreed conversion factors for other GHGs.

- **Gas Coverage:** firms would have the option to agree targets for all six greenhouse gasses or for CO_2 alone.

- **Allocation Mechanisms:** in all cases, it is proposed that the quotas be given free to the participants. In the case of those participating in voluntary agreements (VA) where an absolute limit on emissions has been agreed, the allocation would be what they had agreed in the VA. Firms that are outside this framework would agree a limit with the government. Greenhouse gas reductions below the agreed quota could be sold into the market.

- **Banking:** firms could 'bank' their unused permits for use in future years.

- **Linkage with other International Mechanisms:** international trades in permits and other Kyoto mechanisms such as the Clean Development Mechanism (CDM) and Joint Implementation (JI) would be recognised in the scheme once the rules covering these had been agreed.

- **Incentives to Participate:** a tax credit would encourage participation.

- **Competition Issues:** all new entrants, whether companies setting up in the UK, or expansions in existing capacity, would have to acquire the relevant quota. It is felt that this 'level playing pitch' for all firms will be sufficient to address the 'State Aids' issue.

Proposals for Implementing the Biodegradable Municipal Waste (BDMW) targets in the EU Landfill Directive.

Under the EU landfill Directive, the UK will have to reduce the amount of BDMW going to landfill by 70%. A number of options have been put forward to implement this directive. Under the first, permits to receive BDMW into landfill are issued to landfill operators. Under the second option, permits to send BDMW to landfill are issued to Waste Disposal Authorities. (See 'consultation paper – 'Limiting Landfill: limiting landfill to meet the EC Landfill Directive's targets for the landfill of biodegradable waste' available at: http://www.detr.gov.uk).

6.3.3 Other Countries

Finland, France, Ireland and Sweden are favourably disposed to emissions trading, and have all established advisory bodies and/or commissioned research to explore options (Box 4).

The Netherlands and Germany seem to be the least engaged by the prospects and potential. In the Netherlands, the voluntary agreements (VA's) specifically preclude new quota fixing for those firms involved, but the UK model, where the amount agreed in the VA becomes the quota, could probably overcome this limitation and allow a smooth transition. In Germany, lack of enthusiasm is probably a product of deep commitment to the traditional command and control model of environmental management, and an emerging policy of 'self commitment' with a quid pro quo not to introduce eco-taxes (Jeder 2000).

6.4 Rules and Definitions

6.4.1 Units Traded and Trading Entities

The units traded could be units of emissions reductions or units of national emissions quotas that can be used once during a five year commitment period, or banked for a subsequent period, using an international emissions exchange which never closes. The legal obligation to comply rests with the signatories to the Convention. However, for emissions trading to be effective, the national quotas will need to be divided up amongst the emitters.

6.4.2 Monitoring and Enforcement

Monitoring of national emission levels will be crucial for a reliable and well functioning tradable quota (TQ) system, and – at least for fossil fuel carbon – be relatively easy to measure performance.

Because fuel use equals production plus imports minus exports (plus inventory changes), Bohm (1999) makes the point that it is in the interest of every fossil-fuel exporting country to avoid underestimates of its export volume, and of every importing country to avoid over-estimates of its import volume. These twin incentives will encourage accurate reporting of transactions. Trading rules can be designed and defined to be effective and ensure competitive markets. As a minimum condition for acceptable bilateral transactions, it would seem to be necessary to make all transactions subject to a transparency requirement where the prices are made commonly known to all traders. No 'side payments' implementing multilateral transactions systems, as on an exchange market, would make it possible to keep traders anonymous to one another – anonymity makes market transactions more efficient. Within the EU, enforcement should not pose problems if the assigned amounts to Member States are given legal status via Community

BOX 4

REPORT OF THE CONSULTATION GROUP ON GREENHOUSE GAS EMISSIONS TRADING

The Minister for Environment and Local Government established a Consultation Group to examine and advise "on the options for greenhouse gas emissions trading, both domestically and in the context of developing international and EU requirements, and to offer advice on the Irish position on international trading as required."

The group concluded that: emissions trading should be used to the maximum extent possible, while recognising that there will be a need for complementary action; the 'concrete ceiling' on the volume of trades as recommended by the European Commission should not be supported; compensating measures may be necessary to mitigate the impact on low income households; initial focus should be on CO_2, but methane that can be captured and used in energy production should also be considered for inclusion; a combination of auctioning and 'grandparenting' should be used to allocate permits, with the emphasis on auctioning; exemptions may be necessary to reduce the degree of economic dislocation, via rebates; trading should be between individual entities, and, on grounds of practicality, energy producers and importers (the 'upstream' users) should be favoured over the downstream users (all emitting entities) as the trading parties; Ireland should support the development of an international exchange mechanism rather than a system of bilateral trading, on the basis that the latter is "open to abuse through market dominance;" compliance should be transparent, effective and uniform across countries; although the benefits of a domestic trading scheme would be substantial, the limited size of the Irish market, and the small number of firms responsible for most of the CO_2 could give rise to problems as regards market dominance and potential barriers to entry.

Source: Department of Environment and Local Government (2000).

Regulation or Directive. For trades across frontiers outside the EU, some supranational incentive and enforcement mechanisms will be necessary.

6.4.3 Market Power

For those countries in the EU proposing an internal (within Member State) emissions trading market, the robustness and competitiveness of the market is a crucial issue (Box 5). For small countries such as Ireland, a market in CO_2 emissions is likely to be dominated by a small number of private and public companies and the potential for cartelisation of the market to both influence the price of permits and, perhaps more importantly, to limit access by newcomers, will be substantial. The creation of a quota exchange would help limit the exercise of market power.

6.4.4 Permit Allocation

There is a case made in the literature for auctioning permits rather than 'grandfathering' - giving them away free to existing polluters. Bohm (1999) puts the case as follows: 'auctioning the whole volume of permits provides government revenue that allows a reduction of pre-existing distortionary taxes, a so-called double dividend; the auction price reflects this environmental concern and emerges as a corrective rather than distortionary levy'. He also argues that grandfathering allows benefiting firms to (a) remain in business, when, in the absence of the free endowment of assets represented by grandfathering, a firm would have gone out of business (b) have more funds for risky investments, and (c) have cheaper access to bank loans and capital markets, giving away permits for free to existing firms can be expected to slow down productivity growth. Thus, the fear that countries using 'grandfathering' (free quota allocations) will have a competitive edge is unlikely to be valid, at least in the medium term. In addition, any advantage will be further undermined by revenue recycling, and neutrality towards new firms that imply that auctioning of permits provides other important efficiency benefits. However, it is clear from the emissions trading undertaken to date that the practice has been to give them away free, and this perhaps reflects some political realities as regards securing acceptance for emissions trading from the key emitters. There is also a Single Market issue that is of some substance.

6.5 The Single Market and Emissions Trading

Under the provisions of the Single Market, no Member State can allow discrimination against an individual or groups of firms, regardless of national origin within the Union. Thus, if Ireland introduces a domestic emissions trading scheme, the allocation of quota cannot favour Irish firms, either in terms of existing operations, or in terms of new entrants. With auctioning, no Single Market issue arises, as the entry conditions apply equally to all economic activity. With 'grandfathering' the free quota can in effect comprise a 'State Aid', and would therefore not be allowed, so that it can be difficult constructing a policy framework that will not discriminate against new entrants. Emissions trading proposals at Member State level must be notified to the Commission, and permission to proceed must be forthcoming. An emissions trading proposal from Denmark is before the Commission (Box 3).

6.5.1 Relationship with other Instruments

There are no necessary conflicts between the use of emissions trading and other instruments. Taxes, voluntary agreements and command and control licensing can all be in place, and trading can proceed. However, in implementing these mechanisms, there may be a specific exclusion written into the instrument context that makes the integration of emissions trading difficult. This arises in particular in the case of the Netherlands voluntary 'Benchmarking' energy conservation agreement. Article 10 specifies the obligations of government. "The Ministers, binding the State, will see to it that no additional specific measures as to further energy saving or CO_2 reduction shall be taken with regard to companies; in this covenant this means that no specific energy tax will be levied (emphasis added), no obligatory CO_2 emissions-ceiling will be set, no additional energy efficiency or CO_2 targets will be established and no additional energy savings will be demanded" (Hazewindus 2000).

BOX 5

THE EU GREEN PAPER ON INTERNAL GREENHOUSE GAS EMISSIONS TRADING

Last year, as part of an ongoing consultation process regarding emissions trading, the European Commission issued a green paper on trading within the Union.
The paper sets out the EU's requirements under the Kyoto Protocol and recognises that emissions trading will be a valuable instrument in reaching our obligations efficiently and effectively. The impetus for the paper is drawn from the Commission's desire to see "internal trading by 2005" allowing the Community to reap the full benefits of trading during the first commitment period (2008-2012). With this background set, the paper sets out to examine policy options related to four main areas.

1) Policy Options Related to the Scope of an EC Emissions Trading System
The main area of concern related to the scope of the system is determining the sectoral coverage. The Commission sets out a number of criteria for determining the sectors to be included. These criteria include environmental effectiveness, economic efficiency, the potential effects on competition, administrative feasibility, and the possible existence of alternative policies. The EU position on this matter is to include a small number of sectors that contribute significantly to emissions. To this end, sectors covered by the Large Combustion Plant or Integrated Pollution Prevention and Control directives have been identified as the most practical starting point.

2) Policy Options Related to the Initial Allocation of Emissions Allowances
The Commission refers to finding an equitable burden for companies inside and outside of the trading scheme as "a critical task". In this regard the green paper aims to instigate a debate regarding the allocation of permits, and poses the question "Should this be decided at Community level or at Member State level?"

3) Policy Options Related to the Synergy with Other Policies and Measures
Again, the Commission expresses some degree of concern regarding those companies not involved in the trading system. However, concepts currently employed such as 'Best Available Technology' may result in greater environmental efficiency when combined with emissions trading.

4) Policy Options Related to Compliance and Enforcement
According to the Commission, the "environmental integrity of any emissions trading regime will largely depend upon its compliance provisions and a robust enforcement regime". This raises the question of whether or not such a role should be carried out at the Community level.

7. SCENARIOS AND POTENTIAL VALUE OF CARBON

There are two categories of value: the value to society and the planetary community, and value to the individual forest owner.

7.1 The Value to Society

The impacts of climate change are as follows: storm and flood damage (increased in some regions such as the Caribbean and Pacific but not others), impacts on mortality and morbidity; effects on small islands (sea levels rise due to heating water and melting ice caps, and increasing salinity of estuaries, damage to freshwater aquifers, effects of agriculture, and forestry). It is estimated that as a consequence of a doubling of CO_2 a substantial fraction - a global average of one-third, varying by regions from one seventh to two thirds – of the existing forested area on the world will undergo major changes in broad vegetation types, with the greatest change occurring in high latitudes and the least in the tropics (Bolin 1998).

There are three approaches to placing a monetary value on the benefits of greenhouse gas reductions (Clinch 1999): The Damage-Avoided Approach values a tonne of carbon not emitted by the cost of the damage that would have been done by global warming in the event that it had been emitted. The Offset Approach measures the value of not emitting a tonne of carbon using one method, by the next cheapest alternative method. The Avoided-Cost-of-Compliance Approach measures the above tonne of saved carbon by the avoided cost of compliance with a global/regional CO_2 emissions reduction agreement.

The marginal damage costs per tonne of CO_2 equivalent have been estimated in two models –

FUND and Open Framework - Table 4 (in Euro).

The damage costs per tonne of CO_2 equivalent fall in the range €17 - 84, depending on the gas, the discount rate and the model used. Such data provide an approximation of the benefits of reducing emissions by a tonne of CO_2 equivalent. These studies are being continuously updated, as climate change models are improved, so these numbers will be in a state of flux for some time. For example, recent data generated by Tol (2000) comes up with much lower estimates (Table 5).

TABLE 5: REVISED MARGINAL DAMAGE COSTS FROM CARBON DIOXIDE.

Scenario	Estimated marginal damage equiv. reduced €/t CO_2
Minimum	0
Low	1
Mid	2
High	4
Maximum	16

Source: Tol (2000)

The Offset Approach (marginal costs of abatement) takes the quota we have been assigned as given, and asks what are the costs at the margin of complying with this quota. Estimates have been made of the costs of complying with successive reductions in greenhouse gas emissions in Ireland (ERM 1998). It can be seen (Figure 2) that as emissions are successively reduced, the costs of compliance at the margin rise sharply, reaching almost £80 per tonne of CO_2. However, if emitters of greenhouse gasses are permitted to trade within their own country and across international frontiers, the market will find the least cost compliance opportunities in the jurisdiction in question. The wider the market, the more options there are, and the more likely it is that the costs of abatement at the margin will be relative to the situation that would prevail in a narrower market.

TABLE 4: MARGINAL DAMAGE COSTS PER TONNE OF CO_2 EMITTED.

Model	FUND	FUND	Open Framework	Open Framework
Discount Rate (%)	1	3	1	3
Greenhouse Gas				
CO_2	46	19	44	20
Methane (CH_4)	25	17	19	18
Nitrous Oxide (N_2O)	55	21	84	35

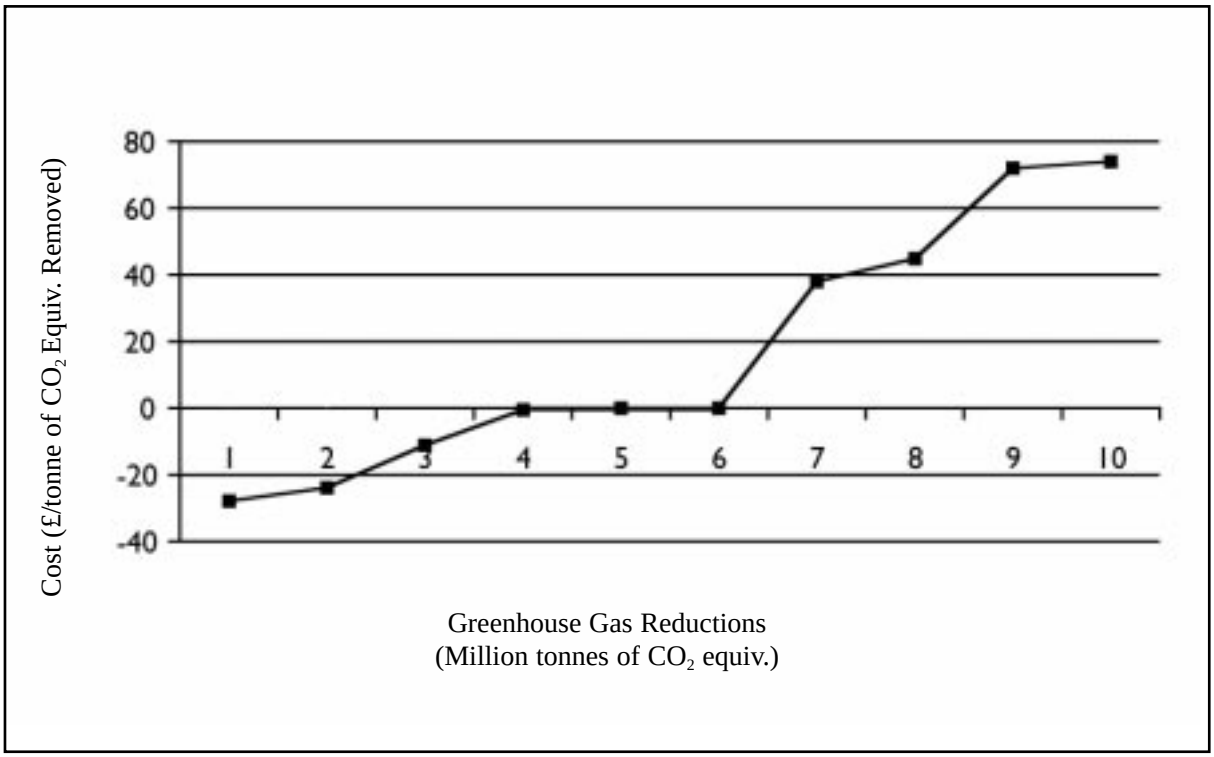


FIGURE 2: THE MARGINAL COST OF REDUCING GREENHOUSE GASES IN IRELAND.

Source: Environmental Resource Management (1998)

The Avoided-Cost-of-Compliance Approach measures a tonne of saved carbon by the avoided cost of compliance with a global/regional CO_2 emissions reduction agreement. In this case the value of the carbon would be equal to the value of carbon permits traded on international markets. Estimates of the value to Irish growers can be extracted from results of modelling conducted by the National Technical University, Athens, on behalf of the European Commission (Capros and Mantzos 2000). Table 6 presents the marginal abatement costs under a number of scenarios analysed by this model. The scenarios were as follows:

- an EU-wide trading scheme among energy suppliers;
- an EU-wide trading scheme among energy suppliers and the most energy intensive industrial sectors;
- an EU-wide trading scheme involving all industrial sectors; and
- a trading scheme involving all sectors of industry in the developed world (Annex B countries).

The permit cost would be the market price of emitting a further tonne of CO_2. So, for example, in the case of an EU-wide trading scheme for energy suppliers, companies would be willing to pay anything up to €32.30 per tonne of CO_2 sequestered.

Policy makers are likely to be interested in the answer to the following question: how much would Irish citizens be willing to sacrifice (i.e. pay) to reduce greenhouse gas emissions in

TABLE 6: MARGINAL COSTS OF CO_2 ABATEMENT UNDER INTERNATIONAL EMISSIONS TRADING SCHEMES.

Scheme	**Permit Cost** **€/t CO_2**	**Marginal costs of firms outside of the scheme** **€/t CO_2**
EU - wide schemes		
Just energy suppliers	32.3	45.3
Energy suppliers and energy intensive industry	33.3	43.3
All sectors	32.6	32.6
Annex B Trading: all sectors	17.7	17.7

Source: Capros and Mantzos (2000).

Ireland? The technique of contingent valuation can be used to assess their willingness to pay.

An issue directly related to the benefits to the global community is what is known as 'carbon leakage,' whereby restrictions on greenhouse gas emissions in some countries results in increased emissions in others (Box 6).

7.2 The Value to the Individual Forest Owner

The benefits, if any, to society, of reducing greenhouse gas emissions will translate into benefits to the individual owner only if there is a mechanism for compensating the owner for the carbon so sequestered. Such benefits could be transferred to landowners via a number of mechanisms.

a) Direct subsidy: the owner is given a once off or annual subsidy to reward him or her for the relevant sequestering activity. Thus, for example, the planting grant or the annual payments could include an amount of Euro to pay for sequestering, where such payment might be based on an estimate of the marginal damage costs avoided.
b) Emissions Trading Markets: payment for the amount of carbon sequestered, based on the value of a tonne of carbon dioxide equivalent being traded in emissions trading markets (see discussion below). A forest owner might be paid annually based on the market price prevailing.
c) Offsets: This is a variation of the emissions trading market, whereby firms that need to hold a quota equivalent to their emissions could meet some or all of their quota by planting trees themselves, or paying others to do so for them.

7.3 Values to Ireland

The value of carbon sequestered in trees will depend fundamentally on the policy context. The following scenarios and associated values can be envisaged.

Scenario 1 – No agreement, no ratification, and no substantive unilateral action in the EU including Ireland

This scenario describes a situation, where the Umbrella Group, the EU and the Group of 77 plus China cannot agree on what carbon sinks qualify as contributions to assigned amounts and/or on other operational aspects of the Kyoto Protocol. The Protocol is not ratified by a sufficient number of parties, and so does not come into effect. The EU does not agree any internally binding targets, nor does Ireland. The carbon leakage issue noted in Box 6 will make it very difficult for the EU and Ireland to take substantive legally binding action in the absence of agreement by competing countries to do so.

In this situation, there will be no market for carbon, and therefore carbon sequestration will have no value in the market. Sequestration that did not result in carbon leakage would yield global benefits, but these would not be translated into private benefits for forest owners.

Scenario 2 – No Agreement with the Umbrella Group, no ratification, no agreed EU collective action but Ireland agrees on unilateral action.

Because action to meet a target would be confined within Ireland, if a domestic emissions trading scheme were to be implemented, the equilibrium price of a tonne of CO_2 would likely be much higher than would prevail if trading could cross frontiers. However, for the same reason, this option is very unlikely politically, as it would expose Irish emitters to relatively high costs, and competitiveness issues would arise. Figure 2 would suggest that if Ireland chose to meet its full Kyoto target, a price per tonne of carbon dioxide sequestered of greater than £80 would be probable.

Scenario 3 – No Agreement with the Umbrella Group, no ratification, but the EU agrees unilateral action

This scenario will be difficult to agree on because of the competitive disadvantage that EU firms - who suffer restrictions not borne by their competitors - will perceive they would experience. But if it is agreed, this will allow an internal EU emissions trading market to emerge. This in turn will result in a price per tonne of carbon dioxide equivalent which could provide the basis for a transfer to forest owners to reward them for their sequestration efforts, either in the form of annual payments based on prevailing market prices, or as offset payments.

Paradoxically, because the costs of abating greenhouse gasses at the margin are likely to be higher within the EU than

BOX 6

CARBON LEAKAGE

So called 'carbon leakage' can occur whereby, firstly, carbon intensive products become more expensive in Signatory countries, and imports increase from non Signatory countries, and secondly, firms using carbon emitting technologies in Signatory countries move to non Signatory countries. The Kyoto Protocol does not contain any policies or measures to counteract carbon leakage. Michaelowa and Stronzik (1999) point out that leakage arose in the US Acid Rain programme. Since it was designed to be implemented in two phases, some energy suppliers used the option of reduced utilisation (of the plant in Phase 1) to cut back sulphur emissions of sources already regulated in the first phase. The problem was dealt with by including the sources used for displacement of emissions in the first phase. Whether leakage will turn out to become a big issue depends crucially on coverage of relevant actors as well as on substitution options of a single company.

Michael Hoel (1999) who has done definitive work on this subject, makes the general point that actions taken by a particular country (or group of countries) will in general affect equilibrium prices of internationally traded goods. This in turn may affect the production and consumption decisions of other countries, and thus emissions from these countries.

Given the Kyoto agreement, it is only leakage to developing (non-annex B) countries that is of importance. Moreover, it is shown that differentiation of a carbon tax is not justified by a concern for CO_2 emissions in developing countries. It is more cost effective to induce these countries to reduce emissions through appropriate transfers. Ignoring the optimal tariff argument, an approximation of the optimal policy is thus to have a uniform carbon tax and no tariffs. Carbon leakage should be taken care of by the industrialised countries giving the developing countries transfers conditional on the developing countries implementing climate policies.

This is an important conclusion, as it provides an efficiency rationale for direct transfers, leaving open issues in implementation, which are touched on later. There may of course also be a political rationale for such action. Concerns about leakage may be misplaced, as there is very little evidence to support the hypothesis that there is much industry flight on the basis of the stringency or cost of environmentally related measures alone (Barker 1998).

These findings are consistent with the direction of change predicted in the econometric literature in the event of a carbon energy tax being imposed, and the proceeds re-cycled; most models indicate that, at least in the short run, it would yield a small aggregate net gain in output and employment, with losses in energy intensive sectors being more than compensated for by gains in less intensive sectors (Barker and Köhler, 1998).

To the extent that positive technological change is induced by the greenhouse gas constraints, as discussed above, this will mitigate, and may even transcend, any leakage losses. Nevertheless, for those economies, e.g. Australia, with heavily energy dependent sectors such as aluminium smelting, the leakage issue is a real concern, as most of the competing sites for such activity are in non Annex 1 countries, and the profit margins are low; relatively small adjustments in real costs could, over the medium to long term trigger some migration. If it happened that the industry that migrated, was operated in a less energy efficient way in the non-Annex country than it was in its original Annex 1 site, then the outcome would be a net increase in emissions.

The evidence to hand indicates that the prospects of seriously damaging leakage from Europe to non-signatory countries in the short run is low. In the long run, if the energy cost asymmetry continues between Annex 1 and non-Annex 1 countries, and the latter improve competitiveness in other areas, then leakage may become a more significant factor. However, the technological optimists, arguing on the basis that innovation, driven by either pricing of quotas or other policy instruments, seems likely to induce technological change, and this will further narrow any potential advantage accruing to non Signatories. To the extent that leakage does become a problem, allocation of generous quotas to developing countries and inclusion in the trading scheme should simultaneously provide an automatic transfer and encourage limitation in the growth of emissions.

Leakage from Europe could however be much more serious if the EU 'went it alone'; in such a scenario, over time we would expect considerable leakage to the Umbrella Group – US, Canada, Australia and Japan.

would prevail if the opportunities across the wider world were available, prices per tonne abated will be higher than if global trading were in place, but not as high as would be the case if trading were confined within Ireland. This scenario has some likelihood of implementation, if special measures were put in place to protect the competitive position of firms competing with their counterparts in the US and other members of the Umbrella Group.

The data presented in Table 6 would suggest a price in the region of €30/tCO_2 depending on the extent of trading proposed by the Commission.

Scenario 4 – Agreement by the Annex 1 countries and the Group of 77 plus China followed by ratification

Such agreement would, over time, allow a global market in emissions trading to develop. Such development is likely to be incremental, with countries being allowed to trade once they meet some minimum standards as regards recording emissions, monitoring performance, enforcement etc. Thus, trading might start within the US and the EU, then extend to include all OECD countries, then to include all of the former Soviet Union countries. In parallel, the Clean Development Mechanism (CDM) and Joint Implementation are put in place. As these latter two mechanisms come on stream, they are likely to have the effect of reducing the equilibrium price in the emissions trading market.

Out of scenarios 2, 3 and 4 a market price per tonne of carbon dioxide equivalent that could be sequestered, would emerge. This in turn would provide a basis for annual payments or offset payments. Under this scenario a price in the region of €18/tCO_2 would be likely, according to the PRIMES model (Capros and Mantzos 2000).

7.3.1 Likely Prices per Tonne of CO_2 equivalent

The prices given above are derived not from real world experience but from models. Even highly sophisticated models will not fully predict future events and, as such, true market values may differ from those predicted.

In regard to the costs of complying with Kyoto, there is enormous variability in the cost of compliance estimates (see variability in US estimates below), but all agree that using the flexibility provisions such as tradable permits, joint implementation etc. will reduce them substantially. Shogren (1999) notes that it is estimated that any agreement without the cost flexibility provided by trading, will at least double the US costs, where flexibility can be measured as the ability to reduce carbon at the lowest cost, either domestically and internationally, including the so-called 'when and where' flexibility. The key is to distribute emissions internationally so as to minimise the costs of climate policy. Manne and Richels (1999) agree. Their model indicates that losses in 2010 are two and one-half times higher with the constraint on the purchase of carbon emission rights - international co-operation through trade is essential if we are to reduce mitigation costs.

Note however, that all such estimates are based on models in which induced technical progress is not included, and the potential benefits therefrom are not incorporated. At the IIASA (International Institute for Applied Systems Analysis) workshop on Induced Technological Change and the Environment in June 1999, following on Goulder and Mathai (1998), a number of papers – see Kratena and Schleider (1999) and Nordhaus (1999) – highlighted the fact that implementation of emission reduction targets may provide incentives for induced technological change with positive slipover effects to many sectors of the economy, possibly even transforming the burden to an opportunity, the so called 'Porter' effect.

Bohm (1999) undertook a simulation of a permit market for the Nordic countries, and concluded that the estimated aggregate cost for Denmark, Finland, Norway and Sweden to stay on their 1990 carbon emission levels by the year 2000 (a 'Rio' target) amounted to USD 713 million in the absence of trade, but was reduced to USD 368 million as a result of (hypothetical) trading.

In the US context, Shogren (1999) notes the contrast between the (in favour of Kyoto) President's Council of Economic advisers' estimate – implementation would result in a small drop of GDP of 0.5% ($10 billion) and a rise in petrol prices of 5 cents a gallon - and the US Congress (opposed to Kyoto) estimate prepared by the World Resource Institute (WRI) and the Wharton Economic Forestry Associates (WEFA) – 3% drop in GDP ($250 billion), and gasoline prices to rise by 50 cents a gallon.

8. CONCLUSIONS AND IMPLICATIONS FOR GROWERS

The outlook for the forestry sector remains uncertain until the COP negotiations come to a conclusion regarding the sinks allowable under Article 3.4. It remains possible that no agreement will be reached. However, there are still a number of actions which growers should undertake in anticipation of a possible carbon trading system.

1) In all planting decisions carbon sequestration, and other environmental impacts, should be taken into account. In cases where the non-carbon financial return is similar, the option yielding the highest rate of sequestration should be taken.
2) Monitoring: As the rules and guidelines for sinks have not yet been fully clarified growers should maintain as good a record as practical of all activities engaged in, so as to reap the full benefits of possible carbon credits. It may be possible to include carbon monitoring under existing audit and certification procedures associated with sustainable forest management (SFM).

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